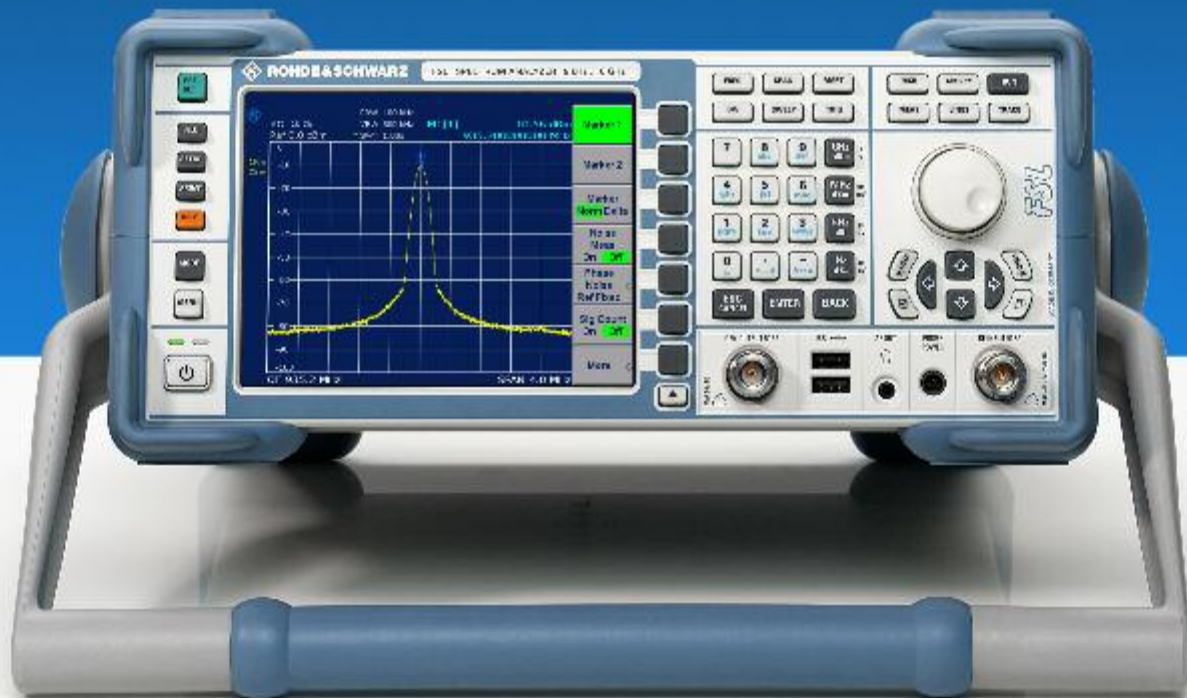


Operating Manual



Spectrum Analyzer

R&S® FSL3

1300.2502.03

1300.2502.13

R&S® FSL6

1300.2502.06

1300.2502.16

Printed in the Federal
Republic of Germany



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Trade names are trademarks of the owners



Before putting the product into operation for the first time, make sure to read the following



Safety Instructions

Rohde & Schwarz makes every effort to keep the safety standard of its products up to date and to offer its customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. This product has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, Rohde & Schwarz will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for an intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its operating manual and within its performance limits (see data sheet, documentation, the following safety instructions). Using the products requires technical skills and knowledge of English. It is therefore essential that the products be used exclusively by skilled and specialized staff or thoroughly trained personnel with the required skills. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation.

Symbols and safety labels

| | | | | | | | |
|--------------------------------|------------------------------------|--------------------------|----------------------|-------------|--------|-----------------|--|
| | | | | | | | |
| Observe operating instructions | Weight indication for units >18 kg | Danger of electric shock | Warning! Hot surface | PE terminal | Ground | Ground terminal | Attention! Electrostatic sensitive devices |

| | | | | | |
|-----------------------|--------------------|---------------------|--------------------------|------------------------------------|--|
| I C | | | | | |
| Supply voltage ON/OFF | Standby indication | Direct current (DC) | Alternating current (AC) | Direct/alternating current (DC/AC) | Device fully protected by double/reinforced insulation |

Safety Instructions

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before putting the product into operation. It is also absolutely essential to observe the additional safety instructions on personal safety that appear in other parts of the documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by Rohde & Schwarz, including instruments, systems and all accessories.

Tags and their meaning

| | |
|-----------|--|
| DANGER | This tag indicates a safety hazard with a high potential of risk for the user that can result in death or serious injuries. |
| WARNING | This tag indicates a safety hazard with a medium potential of risk for the user that can result in death or serious injuries. |
| CAUTION | This tag indicates a safety hazard with a low potential of risk for the user that can result in slight or minor injuries. |
| ATTENTION | This tag indicates the possibility of incorrect use that can cause damage to the product. |
| NOTE | This tag indicates a situation where the user should pay special attention to operating the product but which does not lead to damage. |

Basic safety instructions

1. The product may be operated only under the operating conditions and in the positions specified by the manufacturer. Its ventilation must not be obstructed during operation. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude max. 2000 m.
2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the instrument must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.
4. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.

Safety Instructions

5. Operating the products requires special training and intense concentration. Disabled persons should not use the products unless it is made certain that their disability has no adverse effects while they are operating the products.
6. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
7. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.
8. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
9. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.
10. Never use the product if the power cable is damaged. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.
11. The product may be operated only from TN/TT supply networks fused with max. 16 A.
12. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise this can result in sparks, fire and/or injuries.
13. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
14. For measurements in circuits with voltages $V_{rms} > 30 V$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
15. Ensure that the connections with information technology equipment comply with IEC950/EN60950.
16. Never remove the cover or part of the housing while you are operating the product. This will expose circuits and components and can lead to injuries, fire or damage to the product.
17. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a skilled electrician.
18. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.
19. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.
20. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.

Safety Instructions

21. Rohde & Schwarz products are not protected against penetration of water, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock or damage to the product, which can also lead to personal injury.
22. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.
23. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.
24. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.
25. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries are hazardous waste. Dispose of them only in specially marked containers. Observe local regulations regarding waste disposal. Do not short-circuit batteries or storage batteries.
26. Please be aware that in the event of a fire, toxic gases that may be hazardous to your health may escape from the product.
27. Please be aware of the weight of the product. Be careful when moving it; otherwise you may injure your back or other parts of your body.
28. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).
29. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle; the manufacturer assumes no responsibility for accidents or collisions.
30. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.



Por favor lea imprescindiblemente antes de la primera puesta en funcionamiento las siguientes informaciones de seguridad



Informaciones de seguridad

Es el principio de Rohde&Schwarz de tener a sus productos siempre al día con los standards de seguridad y de ofrecer a sus clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. Este producto ha sido fabricado y examinado según el comprobante de conformidad adjunto según las normas de la CE y ha salido de nuestra planta en estado impecable según los standards técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, deberá el usuario atenerse a todas las informaciones, informaciones de seguridad y notas de alerta. Rohde&Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto solamente fue elaborado para ser utilizado en la industria y el laboratorio o para fines de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda ser dañada. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del maluso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones del correspondiente manual del uso y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso de los productos hace necesarios conocimientos profundos y el conocimiento del idioma inglés. Por eso se deberá tener en cuenta de exclusivamente autorizar para el uso de los productos a personas péritas o debidamente minuciosamente instruidas con los conocimientos citados. Si fuera necesaria indumentaria de seguridad para el uso de productos de R&S, encontrará la información debida en la documentación del producto en el capítulo correspondiente.

Símbolos y definiciones de seguridad

| | | | | | | | |
|-------------------------------------|---|-------------------------------|-------------------------------|--------------------------------|-------------------|----------------------------|---|
| | | | | | | | |
| Ver manual de instrucciones del uso | Informaciones para maquinaria con un peso de > 18kg | Peligro de golpe de corriente | ¡Cuidado! Superficie caliente | Conexión a conductor protector | Conexión a tierra | Conexión a masa conductora | ¡Cuidado! Elementos de construcción con peligro de carga electrostática |

| | | | | | |
|---------------------------|---------------------|-----------------------|----------------------|----------------------------------|--|
| | | | | | |
| potencia EN MARCHA/PARADA | Indicación Stand-by | Corriente continua DC | Corriente alterna AC | Corriente continua/alterna DC/AC | El aparato está protegido en su totalidad por un aislamiento de doble refuerzo |

Informaciones de seguridad

Tener en cuenta las informaciones de seguridad sirve para tratar de evitar daños y peligros de toda clase. Es necesario de que se lean las siguientes informaciones de seguridad concienzudamente y se tengan en cuenta debidamente antes de la puesta en funcionamiento del producto. También deberán ser tenidas en cuenta las informaciones para la protección de personas que encontrarán en otro capítulo de esta documentación y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por Rohde&Schwarz bajo la denominación de „producto“, entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Palabras de señal y su significado

| | |
|-------------|--|
| PELIGRO | Indica un punto de peligro con gran potencial de riesgo para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas. |
| ADVERTENCIA | Indica un punto de peligro con un potencial de riesgo mediano para el usuario. Punto de peligro que puede llevar hasta la muerte o graves heridas . |
| CUIDADO | Indica un punto de peligro con un potencial de riesgo pequeño para el usuario. Punto de peligro que puede llevar hasta heridas leves o pequeñas |
| ATENCIÓN | Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo. |
| INFORMACIÓN | Indica una situación en la que deberían seguirse las instrucciones en el uso del producto, pero que no consecuentemente deben de llevar a un daño del mismo. |

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue:
modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar.
2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal périto autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Despues de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de medición de la corriente conductora, control de funcionamiento).
3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el aluminio). Si se produjeran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.

Informaciones de seguridad

4. Ciertos productos, como por ejemplo las instalaciones de radiación HF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética. El empresario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo de exposición a radiaciones aumentadas de riesgo aumentado para evitar riesgos.
5. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Personas minusválidas solamente deberán utilizar estos productos si está por seguro de que a causa de su handicap no podrá surgir ninguna restricción en el manejo del producto.
6. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la de la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso de cambio cambiar los fusibles correspondientes del producto.
7. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.
8. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto ya que puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro, que es controlado su estado técnico de seguridad.
9. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurarse de que el enchufe sea de fácil acceso y manejo (medida del cable de distribución aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en construcciones o instalaciones, se deberá instalar el interruptor al nivel de la instalación.
10. No utilice nunca el producto si está dañado el cable eléctrico. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
11. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A.
12. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.
13. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.
14. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{eff} > 30 \text{ V}$ se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
15. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos de la EC950/EN60950.
16. Nunca abra la tapa o parte de ella si el producto está en funcionamiento. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
17. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.

Informaciones de seguridad

18. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, deberá la toma de corriente estar protegida de manera que los productos o los usuarios estén suficientemente protegidos.
19. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir corto circuitos en el producto y/o puede causar golpes de corriente, fuego heridas.
20. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.
21. Los productos R&S no están protegidos contra el agua si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente o de daños en el producto lo cual también puede llevar al peligro de personas.
22. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.
23. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.
24. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.
25. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención células de Litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Baterías y acumuladores son desechos problemáticos. Por favor tirelos en los recipientes especiales para este fin. Por favor tengan en cuenta las prescripciones nacionales de cada país referente al tratamiento de desechos. Nunca sometan a las baterías o acumuladores a un corto circuito.
26. Tengan en consideración de que en caso de un incendio pueden escaparse gases tóxicos del producto, que pueden causar daños a la salud.
27. Por favor tengan en cuenta el peso del producto. Muevanlo cuidadosamente ya que el peso puede causar lesiones de la espalda u otros daños físicos.
28. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).
29. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo y el fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
30. Dado el caso de que esté integrado un producto de laser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación. De otra manera pondrá en peligro su salud, ya que el rayo laser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo laser.



Safety Regulations for Batteries (according to BattV)

This equipment houses a battery containing harmful substances that must not be disposed of as normal household waste.

After its useful life, the battery may only be disposed of at a Rohde & Schwarz service center or at a suitable depot.

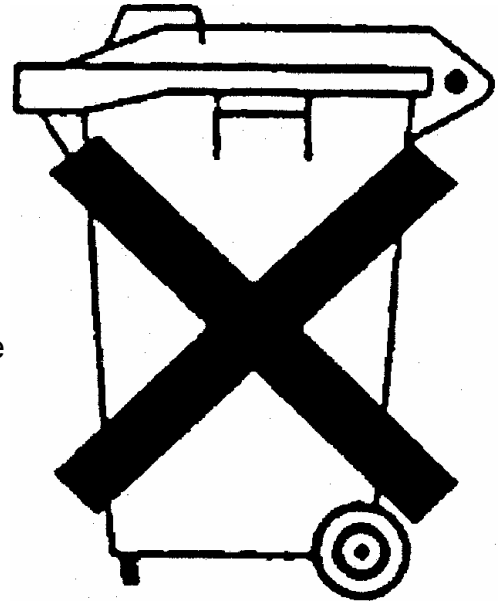
Kundeninformation zur Batterieverordnung (BattV)

Dieses Gerät enthält eine schadstoffhaltige Batterie. Diese darf nicht mit dem Hausmüll entsorgt werden. Nach Ende der Lebensdauer darf die Entsorgung nur über eine Rohde&Schwarz-Kundendienststelle oder eine geeignete Sammelstelle erfolgen.

Consignes de sécurité pour batteries (selon BattV)

Cet appareil est équipé d'une pile comprenant des substances nocives. Ne jamais la jeter dans une poubelle pour ordures ménagères.

Une pile usagée doit uniquement être éliminée par un centre de service client de Rohde & Schwarz ou peut être collectée pour être traitée spécialement comme déchets dangereux.



Certified Quality System

DIN EN ISO 9001 : 2000
DIN EN 9100 : 2003
DIN EN ISO 14001 : 1996

DQS REG. NO 001954 QM/ST UM

QUALITÄTSZERTIFIKAT

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Managementsystems entwickelt, gefertigt und geprüft.

Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

CERTIFICATE OF QUALITY

Dear Customer,

you have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.

The Rohde & Schwarz quality management system is certified according to:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996

CERTIFICAT DE QUALITÉ

Cher Client,

vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.

Le système de gestion qualité de Rohde & Schwarz a été homologué conformément aux normes:

DIN EN ISO 9001:2000
DIN EN 9100:2003
DIN EN ISO 14001:1996



ROHDE & SCHWARZ



Certificate No.: 2005-06

This is to certify that:

| Equipment type | Stock No. | Designation |
|----------------|------------------|---------------------------|
| FSL3 | 1300.2502.03/.13 | Spectrum Analyzer |
| FSL6 | 1300.2502.06/.16 | |
| FSL-B4 | 1300.6008.02 | OCXO Reference Frequency |
| FSL-B5 | 1300.6108.02 | Additional Interfaces |
| FSL-B6 | 1300.5901.02 | TV Trigger |
| FSL-B7 | 1300.5601.02 | Narrow Resolution Filters |
| FSL-B8 | 1300.5701.02 | Gated Sweep Function |
| FSL-B10 | 1300.6208.02 | GPIB Interface |
| FSL-B22 | 1300.5953.02 | RF Amplifier |
| FSL-B30 | 1300.6308.02 | DC Power Supply |
| FSL-B31 | 1300.6408.02 | NIMH Battery Pack |
| FSL-Z4 | 1300.5430.02 | Additional Charger Unit |

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits
(73/23/EEC revised by 93/68/EEC)
- relating to electromagnetic compatibility
(89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12
EN55011 : 1998 + A1 : 1999, Klasse B
EN61326 : 1997 + A1 : 1998 + A2 : 2001

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

Affixing the EC conformity mark as from 2005

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Munich, 2005-02-11

Central Quality Management MF-QZ / Radde

Documentation Overview

The user documentation for the R&S FSL is divided as follows:

- [Quick Start Guide](#)
- [Operating Manual](#)
- [Service Manual](#)
- [Online Help](#)

Quick Start Guide

This manual is delivered with the instrument in printed form and in PDF format on the CD. It provides the information needed to set up and start working with the instrument. Basic operations and basic measurements are described. Also a brief introduction to remote control is given. More detailed descriptions are provided in the Operating Manual. The Quick Start Guide includes general information (Safety Instructions, Certificate of Quality, EU Certificate of Conformity, Support Center Address) and the following chapters:

| | |
|------------|--|
| Chapter 1 | Front and Rear Panel |
| Chapter 2 | Putting into Operation |
| Chapter 3 | Firmware Update and Installation of Firmware Options |
| Chapter 4 | Basic Operations |
| Chapter 5 | Basic Measurement Examples |
| Chapter 6 | Brief Introduction to Remote Control |
| Appendix A | Printer Interface |
| Appendix B | LAN Interface |

Operating Manual

This manual is a supplement to the Quick Start Guide and is available in PDF format on the CD delivered with the instrument. To retain the familiar structure that applies to all operating manuals of Rohde&Schwarz Test & Measurement instruments, the chapters 1 and 3 exist, but only in form of references to the corresponding Quick Start Guide chapters.

In this manual, all instrument functions are described in detail. For additional information on default settings and parameters, refer to the data sheets. The set of measurement examples in the Quick Start Guide is expanded by more advanced measurement examples. In addition to the brief introduction to remote control in the Quick Start Guide, a description of the commands and programming examples is given. Information on maintenance, instrument interfaces and error messages is also provided. The manual includes the following chapters:

| | |
|-----------|--|
| Chapter 1 | Putting into Operation, see Quick Start Guide chapters 1 and 2 |
| Chapter 2 | Advanced Measurement Examples |
| Chapter 3 | Manual Control, see Quick Start Guide chapter 4 |
| Chapter 4 | Instrument Functions |
| Chapter 5 | Remote Control - Basics |
| Chapter 6 | Remote Control - Commands |

| | |
|-----------|---------------------------------------|
| Chapter 7 | Remote Control - Programming Examples |
| Chapter 8 | Maintenance |
| Chapter 9 | Error Messages |

This manual is delivered with the instrument on CD only. The printed manual can be ordered from Rohde & Schwarz GmbH & Co. KG.

Service Manual

This manual is available in PDF format on the CD delivered with the instrument. It informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the R&S FSL by the replacement of modules. The manual includes the following chapters:

| | |
|-----------|--------------------------------------|
| Chapter 1 | Performance Test |
| Chapter 2 | Adjustment |
| Chapter 3 | Repair |
| Chapter 4 | Software Update / Installing Options |
| Chapter 5 | Documents |

Online Help

The Online Help is part of the firmware. It provides a quick access to the description of the instrument functions and the remote control commands. For information on other topics refer to the Quick Start Guide, Operating Manual and Service Manual provided in PDF format on CD or in the Internet. For detailed information on how to use the Online Help, refer to the chapter "Basic Operations" in the Quick Start Guide.

Conventions Used in the Documentation

To visualize important information quickly and to recognize information types faster, a few conventions have been introduced. The following character formats are used to emphasize words:

| | |
|------------------------|---|
| Bold | All names of graphical user interface elements as dialog boxes, softkeys, lists, options, buttons etc. All names of user interface elements on the front and rear panel as keys, connectors etc. |
| Courier | All remote commands (apart from headings, see below) |
| Capital letters | All key names (front panel or keyboard) |

The description of a softkey (Operating Manual and Online Help) always starts with the softkey name, and is followed by explaining text and one or more remote control commands framed by two lines. Each remote command is placed in a single line.

The description of remote control commands (Operating Manual and Online Help) always starts with the command itself, and is followed by explaining text including an example, the characteristics and the mode (standard or only with certain options) framed by two grey lines. The remote commands consist of abbreviations to accelerate the procedure. All parts of the command that have to be entered are in capital letters, the rest is added in small letters to complete the words and transport their meaning.

1 Putting into Operation

For details refer to the Quick Start Guide chapters 1, "Front and Rear Panel", and 2, "Preparing for Use".

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2 Advanced Measurement Examples

This chapter explains how to operate the R&S FSL using typical measurements as examples. Additional background information on the settings is given. Examples of more basic character are provided in the Quick Start Guide, chapter 5, as an introduction. The following topics are included in the Quick Start Guide:

- Measuring a Sinusoidal Signal
 - Measuring the Level and Frequency Using Markers
 - Measuring the Signal Frequency Using the Frequency Counter
- Measuring Harmonics of Sinusoidal Signals
 - Measuring the Suppression of the First and Second Harmonic of an Input Signal
- Measuring Signal Spectra with Multiple Signals
 - Separating Signals by Selecting the Resolution Bandwidth
 - Measuring the Modulation Depth of an AM-Modulated Carrier (Span > 0)
 - Measuring of AM-Modulated Signals
- Measurements with Zero Span
 - Measuring the Power Characteristic of Burst Signals
 - Measuring the Signal-to-Noise Ratio of Burst Signals
 - Measurement of FM-Modulated Signals
- Storing and Loading Instrument Settings
 - Storing an Instrument Configuration (without Traces)
 - Storing Traces
 - Loading an Instrument Configuration (with Traces)
 - Configuring Automatic Loading

Test Setup

All of the following examples are based on the standard settings of the analyzer. These are set with the **PRESET** key. A complete listing of the standard settings can be found in chapter "Instrument Functions", section "Initializing the Configuration – PRESET Key".

In the following examples, a signal generator is used as a signal source. The RF output of the signal generator is connected to the RF input of R&S FSL.

If a 65 MHz signal is required for the test setup, as an alternative to the signal generator, the internal 65 MHz reference generator can be used:

1. Switch on the internal reference generator.
 - Press the **SETUP** key.
 - Press the **Service** softkey.
 - Press the **Input RF/Cal/TG** softkey, until **Cal** is highlighted.

The internal 65 MHz reference generator is now on. The R&S FSL's RF input is switched off.
2. Switch on the RF input again for normal operation of the analyzer. Two ways are possible:
 - Press the **PRESET** key
 - Press the **SETUP** key.
 - Press the **Service** softkey.
 - Press the **Input RF/Cal/TG** softkey, until **RF** is highlighted.

The internal signal path of the R&S FSL is switched back to the RF input in order to resume normal operation.

Measurement of Harmonics

Measuring the harmonics of a signal is a frequent problem which can be solved best by means of a spectrum analyzer. In general, every signal contains harmonics which are larger than others. Harmonics are particularly critical regarding high-power transmitters such as transceivers because large harmonics can interfere with other radio services.

Harmonics are generated by nonlinear characteristics. They can often be reduced by lowpass filters. Since the spectrum analyzer has a nonlinear characteristic, e.g. in its first mixer, measures must be taken to ensure that harmonics produced in the analyzer do not cause spurious results. If necessary, the fundamental wave must be selectively attenuated with respect to the other harmonics with a highpass filter.

When harmonics are being measured, the obtainable dynamic range depends on the second harmonic intercept of the spectrum analyzer. The second harmonic intercept is the virtual input level at the RF input mixer at which the level of the 2nd harmonic becomes equal to the level of the fundamental wave. In practice, however, applying a level of this magnitude would damage the mixer. Nevertheless the available dynamic range for measuring the harmonic distance of a DUT can be calculated relatively easily using the second harmonic intercept.

As shown in Fig. 2-1, the level of the 2nd harmonic drops by 20 dB if the level of the fundamental wave is reduced by 10 dB.

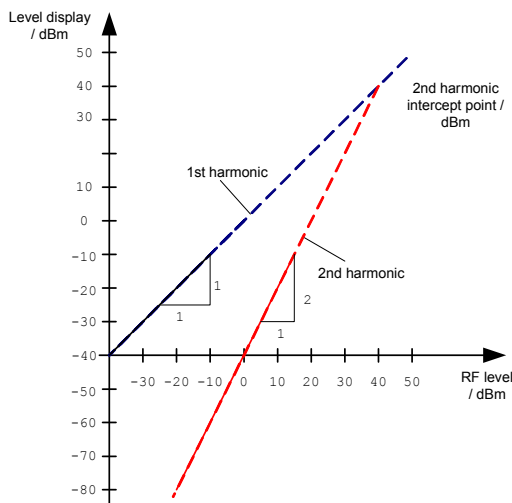


Fig. 2-1 Extrapolation of the 1st and 2nd harmonics to the 2nd harmonic intercept at 40 dBm

The following formula for the obtainable harmonic distortion d_2 in dB is derived from the straight-line equations and the given intercept point:

$$d_2 = S.H.I. - P_1 \quad (1)$$

d_2 = harmonic distortion

P_1 = mixer level/dBm

S.H.I. = second harmonic intercept

Note: The mixer level is the RF level applied to the RF input minus the set RF attenuation.

The formula for the internally generated level P_1 at the 2nd harmonic in dBm is:

$$P_1 = 2 \cdot P_I - S.H.I. \quad (2)$$

The lower measurement limit for the harmonic is the noise floor of the spectrum analyzer. The harmonic of the measured DUT should – if sufficiently averaged by means of a video filter – be at least 4 dB above the noise floor so that the measurement error due to the input noise is less than 1 dB.

The following rules for measuring high harmonic ratios can be derived:

- Select the smallest possible IF bandwidth for a minimal noise floor.
- Select an RF attenuation which is high enough to just measure the harmonic ratio.

The maximum harmonic distortion is obtained if the level of the harmonic equals the intrinsic noise level of the receiver. The level applied to the mixer, according to (2), is:

$$P_I = \frac{P_{noise} / dBm + IP2}{2} \quad (3)$$

At a resolution bandwidth of 10 Hz (noise level –143 dBm, S.H.I. = 40 dBm), the optimum mixer level is – 51.5 dBm. According to (1) a maximum measurable harmonic distortion of 91.5 dB minus a minimum S/N ratio of 4 dB is obtained.

Note: *If the harmonic emerges from noise sufficiently (approx. >15 dB), it is easy to check (by changing the RF attenuation) whether the harmonics originate from the DUT or are generated internally by the spectrum analyzer. If a harmonic originates from the DUT, its level remains constant if the RF attenuation is increased by 10 dB. Only the displayed noise is increased by 10 dB due to the additional attenuation. If the harmonic is exclusively generated by the spectrum analyzer, the level of the harmonic is reduced by 20 dB or is lost in noise. If both – the DUT and the spectrum analyzer – contribute to the harmonic, the reduction in the harmonic level is correspondingly smaller.*

High–Sensitivity Harmonics Measurements

If harmonics have very small levels, the resolution bandwidth required to measure them must be reduced considerably. The sweep time is, therefore, also increased considerably. In this case, the measurement of individual harmonics is carried out with the spectrum analyzer set to a small span. Only the frequency range around the harmonics will then be measured with a small resolution bandwidth.

Signal generator settings (e.g. R&S SMU):

Frequency: 128 MHz

Level: – 25 dBm

Procedure:

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.
The R&S FSL is set to its default state.
2. Set the center frequency to 128 MHz and the span to 100 kHz.
 - Press the **FREQ** key.
The frequency menu is displayed.
 - In the dialog box, enter *128* using the numeric keypad and confirm with the **MHz** key.
 - Press the **SPAN** key.
 - In the dialog box, enter *100* using the numeric keypad and confirm with the **kHz** key.
The R&S FSL displays the reference signal with a span of 100 kHz and resolution bandwidth of 3 kHz.
3. Switching on the marker.
 - Press the **MKR** key.
The marker is positioned on the trace maximum.
4. Set the measured signal frequency and the measured level as reference values
 - Press the **Phase Noise/Ref Fixed** softkey.
The position of the marker becomes the reference point. The reference point level is indicated by a horizontal line, the reference point frequency with a vertical line. At the same time, the delta marker 2 is switched on.
 - Press the **Ref Fixed** softkey.
The mode changes from phase noise measurement to reference fixed, the marker readout changes from dB/Hz to dB.

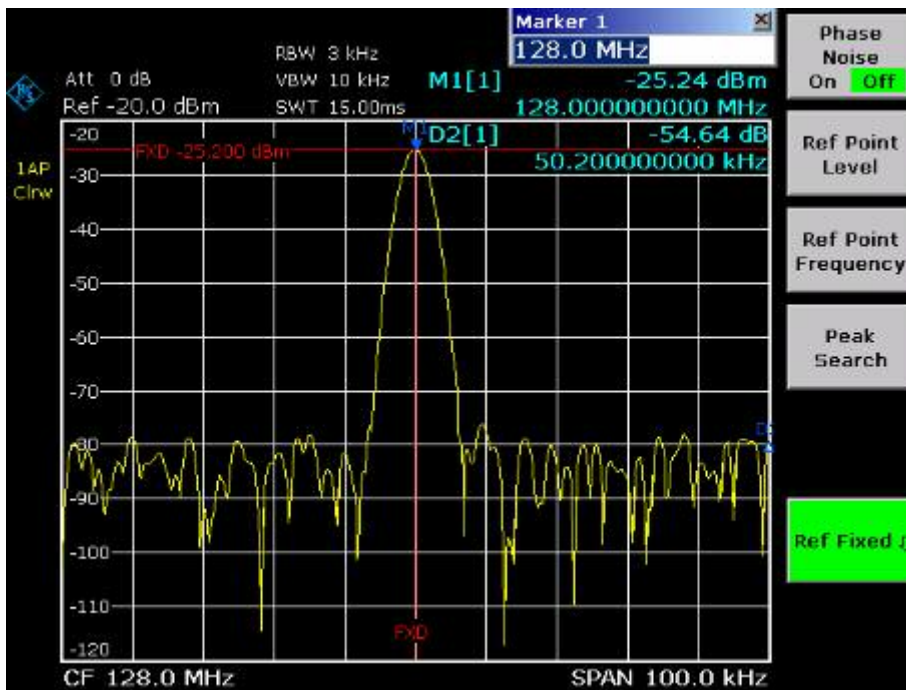


Fig. 2-2 Fundamental wave and the frequency and level reference point

5. Make the step size for the center frequency equal to the signal frequency
 - Press the **FREQ** key.
The frequency menu is displayed.
 - Press the **CF-Stepsize** softkey and press the = **Marker** softkey in the submenu.
The step size for the center frequency is now equal to the marker frequency.
6. Set the center frequency to the 2nd harmonic of the signal
 - Press the **FREQ** key.
The frequency menu is displayed.
 - Press the **UPARROW** key once.
The center frequency is set to the 2nd harmonic.
7. Place the delta marker on the 2nd harmonic.
 - Press the **MKR->** key.
 - Press the **Peak** softkey.
The delta marker moves to the maximum of the 2nd harmonic. The displayed level result is relative to the reference point level (= fundamental wave level).

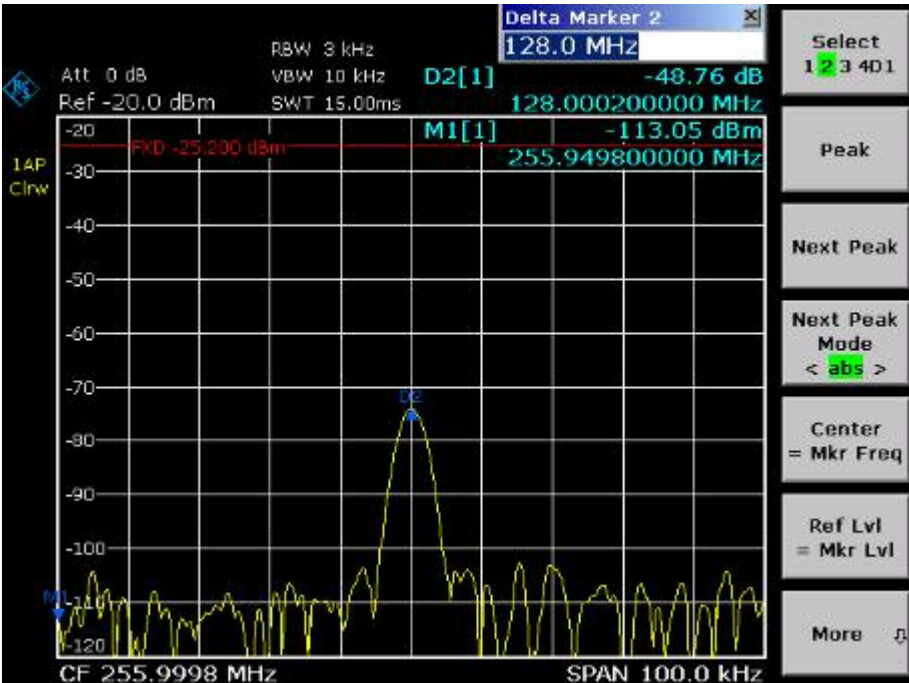


Fig. 2-3 Measuring the level difference between the fundamental wave (= reference point level) and the 2nd harmonic

The other harmonics are measured with steps 5 and 6, the center frequency being incremented or decremented in steps of 128 MHz using the **UPARROW** or **DNARROW** key.

Measuring the Spectra of Complex Signals

Separating Signals by Selecting an Appropriate Resolution Bandwidth

A basic feature of a spectrum analyzer is being able to separate the spectral components of a mixture of signals. The resolution at which the individual components can be separated is determined by the resolution bandwidth. Selecting a resolution bandwidth that is too large may make it impossible to distinguish between spectral components, i.e. they are displayed as a single component.

An RF sinusoidal signal is displayed by means of the passband characteristic of the resolution filter (RBW) that has been set. Its specified bandwidth is the 3 dB bandwidth of the filter.

Two signals with the same amplitude can be resolved if the resolution bandwidth is smaller than or equal to the frequency spacing of the signal. If the resolution bandwidth is equal to the frequency spacing, the spectrum display screen shows a level drop of 3 dB precisely in the center of the two signals. Decreasing the resolution bandwidth makes the level drop larger, which thus makes the individual signals clearer.

If there are large level differences between signals, the resolution is determined by selectivity as well as by the resolution bandwidth that has been selected. The measure of selectivity used for spectrum analyzers is the ratio of the 60 dB bandwidth to the 3 dB bandwidth (= shape factor).

For the R&S FSL, the shape factor for bandwidths is < 5, i.e. the 60 dB bandwidth of the 30 kHz filter is < 150 kHz.

The higher spectral resolution with smaller bandwidths is won by longer sweep times for the same span. The sweep time has to allow the resolution filters to settle during a sweep at all signal levels and frequencies to be displayed. It is given by the following formula.

$$SWT = k \cdot \text{Span}/RBW^2 \quad (1)$$

- SWT = max. sweep time for correct measurement
- k = factor depending on type of resolution filter
= 1 for digital IF filters
- Span = frequency display range
- RBW = resolution bandwidth

If the resolution bandwidth is reduced by a factor of 3, the sweep time is increased by a factor of 9.

Note: *The impact of the video bandwidth on the sweep time is not taken into account in (1). For the formula to be applied, the video bandwidth must be $\geq 3 \times$ the resolution bandwidth.*

FFT filters can be used for resolution bandwidths up to 30 kHz. Like digital filters, they have a shape factor of less than 5 up to 30 kHz. For FFT filters, however, the sweep time is given by the following formula:

$$SWT = k \cdot \text{span}/RBW \quad (2)$$

If the resolution bandwidth is reduced by a factor of 3, the sweep time is increased by a factor of 3 only.

Intermodulation Measurements

If several signals are applied to a transmission two-port device with nonlinear characteristic, intermodulation products appear at its output by the sums and differences of the signals. The nonlinear characteristic produces harmonics of the useful signals which intermodulate at the characteristic. The intermodulation products of lower order have a special effect since their level is largest and they are near the useful signals. The intermodulation product of third order causes the highest interference. It is the intermodulation product generated from one of the useful signals and the 2nd harmonic of the second useful signal in case of two-tone modulation.

The frequencies of the intermodulation products are above and below the useful signals. Fig. 2-4 shows intermodulation products P_{i1} and P_{i2} generated by the two useful signals P_{U1} and P_{U2} .

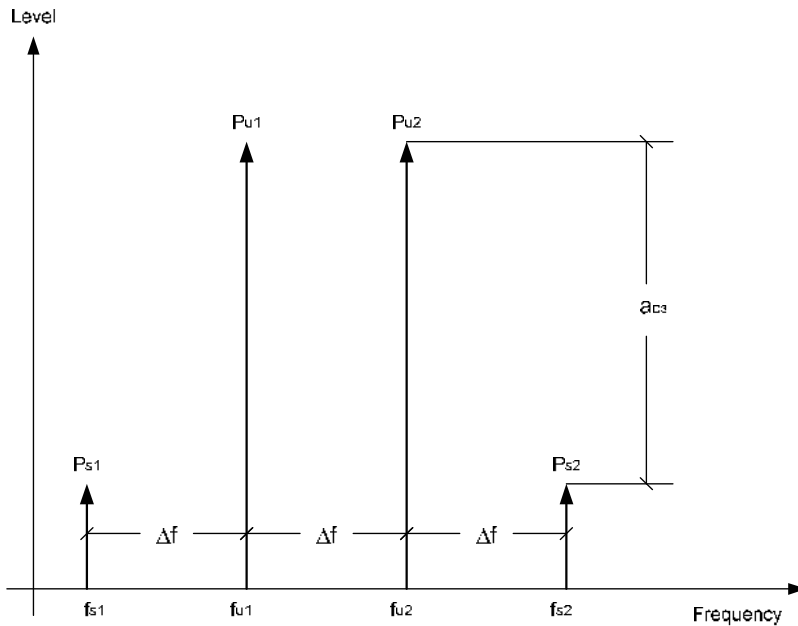


Fig. 2-4 Intermodulation products P_{U1} and P_{U2}

The intermodulation product at f_{i2} is generated by mixing the 2nd harmonic of useful signal P_{U2} and signal P_{U1} , the intermodulation product at f_{i1} by mixing the 2nd harmonic of useful signal P_{U1} and signal P_{U2} .

$$f_{i1} = 2 \times f_{u1} - f_{u2} \quad (1)$$

$$f_{i2} = 2 \times f_{u2} - f_{u1} \quad (2)$$

The level of the intermodulation products depends on the level of the useful signals. If the two useful signals are increased by 1 dB, the level of the intermodulation products increases by 3 dB, which means that spacing a_{D3} between intermodulation signals and useful signals are reduced by 2 dB. This is illustrated in Fig. 2-5.

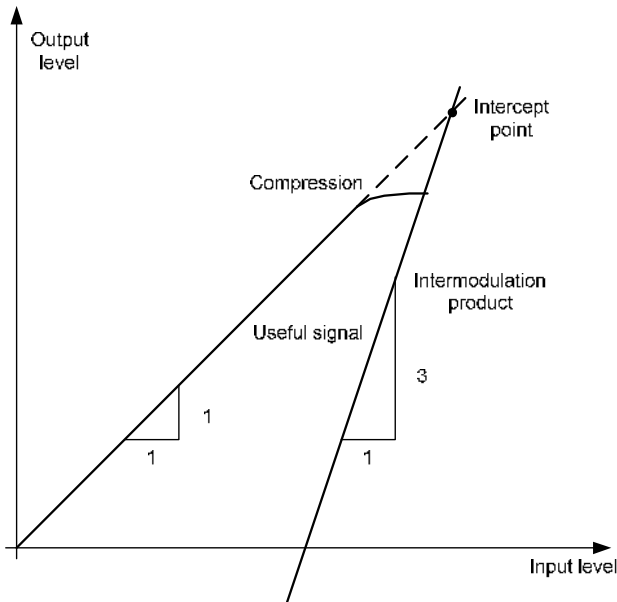


Fig. 2–5 Dependence of intermodulation level on useful signal level

The useful signals at the two–port output increase proportionally with the input level as long as the two–port is in the linear range. A level change of 1 dB at the input causes a level change of 1 dB at the output. Beyond a certain input level, the two–port goes into compression and the output level stops increasing. The intermodulation products of the third order increase three times as much as the useful signals. The intercept point is the fictitious level where the two lines intersect. It cannot be measured directly since the useful level is previously limited by the maximum two–port output power.

It can be calculated from the known line slopes and the measured spacing a_{D3} at a given level according to the following formula.

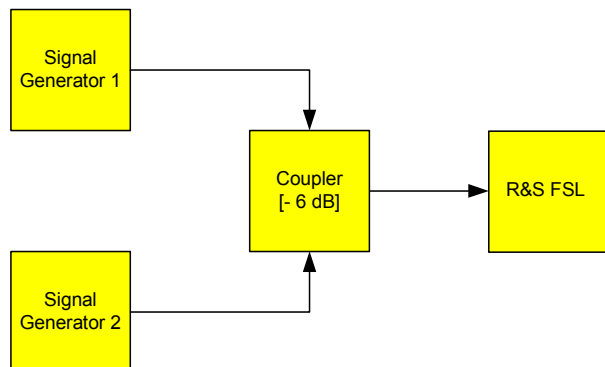
$$IP3 = \frac{a_{D3}}{2} + P_N \quad (3)$$

The 3rd order intercept point (TOI), for example, is calculated for an intermodulation of 60 dB and an input level P_U of –20 dBm according to the following formula:

$$IP3 = \frac{60}{2} + (-20dBm) = 10dBm \quad (4)$$

Measurement example – Measuring the R&S FSL's intrinsic intermodulation

Test setup:



Signal generator settings (e.g. R&S SMU):

| | Level | Frequency |
|--------------------|--------|------------|
| Signal generator 1 | -4 dBm | 999.7 MHz |
| Signal generator 2 | -4 dBm | 1000.3 MHz |

Procedure:

1. Set the spectrum analyzer to its default settings.
 - Press the **PRESET** key.
 - The R&S FSL is in its default state.
2. Set center frequency to 1 GHz and the frequency span to 3 MHz.
 - Press the **FREQ** key and enter *1 GHz*.
 - Press the **SPAN** key and enter *3 MHz*.
3. Set the reference level to -10 dBm and RF attenuation to 0 dB.
 - Press the **AMPT** key and enter *-10 dBm*.
 - Press the **RF Atten Manual** softkey and enter *0 dB*.
4. Set the resolution bandwidth to 10 kHz.
 - Press the **BW** key.
 - Press the **Res BW Manual** softkey and enter *10 kHz*.
 - The noise is reduced, the trace is smoothed further and the intermodulation products can be clearly seen.
 - Press the **Video BW Manual** softkey and enter *1 kHz*.
5. Measuring intermodulation by means of the 3rd order intercept measurement function
 - Press the **MEAS** key.
 - Press the **TOI** softkey.

The R&S FSL activates four markers for measuring the intermodulation distance. Two markers are positioned on the useful signals and two on the intermodulation products. The 3rd order intercept is calculated from the level difference between the useful signals and the intermodulation products. It is then displayed on the screen:

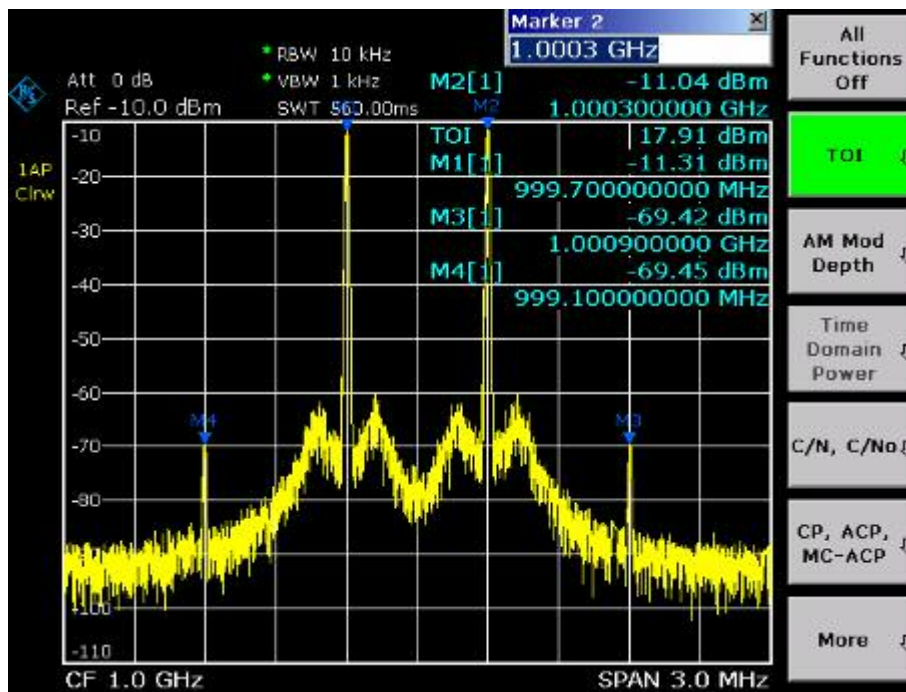


Fig. 2–6 Result of intrinsic intermodulation measurement on the R&S FSL. The 3rd order intercept (TOI) is displayed at the top right corner of the grid.

The level of a spectrum analyzer's intrinsic intermodulation products depends on the RF level of the useful signals at the input mixer. When the RF attenuation is added, the mixer level is reduced and the intermodulation distance is increased. With an additional RF attenuation of 10 dB, the levels of the intermodulation products are reduced by 20 dB. The noise level is, however, increased by 10 dB.

6. Increasing RF attenuation to 10 dB to reduce intermodulation products.
 - Press the **AMPT** key.
 - Press the **RF Atten Manual** softkey and enter *10 dB*.

The R&S FSL's intrinsic intermodulation products disappear below the noise floor.

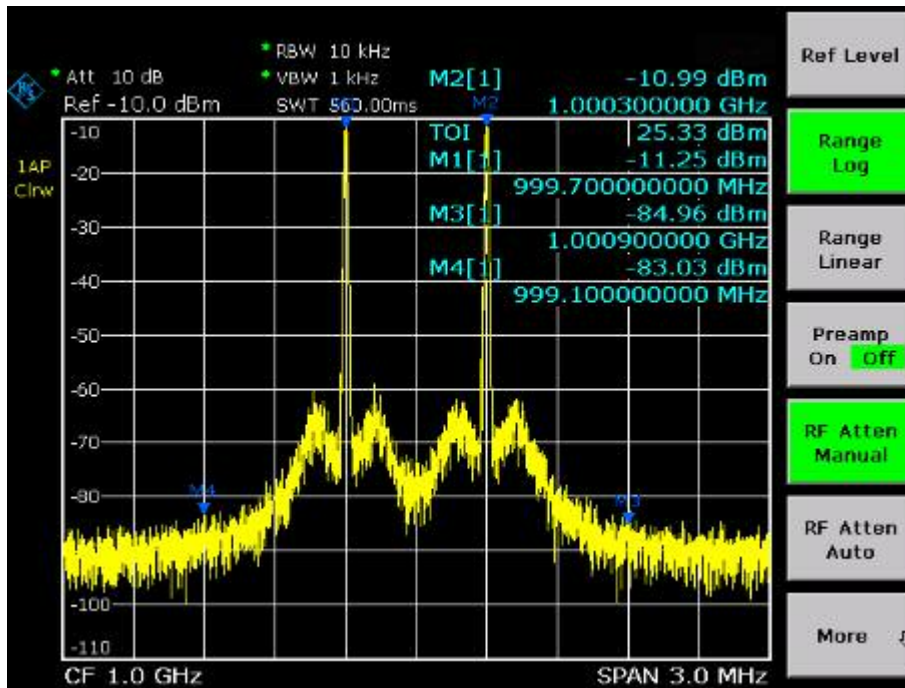


Fig. 2–7 If the RF attenuation is increased, the R&S FSL's intrinsic intermodulation products disappear below the noise floor.

Calculation method:

The method used by the R&S FSL to calculate the intercept point takes the average useful signal level P_u in dBm and calculates the intermodulation d_3 in dB as a function of the average value of the levels of the two intermodulation products. The third order intercept (TOI) is then calculated as follows:

$$TOI/dBm = \frac{1}{2} d_3 + P_u$$

Intermodulation– free dynamic range

The **Intermodulation – free dynamic range**, i.e. the level range in which no internal intermodulation products are generated if two–tone signals are measured, is determined by the 3rd order intercept point, the phase noise and the thermal noise of the spectrum analyzer. At high signal levels, the range is determined by intermodulation products. At low signal levels, intermodulation products disappear below the noise floor, i.e. the noise floor and the phase noise of the spectrum analyzer determine the range. The noise floor and the phase noise depend on the resolution bandwidth that has been selected. At the smallest resolution bandwidth, the noise floor and phase noise are at a minimum and so the maximum range is obtained. However, a large increase in sweep time is required for small resolution bandwidths. It is, therefore, best to select the largest resolution bandwidth possible to obtain the range that is required. Since phase noise decreases as the carrier–offset increases, its influence decreases with increasing frequency offset from the useful signals.

The following diagrams illustrate the intermodulation–free dynamic range as a function of the selected bandwidth and of the level at the input mixer (= signal level – set RF attenuation) at different useful signal offsets.

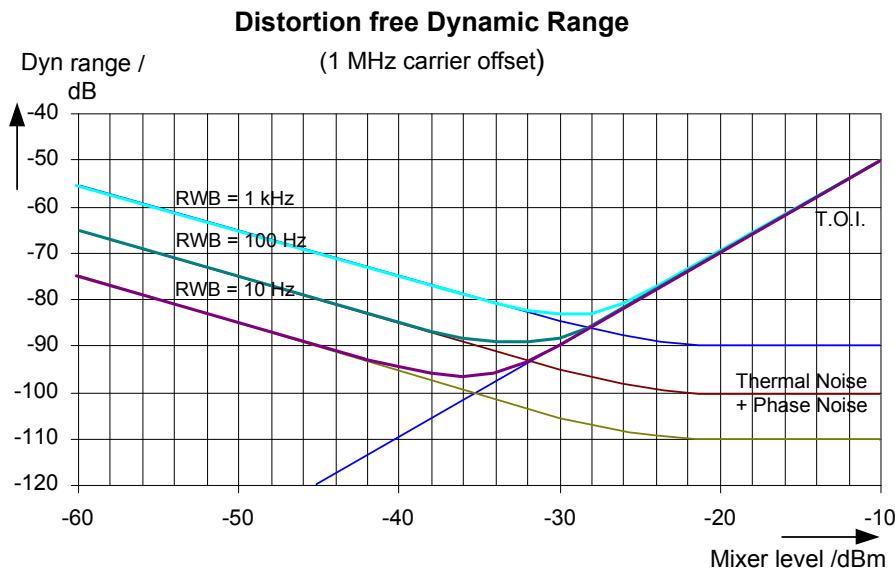


Fig. 2–8 Intermodulation-free range of the R&S FSL as a function of level at the input mixer and the set resolution bandwidth (useful signal offset = 1 MHz, DANL = -145 dBm /Hz, TOI = 15 dBm; typical values at 2 GHz)

The optimum mixer level, i.e. the level at which the intermodulation distance is at its maximum, depends on the bandwidth. At a resolution bandwidth of 10 Hz, it is approx. -35 dBm and at 1 kHz increases to approx. -30 dBm.

Phase noise has a considerable influence on the intermodulation-free range at carrier offsets between 10 and 100 kHz (Fig. 2–9). At greater bandwidths, the influence of the phase noise is greater than it would be with small bandwidths. The optimum mixer level at the bandwidths under consideration becomes almost independent of bandwidth and is approx. -40 dBm.

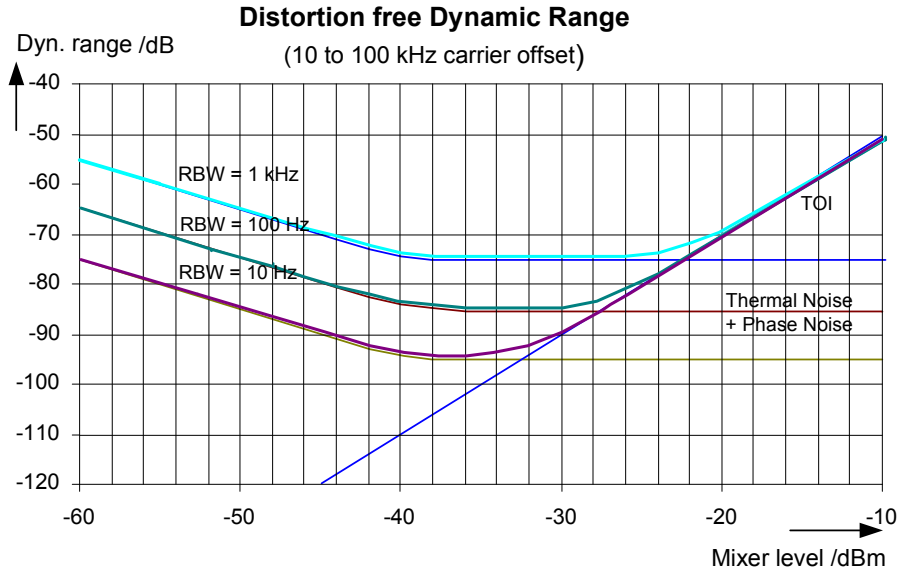


Fig. 2-9 Intermodulation-free dynamic range of the R&S FSL as a function of level at the input mixer and of the selected resolution bandwidth (useful signal offset = 10 to 100 kHz, DANL = -145 dBm /Hz, TOI = 15 dBm; typical values at 2 GHz).

Note: If the intermodulation products of a DUT with a very high dynamic range are to be measured and the resolution bandwidth to be used is therefore very small, it is best to measure the levels of the useful signals and those of the intermodulation products separately using a small span. The measurement time will be reduced— in particular if the offset of the useful signals is large. To find signals reliably when frequency span is small, it is best to synchronize the signal sources and the R&S FSL.

Measuring Signals in the Vicinity of Noise

The minimum signal level a spectrum analyzer can measure is limited by its intrinsic noise. Small signals can be swamped by noise and therefore cannot be measured. For signals that are just above the intrinsic noise, the accuracy of the level measurement is influenced by the intrinsic noise of the spectrum analyzer.

The displayed noise level of a spectrum analyzer depends on its noise figure, the selected RF attenuation, the selected reference level, the selected resolution and video bandwidth and the detector. The effect of the different parameters is explained in the following.

Impact of the RF attenuation setting

The sensitivity of a spectrum analyzer is directly influenced by the selected RF attenuation. The highest sensitivity is obtained at a RF attenuation of 0 dB. The attenuation can be set in 10 dB steps up to 70 dB. Each additional 10 dB step reduces the sensitivity by 10 dB, i.e. the displayed noise is increased by 10 dB.

Impact of the resolution bandwidth

The sensitivity of a spectrum analyzer also directly depends on the selected bandwidth. The highest sensitivity is obtained at the smallest bandwidth (for the R&S FSL: 10 Hz, for FFT filtering: 1 Hz). If the bandwidth is increased, the reduction in sensitivity is proportional to the change in bandwidth. The R&S FSL has bandwidth settings in 1, 3, 10 sequence. Increasing the bandwidth by a factor of 3 increases the displayed noise by approx. 5 dB (4.77 dB precisely). If the bandwidth is increased by a factor of 10, the displayed noise increases by a factor of 10, i.e. 10 dB.

Impact of the video bandwidth

The displayed noise of a spectrum analyzer is also influenced by the selected video bandwidth. If the video bandwidth is considerably smaller than the resolution bandwidth, noise spikes are suppressed, i.e. the trace becomes much smoother. The level of a sinewave signal is not influenced by the video bandwidth. A sinewave signal can therefore be freed from noise by using a video bandwidth that is small compared with the resolution bandwidth, and thus be measured more accurately.

Impact of the detector

Noise is evaluated differently by the different detectors. The noise display is therefore influenced by the choice of detector. Sinewave signals are weighted in the same way by all detectors, i.e. the level display for a sinewave RF signal does not depend on the selected detector, provided that the signal-to-noise ratio is high enough. The measurement accuracy for signals in the vicinity of intrinsic spectrum analyzer noise is also influenced by the detector which has been selected. For details on the detectors of the R&S FSL refer to chapter "Instrument Functions", section "Detector overview" or the Online Help.

Measurement example – Measuring level at low S/N ratios

The example shows the different factors influencing the S/N ratio.

Signal generator settings (e.g. R&S SMU):

Frequency: 128 MHz

Level: -80 dBm

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.
 - The R&S FSL is in its default state.
2. Set the center frequency to 128 MHz and the frequency span to 100 MHz.
 - Press the **FREQ** key and enter *128 MHz*.
 - Press the **SPAN** key and enter *100 MHz*.
3. Set the RF attenuation to 60 dB to attenuate the input signal or to increase the intrinsic noise.
 - Press the **AMPT** key.
 - Press the **RF Atten Manual** softkey and enter *60 dB*.

The RF attenuation indicator is marked with an asterisk (*Att 60 dB) to show that it is no longer coupled to the reference level. The high input attenuation reduces the reference signal which can no longer be detected in noise.

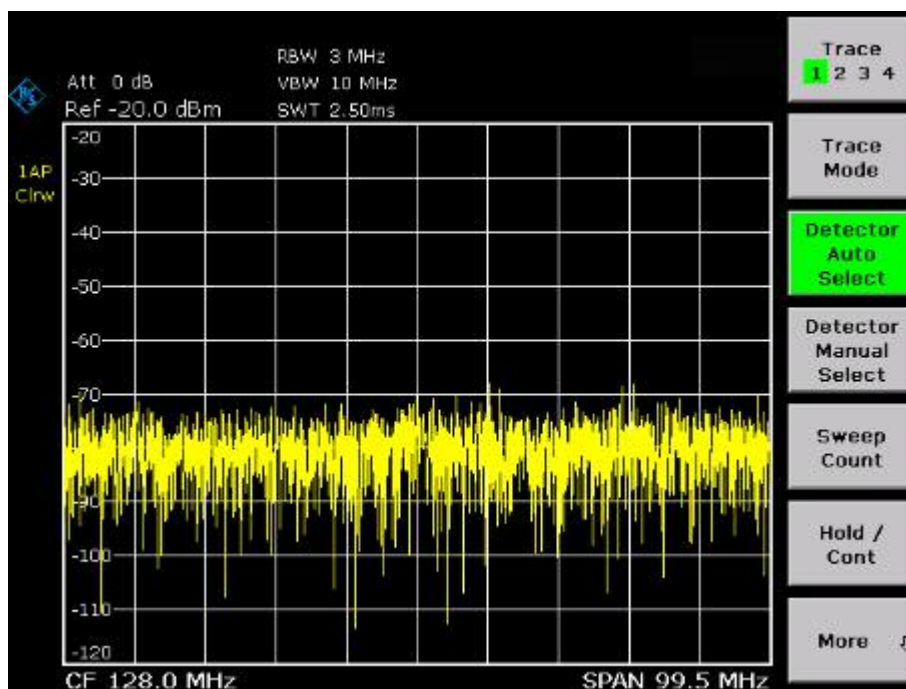


Fig. 2–10 Sinewave signal with low S/N ratio. The signal is measured with the auto peak detector and is completely hidden in the intrinsic noise of the spectrum analyzer.

4. To suppress noise spikes the trace can be averaged.
 - Press the **TRACE** key.
 - Press the **Trace Mode** key.
 - In the **Trace Mode** dialog box, mark **Average** using the rotary knob or the arrow keys and confirm using the rotary knob or the **ENTER** key.

The traces of consecutive sweeps are averaged. To perform averaging, the R&S FSL automatically switches on the sample detector. The RF signal, therefore, can be more clearly distinguished from noise.

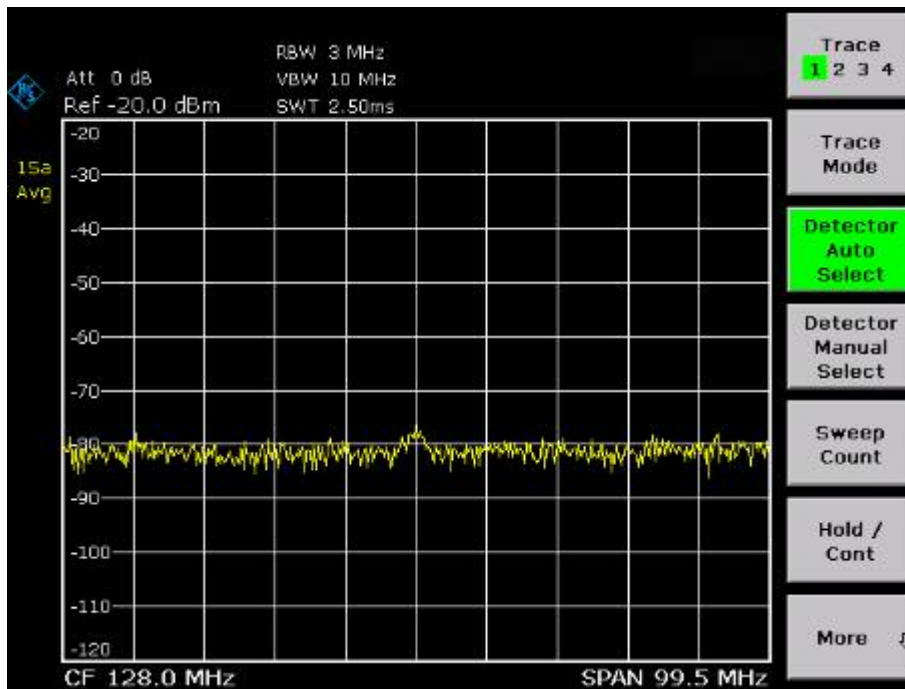


Fig. 2–11 RF sinewave signal with low S/N ratio if the trace is averaged.

5. Instead of trace averaging, a video filter that is narrower than the resolution bandwidth can be selected.
 - Press the **Trace Mode** key.
 - In the **Trace Mode** dialog box, mark **Clear Write** using the rotary knob or the arrow keys and confirm using the rotary knob or the **ENTER** key.
 - Press the **BW** key.
 - Press the **Video BW Manual** softkey and enter *10 kHz*.

The RF signal can be more clearly distinguished from noise.

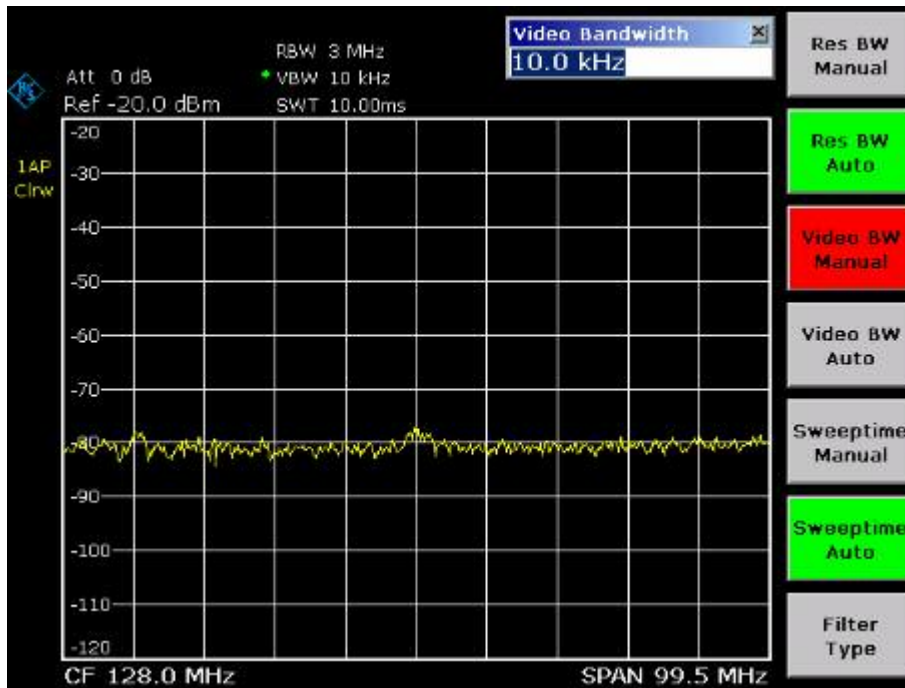


Fig. 2–12 RF sinewave signal with low S/N ratio if a smaller video bandwidth is selected.

6. By reducing the resolution bandwidth by a factor of 10, the noise is reduced by 10 dB.
 - Press the **Res BW Manual** softkey and enter *300 kHz*.

The displayed noise is reduced by approx. 10 dB. The signal, therefore, emerges from noise by about 10 dB. Compared to the previous setting, the video bandwidth has remained the same, i.e. it has increased relative to the smaller resolution bandwidth. The averaging effect of the video bandwidth is therefore reduced. The trace will be noisier.

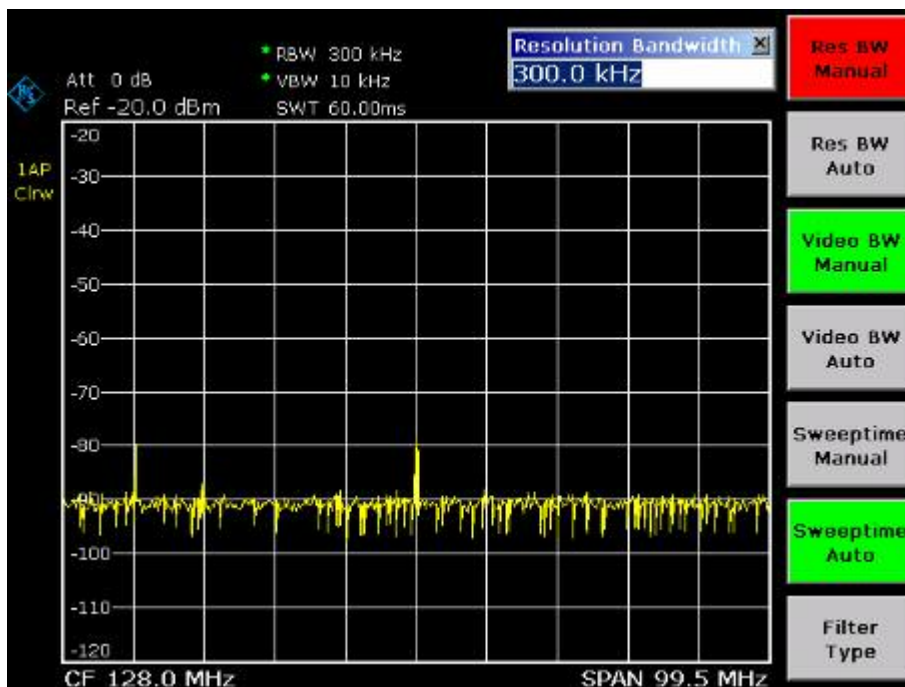


Fig. 2–13 Reference signal at a smaller resolution bandwidth

Noise Measurements

Noise measurements play an important role in spectrum analysis. Noise e.g. affects the sensitivity of radio communication systems and their components.

Noise power is specified either as the total power in the transmission channel or as the power referred to a bandwidth of 1 Hz. The sources of noise are, for example, amplifier noise or noise generated by oscillators used for the frequency conversion of useful signals in receivers or transmitters. The noise at the output of an amplifier is determined by its noise figure and gain.

The noise of an oscillator is determined by phase noise near the oscillator frequency and by thermal noise of the active elements far from the oscillator frequency. Phase noise can mask weak signals near the oscillator frequency and make them impossible to detect.

Measuring Noise Power Density

To measure noise power referred to a bandwidth of 1 Hz at a certain frequency, the R&S FSL provides marker function. This marker function calculates the noise power density from the measured marker level.

Measurement example – Measuring the intrinsic noise power density of the R&S FSL at 1 GHz and calculating the R&S FSL's noise figure

Test setup:

No signal connected to the RF input; RF input terminated with 50 Ω .

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.The R&S FSL is in its default state.
2. Set the center frequency to 1.234 GHz and the span to 1 MHz.
 - Press the **FREQ** key and enter *1.234 GHz*.
 - Press the **SPAN** key and enter *1 MHz*.
3. Switch on the marker and set the marker frequency to 1.234 GHz.
 - Press the **MKR** key and enter *1.234 GHz*.
4. Switch on the noise marker function.
 - Switch on the **Noise Meas** softkey.

The R&S FSL displays the noise power at 1 GHz in dBm (1Hz).

| |
|---|
| Note: <i>Since noise is random, a sufficiently long measurement time has to be selected to obtain stable measurement results. This can be achieved by averaging the trace or by selecting a very small video bandwidth relative to the resolution bandwidth.</i> |
|---|

5. The measurement result is stabilized by averaging the trace.
 - Press the **TRACE** key.
 - Press the **Trace Mode** key.
 - In the **Trace Mode** dialog box, mark **Average** using the rotary knob or the arrow keys and confirm pressing the rotary knob or the **ENTER** key.

The R&S FSL performs sliding averaging over 10 traces from consecutive sweeps. The measurement result becomes more stable.

Conversion to other reference bandwidths

The result of the noise measurement can be referred to other bandwidths by simple conversion. This is done by adding $10 \cdot \log(\text{BW})$ to the measurement result, BW being the new reference bandwidth.

Example

A noise power of -150 dBm (1 Hz) is to be referred to a bandwidth of 1 kHz.

$$P_{[1\text{kHz}]} = -150 + 10 \cdot \log(1000) = -150 + 30 = -120 \text{ dBm (1 kHz)}$$

Calculation method for noise power

If the noise marker is switched on, the R&S FSL automatically activates the sample detector. The video bandwidth is set to 1/10 of the selected resolution bandwidth (RBW).

To calculate the noise, the R&S FSL takes an average over 17 adjacent pixels (the pixel on which the marker is positioned and 8 pixels to the left, 8 pixels to the right of the marker). The measurement result is stabilized by video filtering and averaging over 17 pixels.

Since both video filtering and averaging over 17 trace points is performed in the log display mode, the result would be 2.51 dB too low (difference between logarithmic noise average and noise power). The R&S FSL, therefore, corrects the noise figure by 2.51 dB.

To standardize the measurement result to a bandwidth of 1 Hz, the result is also corrected by $-10 \cdot \log(\text{RBW}_{\text{noise}})$, with $\text{RBW}_{\text{noise}}$ being the power bandwidth of the selected resolution filter (RBW).

Detector selection

The noise power density is measured in the default setting with the sample detector and using averaging. Other detectors that can be used to perform a measurement giving true results are the average detector or the RMS detector. If the average detector is used, the linear video voltage is averaged and displayed as a pixel. If the RMS detector is used, the squared video voltage is averaged and displayed as a pixel. The averaging time depends on the selected sweep time ($=\text{SWT}/501$). An increase in the sweep time gives a longer averaging time per pixel and thus stabilizes the measurement result. The R&S FSL automatically corrects the measurement result of the noise marker display depending on the selected detector (+1.05 dB for the average detector, 0 dB for the RMS detector). It is assumed that the video bandwidth is set to at least three times the resolution bandwidth. While the average or RMS detector is being switched on, the R&S FSL sets the video bandwidth to a suitable value.

The Pos Peak, Neg Peak, Auto Peak and Quasi Peak detectors are not suitable for measuring noise power density.

Determining the noise figure

The noise figure of amplifiers or of the R&S FSL alone can be obtained from the noise power display. Based on the known thermal noise power of a 50 Ω resistor at room temperature (−174 dBm (1Hz)) and the measured noise power P_{noise} the noise figure (NF) is obtained as follows:

$$NF = P_{noise} + 174 - g,$$

where g = gain of DUT in dB

Example

The measured internal noise power of the R&S FSL at an attenuation of 0 dB is found to be −143 dBm/1 Hz. The noise figure of the R&S FSL is obtained as follows

$$NF = -143 + 174 = 31 \text{ dB}$$

Note: If noise power is measured at the output of an amplifier, for example, the sum of the internal noise power and the noise power at the output of the DUT is measured. The noise power of the DUT can be obtained by subtracting the internal noise power from the total power (subtraction of linear noise powers). By means of the following diagram, the noise level of the DUT can be estimated from the level difference between the total and the internal noise level.

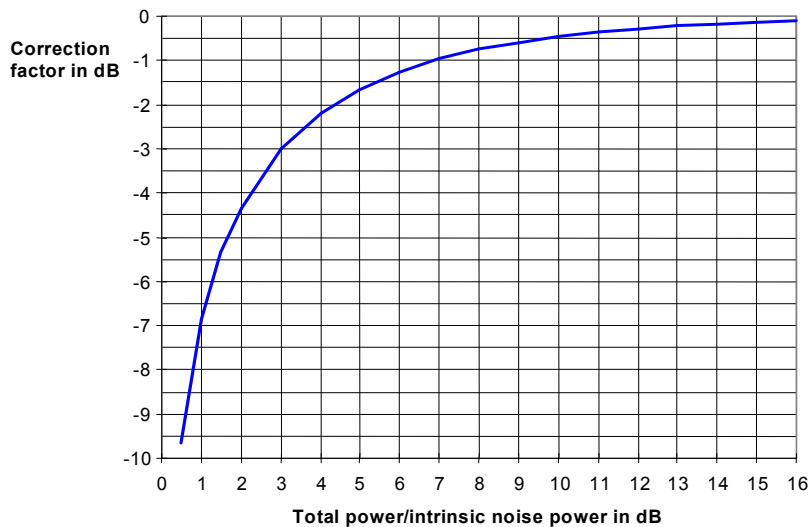


Fig. 2-14 Correction factor for measured noise power as a function of the ratio of total power to the intrinsic noise power of the spectrum analyzer

Measurement of Noise Power within a Transmission Channel

Noise in any bandwidth can be measured with the channel power measurement functions. Thus the noise power in a communication channel can be determined, for example. If the noise spectrum within the channel bandwidth is flat, the noise marker from the previous example can be used to determine the noise power in the channel by considering the channel bandwidth. If, however, phase noise and noise that normally increases towards the carrier is dominant in the channel to be measured, or if there are discrete spurious signals in the channel, the channel power measurement method must be used to obtain correct measurement results.

Measurement example – Measuring the intrinsic noise of the R&S FSL at 1 GHz in a 1.23 MHz channel bandwidth with the channel power function

Test setup:

The RF input of the R&S FSL remains open-circuited or is terminated with 50 Ω .

Procedure:

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.
The R&S FSL is in its default state.
2. Set the center frequency to 1 GHz and the span to 1 MHz.
 - Press the **FREQ** key and enter *1 GHz*.
 - Press the **SPAN** key and enter *2 MHz*.
3. To obtain maximum sensitivity, set RF attenuation on the R&S FSL to 0 dB.
 - Press the **AMPT** key.
 - Press the **RF Atten Manual** softkey and enter *0 dB*.
4. Switch on and configure the channel power measurement.
 - Press the **MEAS** key.
 - Press the **CP, ACP, MC-ACP** softkey.
The R&S FSL activates the channel or adjacent channel power measurement according to the currently set configuration.
 - Press the **CP/ACP Config** softkey.
The submenu for configuring the channel is displayed.
 - Press the **Channel Settings** softkey.
The submenu for channel settings is displayed.

- Press the **Channel Bandwidth** softkey and enter 1.23 MHz.

The R&S FSL displays the 1.23 MHz channel as two vertical lines which are symmetrical to the center frequency.

- Press the **Adjust Settings** softkey.

The settings for the frequency span, the bandwidth (RBW and VBW) and the detector are automatically set to the optimum values required for the measurement.

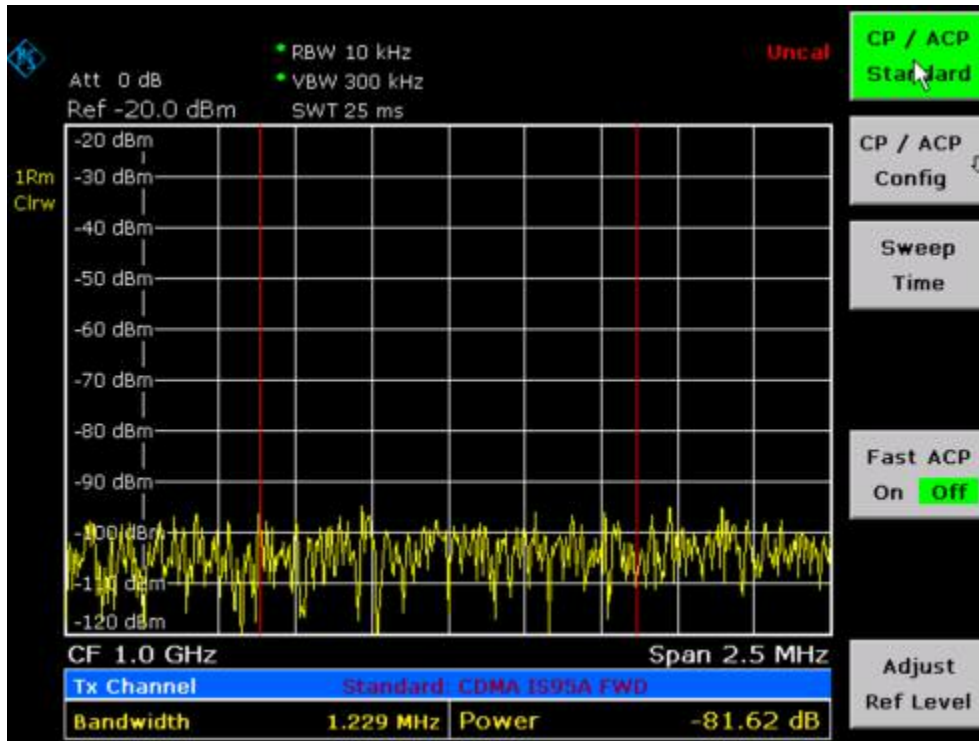


Fig. 2–15 Measurement of the R&S FSL's intrinsic noise power in a 1.23 MHz channel bandwidth.

5. Stabilizing the measurement result by increasing the sweep time

- Press the ▲ key twice.

The main menu for channel and adjacent channel power measurement is displayed.

- Press the **Sweep Time** softkey and enter 1 s.

The trace becomes much smoother because of the RMS detector and the channel power measurement display is much more stable.

Method of calculating the channel power

When measuring the channel power, the R&S FSL integrates the linear power which corresponds to the levels of the pixels within the selected channel. The analyzer uses a resolution bandwidth which is far smaller than the channel bandwidth. When sweeping over the channel, the channel filter is formed by the passband characteristics of the resolution bandwidth (see Fig. 2-16).

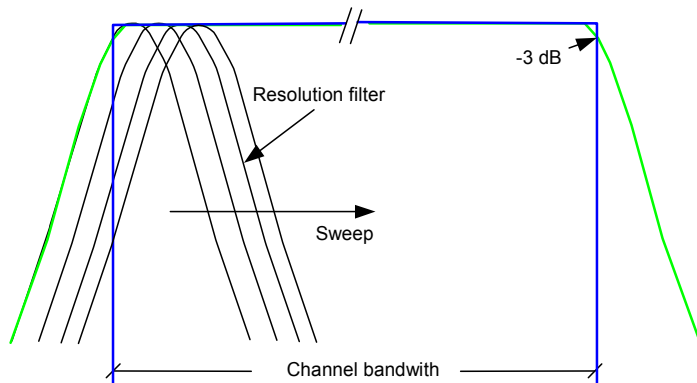


Fig. 2-16 Approximating the channel filter by sweeping with a small resolution bandwidth

The following steps are performed:

- The linear power of all the trace pixels within the channel is calculated.

$$P_i = 10^{(L_i/10)}$$

where P_i = power of the trace pixel i

L_i = displayed level of trace point i

- The powers of all trace pixels within the channel are summed up and the sum is divided by the number of trace pixels in the channel.
- The result is multiplied by the quotient of the selected channel bandwidth and the noise bandwidth of the resolution filter (RBW).

Since the power calculation is performed by integrating the trace within the channel bandwidth, this method is also called the IBW method (Integration Bandwidth method).

Parameter settings

For selection of the sweep time, see next section. For details on the parameter settings refer to chapter "Instrument Functions", section "Settings of the CP / ACP test parameters" or the Online Help.

Sweep time selection

The number of A/D converter values, N , used to calculate the power, is defined by the sweep time. The time per trace pixel for power measurements is directly proportional to the selected sweep time.

If the sample detector is used, it is best to select the smallest sweep time possible for a given span and resolution bandwidth. The minimum time is obtained if the setting is coupled. This means that the time per measurement is minimal. Extending the measurement time does not have any advantages as the number of samples for calculating the power is defined by the number of trace pixels in the channel.

If the RMS detector is used, the repeatability of the measurement results can be influenced by the selection of sweep times. Repeatability is increased at longer sweep times.

Repeatability can be estimated from the following diagram:

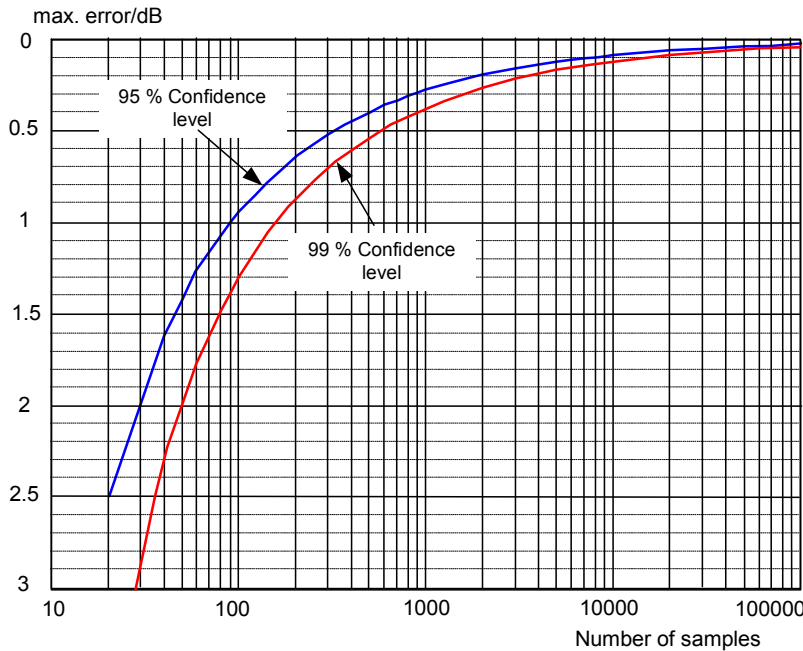


Fig. 2–17 Repeatability of channel power measurements as a function of the number of samples used for power calculation

The curves in Fig. 2–17 indicate the repeatability obtained with a probability of 95% and 99% depending on the number of samples used.

The repeatability with 600 samples is ± 0.5 dB. This means that – if the sample detector and a channel bandwidth over the whole diagram (channel bandwidth = span) is used – the measured value lies within ± 0.5 dB of the true value with a confidence level of 99%.

If the RMS detector is used, the number of samples can be estimated as follows:

Since only uncorrelated samples contribute to the RMS value, the number of samples can be calculated from the sweep time and the resolution bandwidth.

Samples can be assumed to be uncorrelated if sampling is performed at intervals of $1/RBW$. The number of uncorrelated samples is calculated as follows:

$$N_{decorr} = SWT \cdot RBW \text{ (} N_{decorr} \text{ means uncorrelated samples)}$$

The number of uncorrelated samples per trace pixel is obtained by dividing N_{decorr} by 501 (= pixels per trace).

Example

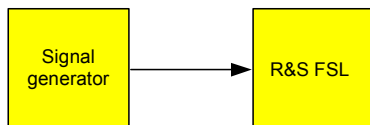
At a resolution bandwidth of 30 kHz and a sweep time of 100 ms, 3000 uncorrelated samples are obtained. If the channel bandwidth is equal to the frequency display range, i.e. all trace pixels are used for the channel power measurement, a repeatability of 0.2 dB with a probability of 99% is the estimate that can be derived from Fig. 2–17.

Measuring Phase Noise

The R&S FSL has an easy-to-use marker function for phase noise measurements. This marker function indicates the phase noise of an RF oscillator at any carrier in dBc in a bandwidth of 1 Hz.

Measurement example – Measuring the phase noise of a signal generator at a carrier offset of 10 kHz

Test setup:



Signal generator settings (e.g. R&S SMU):

Frequency: 100 MHz

Level: 0 dBm

Procedure:

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.
R&S FSL is in its default state.
2. Set the center frequency to 100 MHz and the span to 50 kHz.
 - Press the **FREQ** key and enter *100 MHz*.
 - Press the **SPAN** key and enter *50 kHz*.
3. Set the R&S FSL's reference level to 0 dBm (=signal generator level).
 - Press the **AMPT** key and enter *0 dBm*.
4. Enable phase noise measurement.
 - Press the **MKR** key.
 - Press the **Phase Noise/Ref Fixed** softkey.

The R&S FSL activates phase noise measurement. Marker 1 (=main marker) and marker 2 (= delta marker) are positioned on the signal maximum. The position of the marker is the reference (level and frequency) for the phase noise measurement. A horizontal line represents the level of the reference point and a vertical line the frequency of the reference point. The dialog box for the delta marker is displayed so that the frequency offset at which the phase noise is to be measured can be entered directly.

5. Set the frequency offset to 10 kHz for determining phase noise.

- Enter 10 kHz.

The R&S FSL displays the phase noise at a frequency offset of 10 kHz. The magnitude of the phase noise in dBc/Hz is displayed in the delta marker output field at the top right of the screen (Phn2).

6. Stabilize the measurement result by activating trace averaging.

- Press the **TRACE** key.
- Press the **Trace Mode** key.
- In the **Trace Mode** dialog box, mark **Average** using the rotary knob or the arrow keys and confirm using the rotary knob or the **ENTER** key.

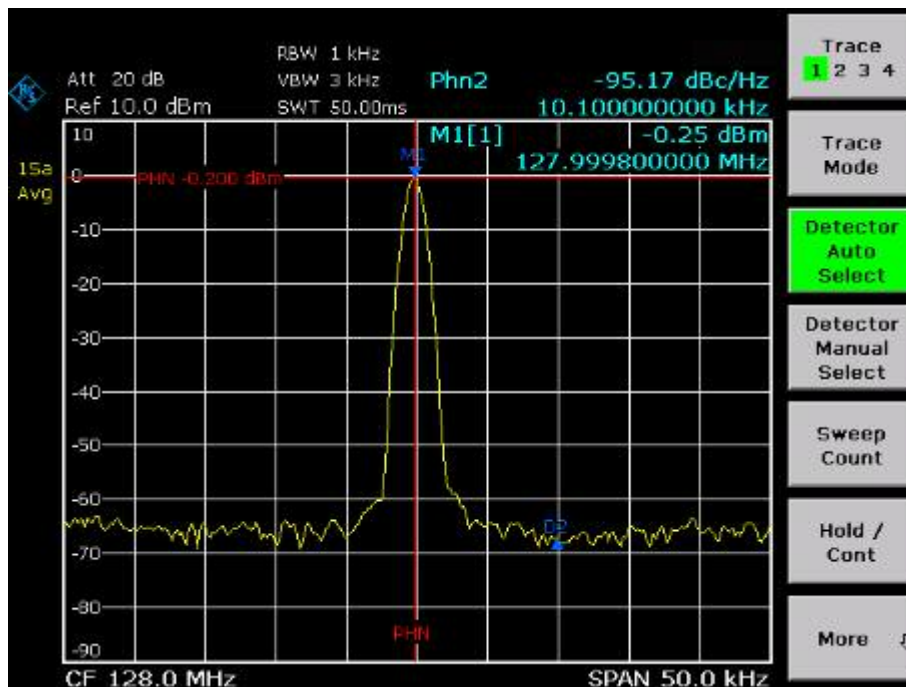


Fig. 2–18 Measuring phase noise with the phase–noise marker function

The frequency offset can be varied by moving the marker with the rotary knob or by entering a new frequency offset as a number.

Measurements on Modulated Signals

For measurements on AM and FM signals refer to the Quick Start Guide, chapter 5, "Basic Measurements Examples".

Measuring Channel Power and Adjacent Channel Power

Measuring channel power and adjacent channel power is one of the most important tasks in the field of digital transmission for a spectrum analyzer with the necessary test routines. While, theoretically, channel power could be measured at highest accuracy with a power meter, its low selectivity means that it is not suitable for measuring adjacent channel power as an absolute value or relative to the transmit channel power. The power in the adjacent channels can only be measured with a selective power meter.

A spectrum analyzer cannot be classified as a true power meter, because it displays the IF envelope voltage. However, it is calibrated such as to correctly display the power of a pure sinewave signal irrespective of the selected detector. This calibration cannot be applied for non-sinusoidal signals. Assuming that the digitally modulated signal has a Gaussian amplitude distribution, the signal power within the selected resolution bandwidth can be obtained using correction factors. These correction factors are normally used by the spectrum analyzer's internal power measurement routines in order to determine the signal power from IF envelope measurements. These factors apply if and only if the assumption of a Gaussian amplitude distribution is correct.

Apart from this common method, the R&S FSL also has a true power detector, i.e. an RMS detector. It correctly displays the power of the test signal within the selected resolution bandwidth irrespective of the amplitude distribution, without additional correction factors being required. The absolute measurement uncertainty of the FSL is < 1.5 dB and a relative measurement uncertainty of < 0.5 dB (each with a confidence level of 95%).

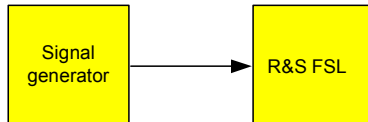
There are two possible methods for measuring channel and adjacent channel power with a spectrum analyzer:

- **IBW method (Integration Bandwidth Method)**
The spectrum analyzer measures with a resolution bandwidth that is less than the channel bandwidth and integrates the level values of the trace versus the channel bandwidth. This method is described in section "[Method of calculating the channel power](#)".
- Using a channel filter
For a detailed description, refer to the following section.

Measurement using a channel filter

In this case, the spectrum analyzer makes zero span measurements using an IF filter that corresponds to the channel bandwidth. The power is measured at the output of the IF filter. Until now, this method has not been used for spectrum analyzers, because channel filters were not available and the resolution bandwidths, optimized for the sweep, did not have a sufficient selectivity. The method was reserved for special receivers optimized for a particular transmission method. It is available in R&S FSQ, FSU, FSP and FSL series.

The R&S FSL has test routines for simple channel and adjacent channel power measurements. These routines give quick results without any complex or tedious setting procedures.

Measurement example 1 – ACPR measurement on an CDMA 2000 signal**Test setup:****Signal generator settings (e.g. R&S SMU):**

Frequency: 850 MHz

Level: 0 dBm

Modulation: CDMA 2000

Procedure:

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.The R&S FSL is in its default state.
2. Set the center frequency to 850 MHz and span to 4 MHz.
 - Press the **FREQ** key and enter *850 MHz*.
 - Press the **SPAN** key and enter *4 MHz*.
3. Set the reference level to +10 dBm.
 - Press the **AMPT** key and enter *10 dBm*.
4. Configuring the adjacent channel power for the CDMA 2000 MC1.
 - Press the **MEAS** key.
 - Press the **CP, ACP, MC-ACP** softkey.
 - Press the **CP / ACP Standard** softkey.
 - In the standards list, mark **CDMA 2000 MC1** using the rotary knob or the arrow keys and confirm pressing the rotary knob or the **ENTER** key.

The R&S FSL sets the channel configuration according to the 2000 MC1 standard for mobile stations with 2 adjacent channels above and below the transmit channel. The spectrum is displayed in the upper part of the screen, the numeric values of the results and the channel configuration in the lower part of the screen. The various channels are represented by vertical lines on the graph.

The frequency span, resolution bandwidth, video bandwidth and detector are selected automatically to give correct results. To obtain stable results – especially in the adjacent channels (30 kHz bandwidth) which are narrow in comparison with the transmission channel bandwidth (1.23 MHz) – the RMS detector is used.

5. Set the optimal reference level and RF attenuation for the applied signal level.

- Press the **Adjust Ref Level** softkey.

The R&S FSL sets the optimal RF attenuation and the reference level based on the transmission channel power to obtain the maximum dynamic range. Fig. 2–19 shows the result of the measurement.

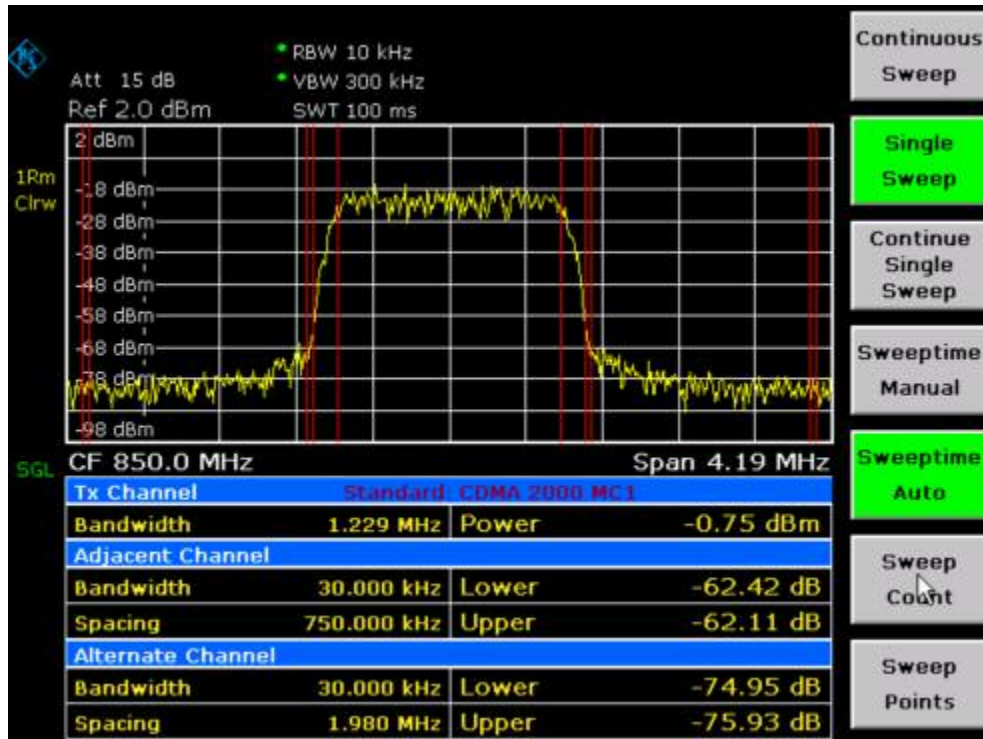


Fig. 2–19 Adjacent channel power measurement on a CDMA 2000 MC1 signal

The repeatability of the results, especially in the narrow adjacent channels, strongly depends on the measurement time since the dwell time within the 30 kHz channels is only a fraction of the complete sweep time. A longer sweep time may increase the probability that the measured value converges to the true value of the adjacent channel power, but this increases measurement time.

To avoid long measurement times, the R&S FSL measures the adjacent channel power with zero span (fast ACP mode). In the fast ACP mode, the R&S FSL measures the power of each channel at the defined channel bandwidth, while being tuned to the center frequency of the channel in question. The digital implementation of the resolution bandwidths makes it possible to select filter characteristics that is precisely tailored to the signal. In case of CDMA 2000 MC1, the power in the useful channel is measured with a bandwidth of 1.23 MHz and that of the adjacent channels with a bandwidth of 30 kHz. Therefore the R&S FSL changes from one channel to the other and measures the power at a bandwidth of 1.23 MHz or 30 kHz using the RMS detector. The measurement time per channel is set with the sweep time. It is equal to the selected measurement time divided by the selected number of channels. The five channels from the above example and the sweep time of 100 ms give a measurement time per channel of 20 ms.

Compared to the measurement time per channel given by the span (= 5 MHz) and sweep time (= 100 ms, equal to 1.66 ms per 30 kHz channel) used in the example, this is a far longer dwell time on the adjacent channels (factor of 12). In terms of the number of uncorrelated samples this means $20000/33 \mu\text{s} = 606$ samples per channel measurement compared to $1667/33 \mu\text{s} = 50.5$ samples per channel measurement.

Repeatability with a confidence level of 95% is increased from ± 1.4 dB to ± 0.38 dB as shown in Fig. 2–17. For the same repeatability, the sweep time would have to be set to 1.2 s with the integration method. Fig. 2–20 shows the standard deviation of the results as a function of the sweep time.

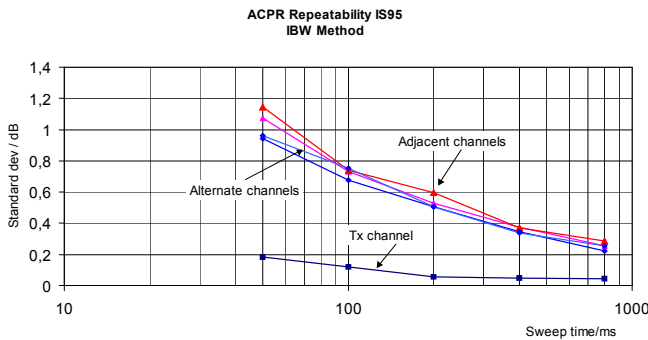


Fig. 2–20 Repeatability of adjacent channel power measurement on CDMA 2000 standard signals if the integration bandwidth method is used

6. Switch to fast ACP mode to increase the repeatability of results.

- Switch the **Fast ACP** softkey to **On**.

The R&S FSL measures the power of each channel with zero span. The trace represents power as a function of time for each channel (see Fig. 2–23). The numerical results over consecutive measurements become much more stable.

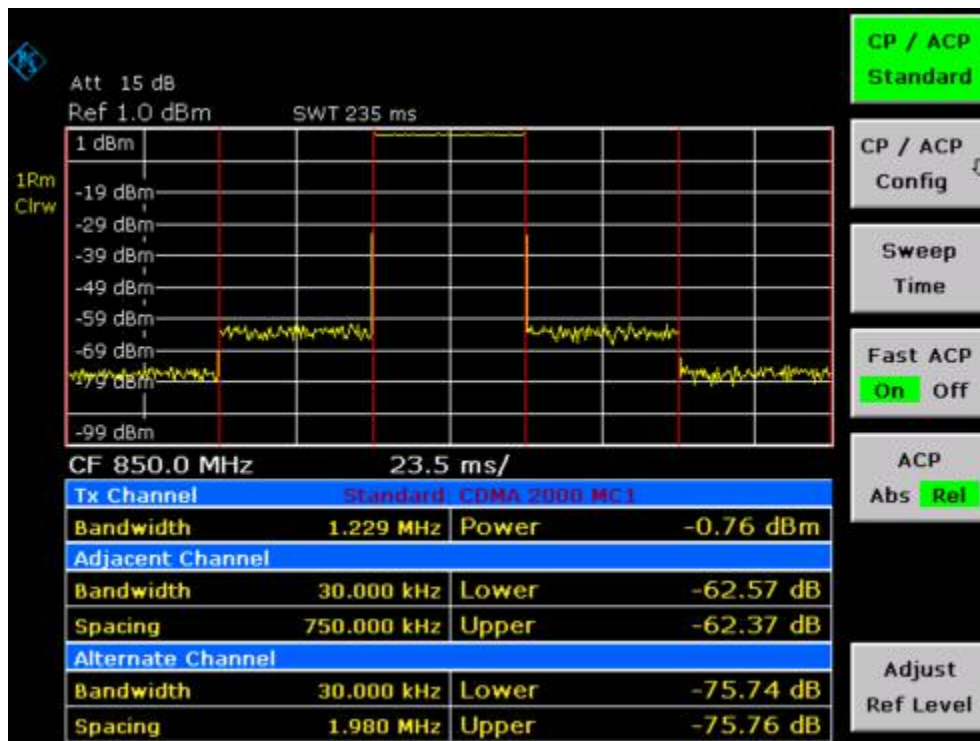


Fig. 2–21 Measuring the channel power and adjacent channel power ratio for 2000 MC1 signals with zero span (Fast ACP)

Fig. 2–22 shows the repeatability of power measurements in the transmit channel and of relative power measurements in the adjacent channels as a function of sweep time. The standard deviation of measurement results is calculated from 100 consecutive measurements as shown in Fig. 2–22. Take scaling into account if comparing power values.

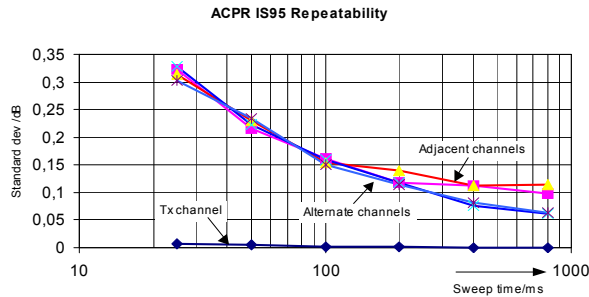


Fig. 2–22 Repeatability of adjacent channel power measurements on CDMA 2000 signals in the fast ACP mode

Note on adjacent channel power measurements on 2000 MC1 base–station signals:

When measuring the adjacent channel power of 2000 MC1 base–station signals, the frequency spacing of the adjacent channel to the nominal transmit channel is specified as ± 750 kHz. The adjacent channels are, therefore, so close to the transmit channel that the power of the transmit signal leaks across and is also measured in the adjacent channel if the usual method using the 30 kHz resolution bandwidth is applied. The reason is the low selectivity of the 30 kHz resolution filter. The resolution bandwidth, therefore, must be reduced considerably, e.g. to 3 kHz to avoid this. This causes very long measurement times (factor of 100 between a 30 kHz and 3 kHz resolution bandwidth).

This effect is avoided with the zero span method which uses steep IF filters. The 30 kHz channel filter implemented in the R&S FSL has a very high selectivity so that even with a ± 750 kHz spacing to the transmit channel the power of the useful modulation spectrum is not measured.

The following figure shows the passband characteristics of the 30 kHz channel filter in the R&S FSL.

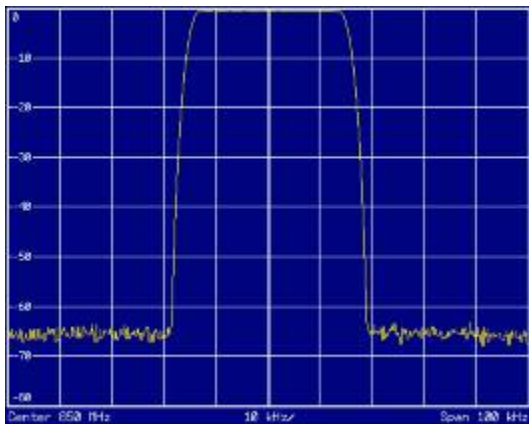
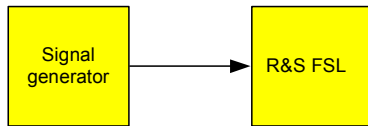


Fig. 2–23 Frequency response of the 30 kHz channel filter for measuring the power in the 2000 MC1 adjacent channel

Measurement example 2 – Measuring adjacent channel power of a W–CDMA uplink signal

Test setup:



Signal generator settings (e.g. R&S SMU):

Frequency: 1950 MHz
Level: 4 dBm
Modulation: 3 GPP W–CDMA Reverse Link

Procedure:

1. Set the spectrum analyzer to its default state.
 - Press the **PRESET** key.
The R&S FSL is in its default state.
2. Set the center frequency to 1950 MHz.
 - Press the **FREQ** key and enter *1950 MHz*.
3. Switch on the ACP measurement for W–CDMA.
 - Press the **MEAS** key.
 - Press the **CP, ACP, MC–ACP** softkey.
 - Press the **CP / ACP Standard** softkey.
 - In the standards list, mark **W–CDMA 3GPP REV** using the rotary knob or the arrow keys and confirm pressing the rotary knob or the **ENTER** key.

The R&S FSL sets the channel configuration to the 3GPP W–CDMA standard for mobiles with two adjacent channels above and below the transmit channel. The frequency span, the resolution and video bandwidth and the detector are automatically set to the correct values. The spectrum is displayed in the upper part of the screen and the channel power, the level ratios of the adjacent channel powers and the channel configuration in the lower part of the screen. The individual channels are displayed as vertical lines on the graph.

4. Set the optimum reference level and the RF attenuation for the applied signal level.
 - Press the **Adjust Ref Level** softkey.

The R&S FSL sets the optimum RF attenuation and the reference level for the power in the transmission channel to obtain the maximum dynamic range. The following figure shows the result of the measurement.

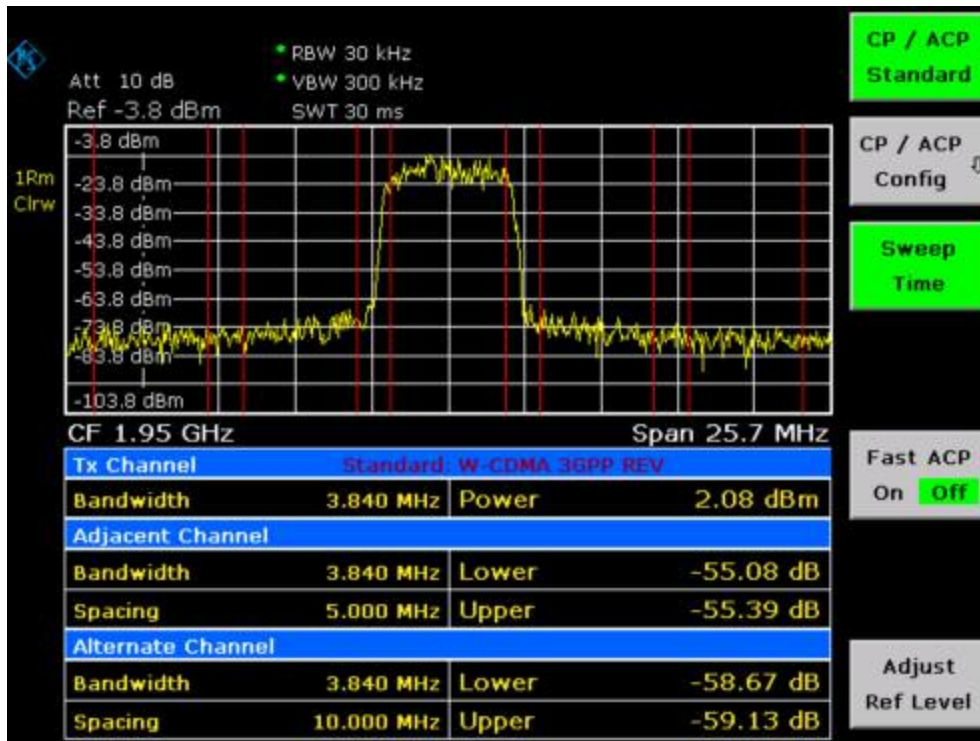


Fig. 2–24 Measuring the relative adjacent channel power on a W–CDMA uplink signal

5. Measuring adjacent channel power with the fast ACP mode.

- Set **Fast ACP** softkey to **On**.
- Press the **Adjust Ref Level** softkey.

The R&S FSL measures the power of the individual channels with zero span. A root raised cosine filter with the parameters $\alpha = 0.22$ and chip rate 3.84 Mcps (= receive filter for 3GPP W–CDMA) is used as channel filter.

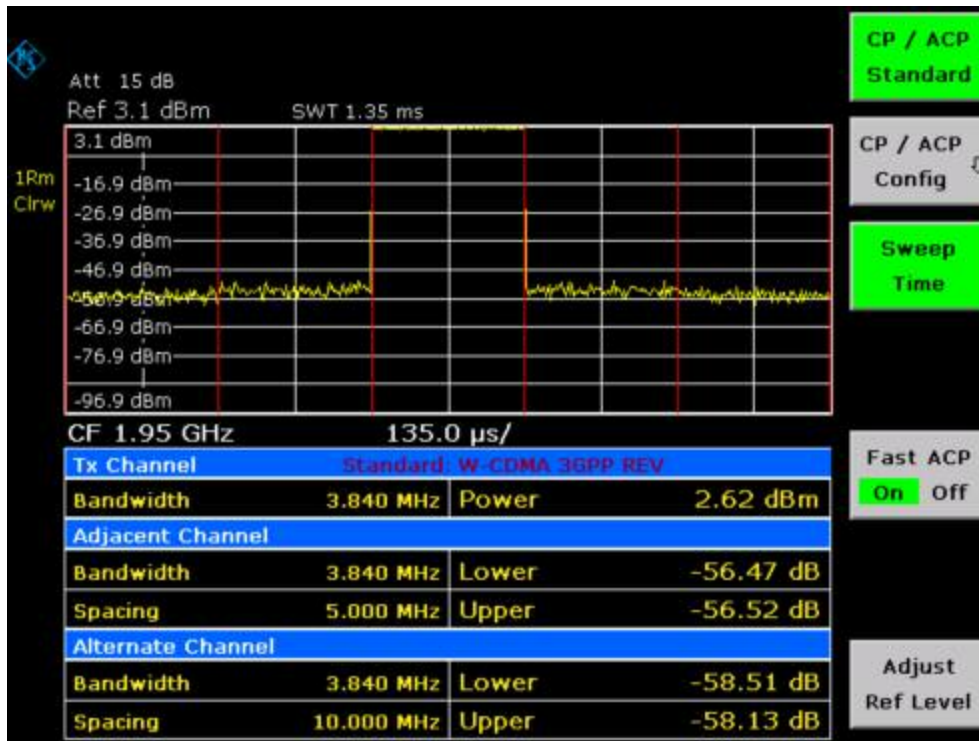


Fig. 2–25 Measuring the adjacent channel power of a W–CDMA signal with the fast ACP mode

Note: With W–CDMA, the R&S FSL's dynamic range for adjacent channel measurements is limited by the 12–bit A/D converter. The greatest dynamic range is, therefore, obtained with the IBW method.

Optimum Level Setting for ACP Measurements on W–CDMA Signals

The dynamic range for ACPR measurements is limited by the thermal noise floor, the phase noise and the intermodulation (spectral regrowth) of the spectrum analyzer. The power values produced by the R&S FSL due to these factors accumulate linearly. They depend on the applied level at the input mixer. The three factors are shown in the figure below for the adjacent channel (5 MHz carrier offset).

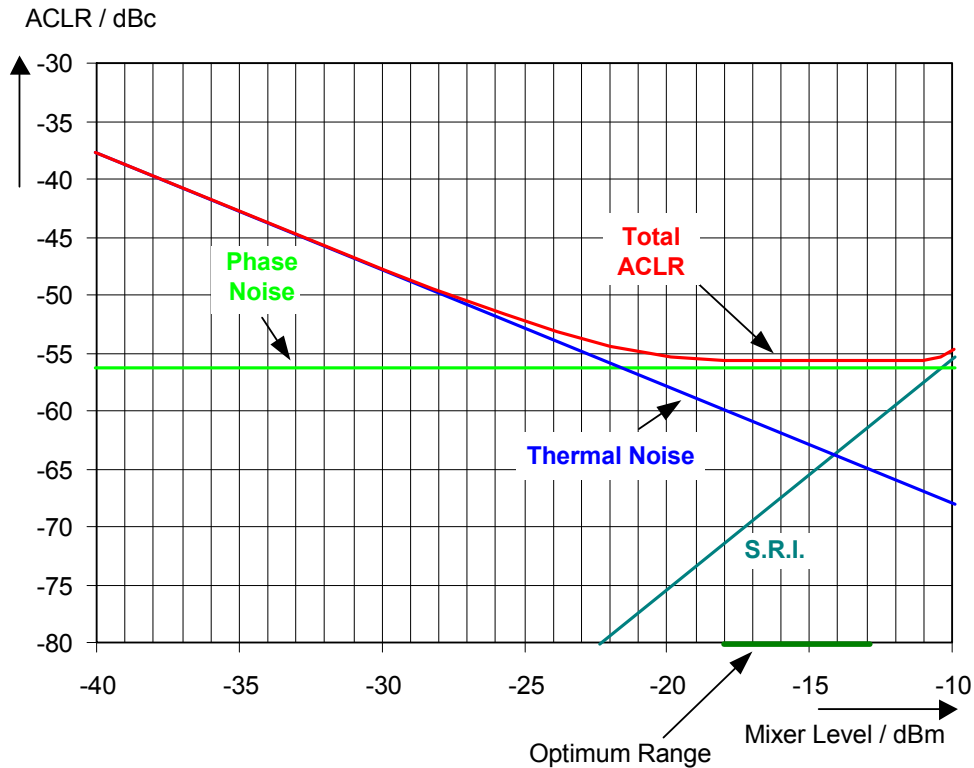


Fig. 2–26 The R&S FSL's dynamic range for adjacent channel power measurements on W–CDMA uplink signals is a function of the mixer level.

The level of the W–CDMA signal at the input mixer is shown on the horizontal axis, i.e. the measured signal level minus the selected RF attenuation. The individual components which contribute to the power in the adjacent channel and the resulting relative level (total ACPR) in the adjacent channel are displayed on the vertical axis. The optimum mixer level is –21 dBm. The relative adjacent channel power (ACPR) at an optimum mixer level is –65 dBc. Since, at a given signal level, the mixer level is set in 10 dB steps with the 10 dB RF attenuator, the optimum 10 dB range is shown in the figure: it spreads from –16 dBm to –26 dBm. In this range, the obtainable dynamic range is 62 dB.

To set the attenuation parameter manually, the following method is recommended:

- Set the RF attenuation so that the mixer level (= measured channel power – RF attenuation) is between –11 dBm and –21 dBm.
- Set the reference level to the largest possible value where no overload (IFOVL) is indicated.

This method is automated with the **Adjust Ref Level** function. Especially in remote control mode, e.g. in production environments, it is best to correctly set the attenuation parameters prior to the measurement, as the time required for automatic setting can be saved.

Note: To measure the R&S FSL's intrinsic dynamic range for W–CDMA adjacent channel power measurements, a filter which suppresses the adjacent channel power is required at the output of the transmitter. A SAW filter with a bandwidth of 4 MHz, for example, can be used.

Amplitude Distribution Measurements

If modulation types are used that do not have a constant zero span envelope, the transmitter has to handle peak amplitudes that are greater than the average power. This includes all modulation types that involve amplitude modulation –QPSK for example. CDMA transmission modes in particular may have power peaks that are large compared to the average power.

For signals of this kind, the transmitter must provide large reserves for the peak power to prevent signal compression and thus an increase of the bit error rate at the receiver.

The peak power or the crest factor of a signal is therefore an important transmitter design criterion. The crest factor is defined as the peak power / mean power ratio or, logarithmically, as the peak level minus the average level of the signal.

To reduce power consumption and cut costs, transmitters are not designed for the largest power that could ever occur, but for a power that has a specified probability of being exceeded (e.g. 0.01%).

To measure the amplitude distribution, the R&S FSL has simple measurement functions to determine both the APD = Amplitude Probability Distribution and CCDF = Complementary Cumulative Distribution Function.

In the APD display mode, the probability of occurrence of a certain level is plotted against the level.

In the CCDF display mode, the probability that the mean signal power will be exceeded is shown in percent.

Measurement example – Measuring the APD and CCDF of white noise generated by the R&S FSL

1. Set the spectrum analyzer to its default state.

- Press the **PRESET** key.
The R&S FSL is in its default state.

2. Configure the R&S FSL for APD measurement

- Press the **AMPT** key and enter *–60 dBm*.
The R&S FSL's intrinsic noise is displayed at the top of the screen.
- Press the **MEAS** key.
- Press the **More** softkey.
- Press the **APD** softkey.

The R&S FSL sets the frequency span to 0 Hz and measures the amplitude probability distribution (APD). The number of uncorrelated level measurements used for the measurement is 100000. The mean power and the peak power are displayed in dBm. The crest factor (peak power – mean power) is output as well.

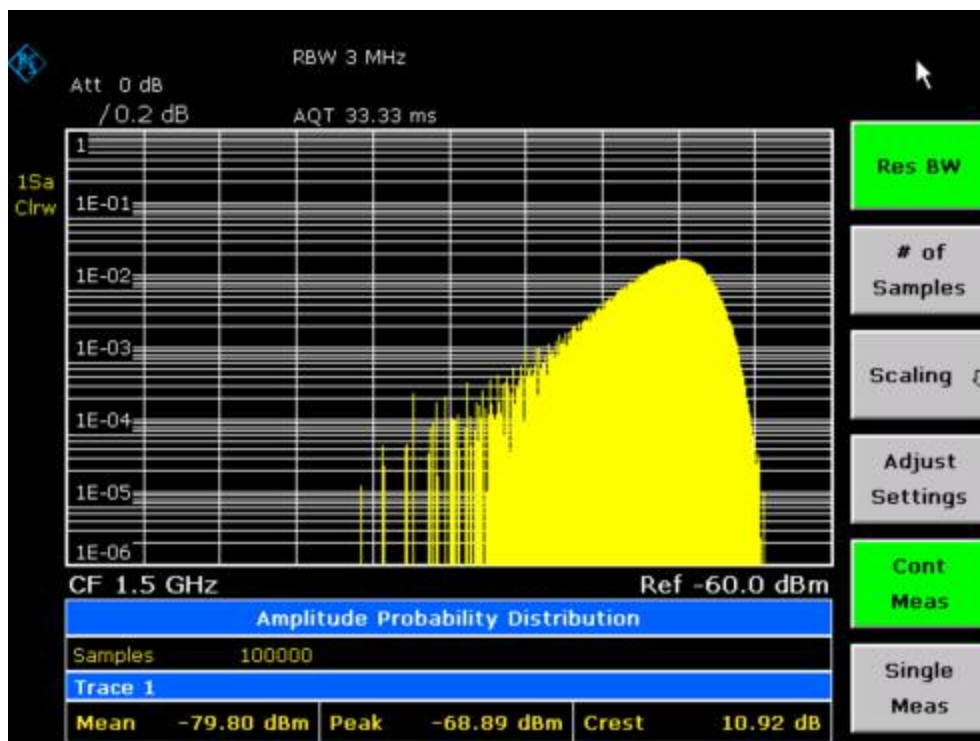


Fig. 2-27 Amplitude probability distribution of white noise

3. Switch to the CCDF display mode.

- Press the **▲** key.
- Press the **CCDF** softkey.

The CCDF display mode is switched on.

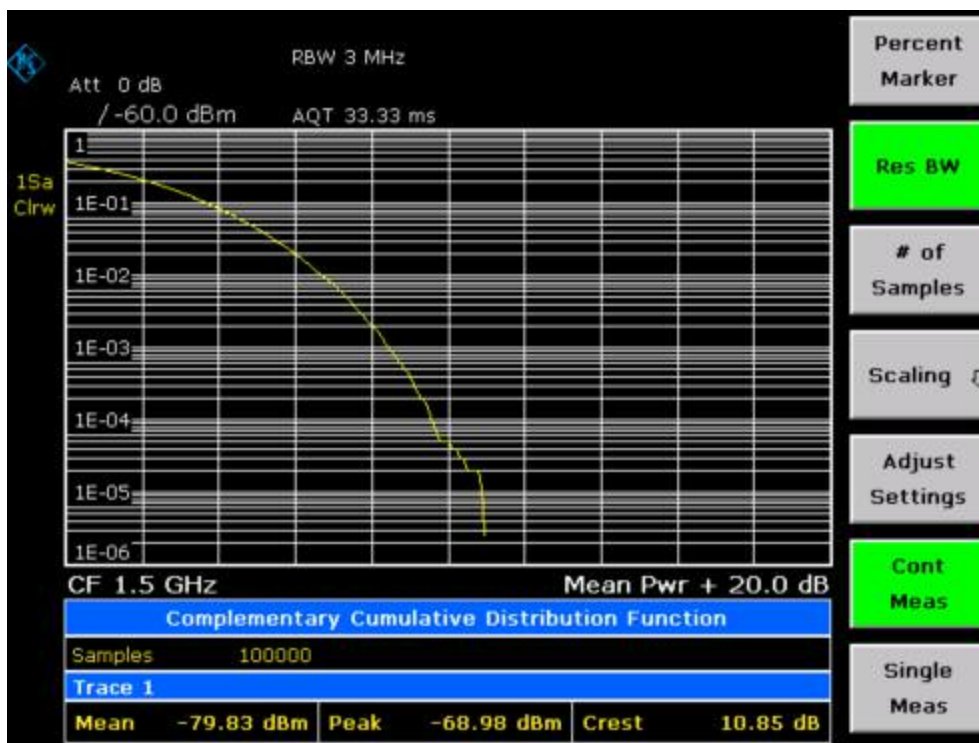


Fig. 2–28 CCDF of white noise

The CCDF trace indicates the probability that a level will exceed the mean power. The level above the mean power is plotted along the X axis of the graph. The origin of the axis corresponds to the mean power level. The probability that a level will be exceeded is plotted along the Y axis.

4. Bandwidth selection

When the amplitude distribution is measured, the resolution bandwidth must be set so that the complete spectrum of the signal to be measured falls within the bandwidth. This is the only way of ensuring that all the amplitudes will pass through the IF filter without being distorted. If the resolution bandwidth which is selected is too small for a digitally modulated signal, the amplitude distribution at the output of the IF filter becomes a Gaussian distribution according to the central limit theorem and so corresponds to a white noise signal. The true amplitude distribution of the signal therefore cannot be determined.

5. Selecting the number of samples

For statistics measurements with the R&S FSL, the number of samples N_{Samples} is entered for statistical evaluation instead of the sweep time. Since only statistically independent samples contribute to statistics, the measurement or sweep time is calculated automatically and displayed. The samples are statistically independent if the time difference is at least $1/\text{RBW}$. The sweep time SWT is, therefore, expressed as follows:

$$\text{SWT} = N_{\text{Samples}} / \text{RBW}$$

Measurement Examples of the WLAN TX Measurements Option (K91)

This chapter describes measurement examples for the WLAN TX Measurements option (K91) and gives details to signal processing. For further information on measurement examples refer to chapter "Advanced Measurement Examples" or the Quick Start Guide, chapter 5 "Basic Measurement Examples".

This option is available from firmware version 1.20.

Basic Measurement Example

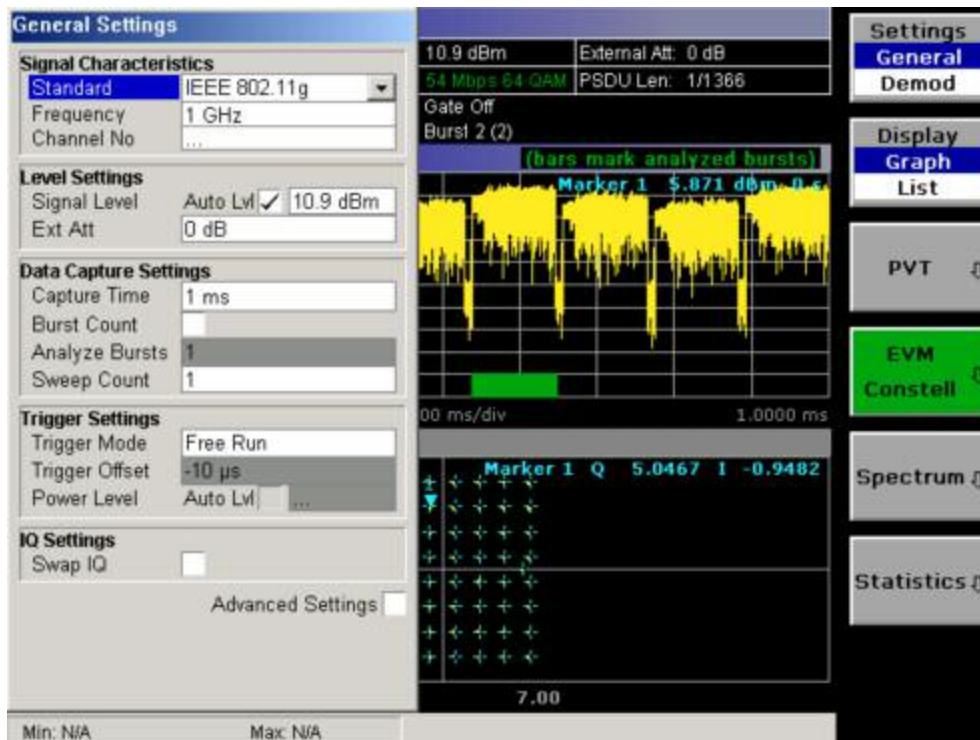
This section helps the user to quickly become familiar with the WLAN TX Measurements option (K91) by working step-by-step through an ordinary measurement. The following steps are described:

1. Setting up the measurement
2. Performing the level detection
3. Performing the main measurement

In this example, a DUT using IEEE 802.11a is be used. The DUT is connected to the analyzer using the RF input of the analyzer. The DUT generates a signal modulated using 16QAM.

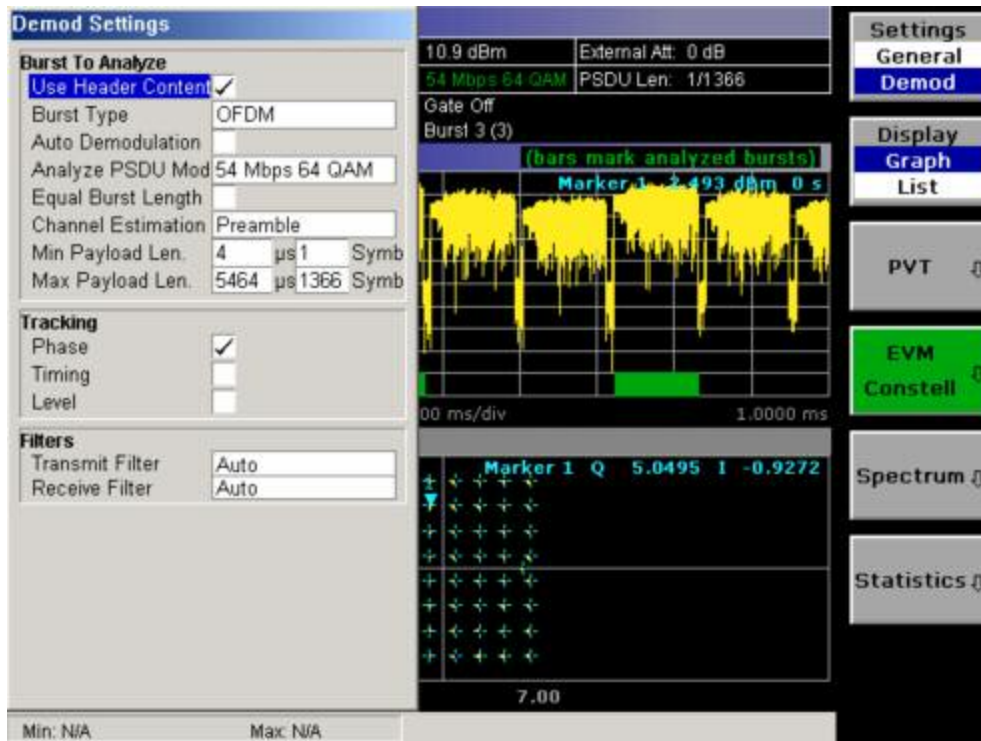
Setting up the measurement

1. Activate the **WLAN** mode in order (for details refer to chapter "Instrument Functions", section "Measurement Mode Selection – MODE Key").
2. Press the **Settings** softkey once to select and open the **General Settings** dialog box.



- Select the **Frequency** field and enter the desired frequency to measure.

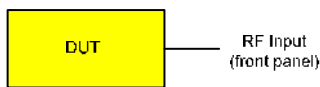
- If a frequency is entered, which maps to a specific channel, the **Channel No** field updates.
 - Deactivate the **Auto Level** option. In this example the level detection measurement is executed manually (for details see [Performing the level detection](#)).
3. Press the **Settings** softkey once to select and open the **Demod Settings** dialog box.



- Enter the modulation scheme used in the **Demodulator** field.

Performing the level detection

1. Connect the DUT to the RF input of the spectrum analyzer.



2. Start the Level Detection measurement by pressing the **SWEEP** hardkey and then the **Auto Level** softkey.

During the level detection measurement the text **Running** is displayed in the status bar at the bottom of the screen.

After successful level detection, the status message **Measurement Complete** is displayed, the signal level field for the selected input displays the detected signal level and the Magnitude Capture Buffer (Screen A) displays the zero span trace obtained during the measurement sequence.

Performing the main measurement

1. Select single sweep measurements by pressing the **SWEEP** hardkey and then the **Meas** softkey to select **Single**.
2. Start the measurement by pressing the **RUN** hardkey.

During the measurement, the status message **Running** is displayed.

Measurement results are updated once the measurement has completed. The results are displayed in graphical form. The display can be toggled to a tabular list of measurement points by pressing the **Display** softkey.

Signal Processing of the IEEE802.11a application

Abbreviations

| | |
|-----------------------|--|
| $a_{l,k}$ | symbol at symbol l of sub carrier k |
| EVM_k | error vector magnitude of sub carrier k |
| EVM | error vector magnitude of current packet |
| g | signal gain |
| Δf | frequency deviation between Tx and Rx |
| l | symbol index $l = [1, \text{nof_Symbols}]$ |
| nof_symbols | number of symbols of payload |
| H_k | channel transfer function of sub carrier k |
| k | channel index $k = [-31, 32]$ |
| K_{mod} | modulation dependant normalization factor |
| ξ | relative clock error of reference oscillator |
| $r_{l,k}$ | sub carrier k of symbol l |

This description gives a rough view of the IEEE802.11a application signal processing. Details are disregarded in order to get a concept overview.

A diagram of the interesting blocks is shown in [Fig. 2–29](#) First the RF signal is down converted to the IF frequency $f_{IF} = 20.4$ MHz. The resulting IF signal $r_{IF}(t)$ is shown on the left-hand side of the figure. After bandpass filtering, the signal is sampled by an Analog to Digital Converter (ADC) at a sampling rate of $f_{s1} = 81.6$ MHz. This digital sequence is resampled to the new sampling frequency of $f_{s2} = 80$ MHz which is a multiple of the Nyquist rate (20 MHz). The subsequent digital down converter shifts the IF signal to the complex base band. In the next step the base band signal is filtered by a FIR filter. To get an idea, the rough transfer function is plotted in the figure. This filter fulfills two tasks: first it suppresses the IF image frequency, secondly it attenuates the aliasing frequency bands caused by the subsequent down sampling. After filtering, the sequence is sampled down by the factor of 4. Thus the sampling rate of the down sampled sequence $r(i)$ is the Nyquist rate of $f_{s3} = 20$ MHz. Up to this point the digital part is implemented in an ASIC.

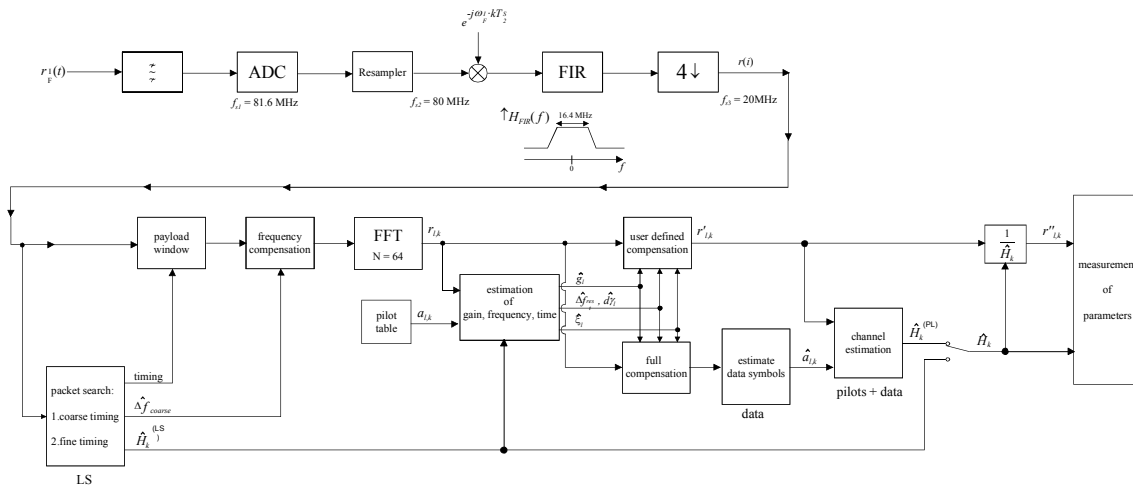


Fig. 2–29 Signal processing of the IEEE802.11a application

In the lower part of the figure the subsequent digital signal processing is shown. In the first block the packet search is performed. This block detects the Long Symbol (LS) and recovers the timing. The coarse timing is detected first. This search is implemented in the time domain. The algorithm is based on cyclic repetition within the LS after $N = 64$ samples. Numerous treatises exist on this subject, e.g. [1] to [3]. Furthermore a coarse estimate $\hat{\Delta f}_{coarse}^1$ of the Rx–Tx frequency offset Δf is derived from the metric in [6]. This can easily be understood because the phase of $r(i) \cdot r^*(i + N)$ is determined by the frequency offset. As the frequency deviation Δf can exceed half a bin (distance between neighbor sub-carriers) the preceding Short Symbol (SS) is also analyzed in order to detect the ambiguity.

After the coarse timing calculation the time estimate is improved by the fine timing calculation. This is achieved by first estimating the coarse frequency response $\hat{H}_k^{(LS)}$, with $k = [-26, 26]$ denoting the channel index of the occupied sub-carriers. First the FFT of the LS is calculated. After the FFT calculation the known symbol information of the LS sub-carriers is removed by dividing by the symbols. The result is a coarse estimate \hat{H}_k of the channel transfer function. In the next step the complex channel impulse response is computed by an IFFT. Next the energy of the windowed impulse response (the window size is equal to the guard period) is calculated for every trial time. Afterwards the trial time of the maximum energy is detected. This trial time is used to adjust the timing.

Now the position of the LS is known and the starting point of the useful part of the first payload symbol can be derived. In the next block this calculated time instant is used to position the payload window. Only the payload part is windowed. This is sufficient because the payload is the only subject of the subsequent measurements.

In the next block the windowed sequence is compensated by the coarse frequency estimate $\hat{\Delta f}_{coarse}$. This is necessary because otherwise inter channel interference (ICI) would occur in the frequency domain.

The transition to the frequency domain is achieved by an FFT of length 64. The FFT is performed symbol-wise for every of the *nof_symbols* symbols of the payload. The calculated FFTs are described by $r_{l,k}$ with

the symbol index $l = [1, \text{nof_symbols}]$ and

the channel index $k = [-31, 32]$.

In case of an additive white Gaussian noise (AWGN) channel the FFT is described by [4], [5]

¹ The hat generally describes an estimate. Example: \hat{x} is the estimate of x .

$$r_{l,k} = K_{\text{mod}} \times a_{l,k} \times g_l \times H_k \times e^{j(\text{phase}_l^{(\text{common})} + \text{phase}_{l,k}^{(\text{timing})})} + n_{l,k} \quad (1)$$

with

the modulation–dependant normalization factor K_{mod} ,

the symbol $a_{l,k}$ of sub–carrier k at symbol l ,

the gain g_l at the symbol l in relation to the reference gain $g = 1$ at the long symbol (LS),

the channel frequency response H_k at the long symbol (LS),

the common phase drift $\text{phase}_l^{(\text{common})}$ of all sub–carriers at symbol l (see below),

the phase $\text{phase}_{l,k}^{(\text{timing})}$ of sub–carrier k at symbol l caused by the timing drift (see below),

the independent Gaussian distributed noise samples $n_{l,k}$.

The common phase drift in equation (1) is given by

$$\text{phase}_l^{(\text{common})} = 2\pi \times N_s / N \times \Delta f_{\text{rest}} T \times l + d\gamma_l \quad (2)$$

with

$N_s = 80$ being the number of Nyquist samples of the symbol period,

$N = 64$ being the number of Nyquist samples $N = 64$ of the useful part of the symbol,

Δf_{rest} being the (not yet compensated) frequency deviation,

$d\gamma_l$ being the phase jitter at the symbol l .

In general, the coarse frequency estimate $\hat{\Delta f}_{\text{coarse}}$ (see figure 1) is not error–free. Therefore the remaining frequency error Δf_{rest} represents the not yet compensated frequency deviation in $r_{l,k}$. Consequently the overall frequency deviation of the device under test (DUT) is calculated by $\Delta f = \hat{\Delta f}_{\text{coarse}} + \Delta f_{\text{rest}}$. Remark: The only motivation for dividing the common phase drift in equation (2) into two parts is to be able to calculate the overall frequency deviation of the DUT.

The reason for the phase jitter $d\gamma_l$ in equation (2) may be different. The nonlinear part of the phase jitter may be caused by the phase noise of the DUT oscillator. Another reason for nonlinear phase jitter may be the increase of the DUT amplifier temperature at the beginning of the burst. Please note that besides the nonlinear part the phase jitter $d\gamma_l$ also contains a constant part. This constant part is caused by the not yet compensated frequency deviation Δf_{rest} . To understand this, please keep in mind that the measurement of the phase starts at the first symbol $l = 1$ of the payload. In contrast the channel frequency response H_k in equation (1) represents the channel at the long symbol of the preamble. Consequently the not yet compensated frequency deviation Δf_{rest} produces a phase drift between the long symbol and the first symbol of the payload. Therefore this phase drift appears as a constant value ("DC value") in $d\gamma_l$.

Referring to the IEEE802.11a measurement standard *Chapter 17.3.9.7 "Transmit modulation accuracy test"* [6], the common phase drift $\text{phase}_l^{(\text{common})}$ must be estimated and compensated from the pilots. Therefore this "symbol wise phase tracking" (Tracking Phase) is activated as the default setting of the R&S FSL–K91.

Furthermore the timing drift in equation (1) is given by

$$\text{phase}_{l,k}^{(\text{timing})} = 2\pi \times N_s / N \times \xi \times k \times l \quad (3)$$

with ξ being the relative clock deviation of the reference oscillator. Normally a symbol-wise timing jitter is negligible and thus not modeled in equation (3). There may be situations where the timing drift has to be taken into account. This is illustrated by an example: In accordance to [6] the allowed clock deviation of the DUT is up to $\xi_{\max} = 20$ ppm. Furthermore a long packet with $nof_symbols = 400$ symbols is assumed. From equations (1) and (3), it results that the phase drift of the highest sub-carrier $k = 26$ in the last symbol $l = nof_symbols$ is 93 degrees. Even in the noise-free case, this would lead to symbol errors. The example shows that it is actually necessary to estimate and compensate the clock deviation, which is accomplished in the next block.

Referring to the IEEE802.11a measurement standard [6], the timing drift $phase_{l,k}^{(timing)}$ is not part of the requirements. Therefore the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSL-K91.

The time tracking option should rather be seen as a powerful analyzing option.

In addition the tracking of the gain g_l in equation (1) is supported for each symbol in relation to the reference gain $g = 1$ at the time instant of the long symbol (LS). At this time the coarse channel transfer function $\hat{H}_k^{(LS)}$ is calculated. This makes sense since the sequence $r_{l,k}^1$ is compensated by the coarse channel transfer function $\hat{H}_k^{(LS)}$ before estimating the symbols. Consequently a potential change of the gain at the symbol l (caused, for example, by the increase of the DUT amplifier temperature) may lead to symbol errors especially for a large symbol alphabet M of the MQAM transmission. In this case the estimation and the subsequent compensation of the gain are useful.

Referring to the IEEE802.11a measurement standard [6], the compensation of the gain g_l is not part of the requirements. Therefore the "gain tracking" (Tracking Gain) is not activated as the default setting of the R&S FSL-K91.

How can the parameters above be calculated? In this application the optimum maximum likelihood algorithm is used. In the first estimation step the symbol-independent parameters Δf_{rest} and ξ are estimated. The symbol dependent parameters can be neglected in this step i.e. the parameters are set to $g_l = 1$ and $d\gamma_l = 0$. Referring to equation (1) the log likelihood function²

$$L_1(\tilde{\Delta f}_{rest}, \tilde{\xi}) = \sum_{l=1}^{nof_symbols} \sum_{k=-21,-7,7,21} \left| r_{l,k} - a_{l,k} \times \hat{H}_k^{(LS)} \times e^{j(\tilde{p}hase_l^{(common)} + \tilde{p}hase_{l,k}^{(timing)})} \right|^2 \quad (4)$$

with

$$\tilde{p}hase_l^{(common)} = 2\pi \times N_s / N \times \tilde{\Delta f}_{rest} T \times l$$

$$\tilde{p}hase_l^{(timing)} = 2\pi \times N_s / N \times \tilde{\xi} \times k \times l$$

must be calculated as a function of the trial parameters $\tilde{\Delta f}_{rest}$ and $\tilde{\xi}$. The trial parameters leading to the minimum of the log likelihood function are used as estimates $\hat{\Delta f}_{rest}$ and $\hat{\xi}$. In equation (4) the known pilot symbols $a_{l,k}$ are read from a table.

In the second step for every symbol l the log likelihood function

$$L_2(\tilde{g}_l, \tilde{d}\gamma_l) = \sum_{k=-21,-7,7,21} \left| r_{l,k} - a_{l,k} \times \tilde{g}_l \times \hat{H}_k^{(LS)} \times e^{j(\tilde{p}hase_l^{(common)} + \tilde{p}hase_{l,k}^{(timing)})} \right|^2$$

with

$$\tilde{p}hase_l^{(common)} = 2\pi \times N_s / N \times \hat{\Delta f}_{rest} T \times l + \tilde{d}\gamma_l$$

$$\tilde{p}hase_l^{(timing)} = 2\pi \times N_s / N \times \hat{\xi} \times k \times l$$

² The tilde generally describes an estimate. Example: \tilde{x} is the trial parameter of x .

is calculated as a function of the trial parameters \tilde{g}_i and $d\tilde{\gamma}_i$. Finally, the trial parameters leading to the minimum of the log likelihood function are used as estimates \hat{g}_i and $d\hat{\gamma}_i$.

This robust algorithm works well even at low signal to noise ratios with the Cramer Rao Bound being reached.

After estimation of the parameters, the sequence $r_{l,k}$ is compensated in the compensation blocks.

In the upper analyzing branch the compensation is user-defined i.e. the user determines which of the parameters are compensated. This is useful in order to extract the influence of these parameters. The resulting output sequence is described by $r'_{l,k}$.

In the lower compensation branch the full compensation is always performed. This separate compensation is necessary in order to avoid symbol errors. After the full compensation the secure estimation of the data symbols $\hat{a}_{l,k}$ is performed. From equation (1) it is clear that first the channel transfer function H_k must be removed. This is achieved by dividing the known coarse channel estimate $\hat{H}_k^{(LS)}$ calculated from the LS. Usually an error free estimation of the data symbols can be assumed.

In the next block a better channel estimate $\hat{H}_k^{(PL)}$ of the data and pilot sub-carriers is calculated by using all *nof_symbols* symbols of the payload (PL). This can be accomplished at this point because the phase is compensated and the data symbols are known. The long observation interval of *nof_symbols* symbols (compared to the short interval of 2 symbols for the estimation of $\hat{H}_k^{(LS)}$) leads to a nearly error-free channel estimate.

In the following equalizer block $r'_{l,k}$ is compensated by the channel estimate. The resulting channel-compensated sequence is described by $r''_{l,k}$. The user may either choose the coarse channel estimate $\hat{H}_k^{(LS)}$ (from the long symbol) or the nearly error-free channel estimate $\hat{H}_k^{(LS)}$ (from the payload) for equalization. In case of using the improved estimate $\hat{H}_k^{(LS)}$ a 2 dB reduction of the subsequent EVM measurement can be expected.

According to the IEEE802.11a measurement standard [6], the coarse channel estimation $\hat{H}_k^{(LS)}$ (from the long symbol) has to be used for equalization. Therefore the default setting of the R&S FSL-K91 is equalization from the coarse channel estimate derived from the long symbol.

In the last block the measurement variables are calculated. The most important variable is the error vector magnitude

$$EVM_k = \sqrt{\frac{1}{\text{nof_symbols}} \sum_{l=1}^{\text{nof_symbols}} \left| r''_{l,k} - K_{\text{mod}} \times a_{l,k} \right|^2} \quad (5)$$

of the sub-carrier k of the current packet. Furthermore the packet error vector magnitude

$$EVM = \sqrt{\frac{1}{52} \sum_{k=-26(k \neq 0)}^{26} EVM_k^2} \quad (6)$$

is derived by averaging the squared EVM_k versus k . Finally the average error vector magnitude

$$\overline{EVM} = \sqrt{\frac{1}{\text{nof_packets}} \sum_{\text{counter}=1}^{\text{nof_packets}} EVM^2(\text{counter})} \quad (7)$$

is calculated by averaging the packet EVM of all *nof_packets* detected packets. This parameter is equivalent to the so-called "RMS average of all errors $Error_{RMS}$ " of the IEEE802.11a measurement commandment (see [6], *Chapter 17.3.9.7*).

Literature

- [1] Speth, Classen, Meyr: "Frame synchronization of OFDM systems in frequency selective fading channels", VTC '97, pp. 1807–1811
- [2] Schmidl, Cox: "Robust Frequency and Timing Synchronization of OFDM", IEEE Trans. on Comm., Dec. 1997, pp. 1613–621
- [3] Minn, Zeng, Bhargava: "On Timing Offset Estimation for OFDM", IEEE Communication Letters, July 2000, pp. 242–244
- [4] Speth, Fechtel, Fock, Meyr: "Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM – Part I", IEEE Trans. On Comm. VOL. 47, NO 11, Nov. 1999
- [5] Speth, Fechtel, Fock, Meyr: "Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM – Part II", IEEE Trans. On Comm. VOL. 49, NO 4, April. 2001
- [6] IEEE802.11a, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

Signal Processing of the IEEE802.11b application**Abbreviations**

| | |
|--------------------|---|
| ε | timing offset |
| Δf | frequency offset |
| $\Delta \phi$ | phase offset |
| $ARG\{\dots\}$ | calculation of the angle of a complex value |
| EVM | error vector magnitude |
| \hat{g}_I | estimate of the gain factor in the I-branch |
| \hat{g}_Q | estimate of the gain factor in the Q-branch |
| $\Delta \hat{g}_Q$ | accurate estimate of the crosstalk factor of the Q-branch in the I-branch |
| $\hat{h}_s(v)$ | estimated baseband filter of the transmitter |
| $\hat{h}_r(v)$ | estimated baseband filter of the receiver |
| $\hat{\delta}_I$ | estimate of the IQ-offset in the I-branch |
| $\hat{\delta}_Q$ | estimate of the IQ-offset in the I-branch |
| $r(v)$ | measurement signal |
| $\hat{s}(v)$ | estimate of the reference signal |
| $\hat{s}_n(v)$ | estimate of the power normalized and undisturbed reference signal |
| $REAL\{\dots\}$ | calculation of the real part of a complex value |
| $IMAG\{\dots\}$ | calculation of the imaginary part of a complex value |

This description gives a rough overview of the signal processing concept of the IEEE802.11b application.

A block diagram of the measurement application is shown in Fig. 2–30. The baseband signal of an IEEE802.11b wireless LAN system transmitter is sampled with a sampling rate of 44 MHz.

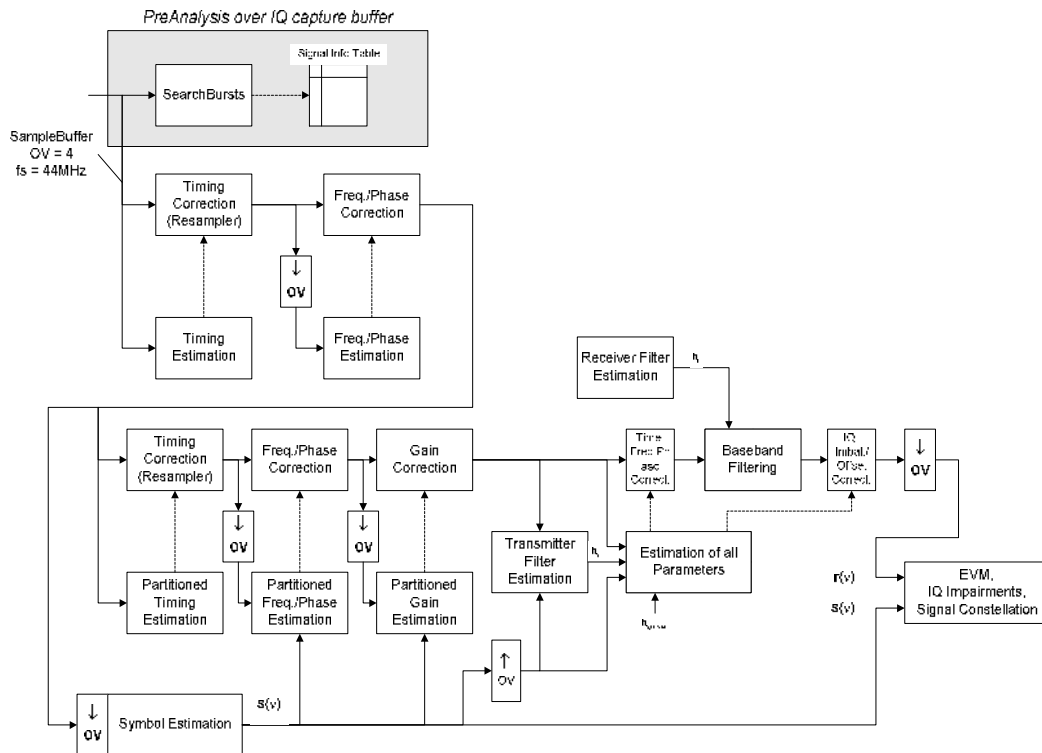


Fig. 2–30 Signal processing of the IEEE802.11b application

The first task of the measurement application is to detect the position of the bursts within the measurement signal $r_1(v)$. The detection algorithm is able to find the positions of the beginning of short and long bursts and can distinguish between them. The algorithm also detects the initial state of the scrambler. This is required if IEEE802.11 signals should be analyzed, because this standard does not specify the initial state of the scrambler.

With the knowledge of the start position of the burst, the header of the burst can be demodulated. The bits transmitted in the header provide information about the length of the burst and the modulation type used in the PSDU.

After the start position and the burst length is fully known, better estimates of timing offset, timing drift, frequency offset and phase offset can be calculated using the entire data of the burst.

At this point of the signal processing a demodulation can be performed without decision error. After demodulation the normalized and undisturbed reference signal $s(v)$ is available.

If the frequency offset is not constant and varies with time, the frequency- and phase offset in several partitions of the burst must be estimated and corrected. Additionally, timing offset, timing drift and gain factor can be estimated and corrected in several partitions of the burst. These corrections can be separately switched off in the demodulation settings menu.

Knowing the normalized power and undisturbed reference signal, the transmitter baseband filter is estimated by minimizing the cost function

$$L_1 = \sum_{v=0}^{N-1} \left| r(v) \times e^{-j2\pi\tilde{f}v} \times e^{-j\Delta\tilde{\phi}} - \sum_{i=-L}^{+L} \tilde{h}_s(i) \times \hat{s}_n(v-i) - \tilde{o}_I - j\tilde{o}_Q \right|^2 \quad \text{Eq. 2.1}$$

of a maximum-likelihood-based estimator, where $r(v)$ is the over sampled measurement signal, $\hat{s}_n(v)$ the over sampled power normalized and undisturbed reference signal, N the observation length, L the filter length, $\Delta\tilde{f}$, $\Delta\tilde{\phi}$, \tilde{o}_I , \tilde{o}_Q and $\tilde{h}_s(v)$ the variation parameters of the frequency-, the phase, the IQ-offset and the coefficients of the transmitter filter. The frequency-, the phase- and the IQ-offset are estimated jointly with the coefficients of the transmitter filter to increase the estimation quality.

Once the transmitter filter is known, all other unknown signal parameters are estimated with a maximum-likelihood-based estimation, which minimizes the cost function

$$L_2 = \sum_{v=0}^{N-1} \left| r(v - \tilde{\epsilon}) \times e^{-j2\pi\tilde{f}v} \times e^{-j\Delta\tilde{\phi}} - \tilde{g}_I \times s_I(v) - j\tilde{g}_Q \times s_Q(v) + \Delta\tilde{g}_Q \times s_Q(v) - \tilde{o}_I - j\tilde{o}_Q \right|^2 \quad \text{Eq. 2.2}$$

where \tilde{g}_I resp. \tilde{g}_Q are the variation parameters of the gain used in the I- resp. the Q-branch, $\Delta\tilde{g}_Q$ is the crosstalk factor of the Q-branch into the I-branch and $s_I(v)$ resp. $s_Q(v)$ are the filtered reference signal of the I- resp. the Q-branch. The unknown signal parameters are estimated in a joint estimation process to increase the accuracy of the estimates.

The accurate estimates of the frequency offset, the IQ-imbalance, the quadratur-mismatch and the normalized IQ-offset are displayed by the measurement software. The IQ-imbalance

$$IQ - Imbalance = \left| \frac{\tilde{g}_Q + \Delta\tilde{g}_Q}{\tilde{g}_I} \right| \quad \text{Eq. 2.3}$$

is the quotient of the estimates of the gain factor of the Q-branch, the crosstalk factor and the gain factor of the I-branch, the quadrature-mismatch

$$Quadrature - Mismatch = ARG\{\tilde{g}_Q + j \times \Delta\tilde{g}_Q\} \quad \text{Eq. 2.4}$$

is a measure for the crosstalk of the Q-branch into the I-branch. The normalized IQ-offset

$$IQ - Offset = \frac{\sqrt{\hat{o}_I^2 + \hat{o}_Q^2}}{\sqrt{\frac{1}{2} \cdot [\hat{g}_I^2 + \hat{g}_Q^2]}} \quad \text{Eq. 2.5}$$

is defined as the magnitude of the IQ-offset normalized by the magnitude of the reference signal.

At this point of the signal processing all unknown signal parameters such as timing-, frequency-, phase-, IQ-offset and IQ-imbalance have been evaluated and the measurement signal can be corrected accordingly.

Using the corrected measurement signal $r(v)$ and the estimated reference signal $\hat{s}(v)$ the modulation quality parameters can be calculated. The mean error vector magnitude (EVM)

$$EVM = \frac{\sqrt{\sum_{v=0}^{N-1} |r(v) - \hat{s}(v)|^2}}{\sqrt{\sum_{v=0}^{N-1} |\hat{s}(v)|^2}} \quad \text{Eq. 2.6}$$

is the quotient of the root-mean-square values of the error signal power and the reference signal power, whereas the instant error vector magnitude

$$EVM(v) = \frac{|r(v) - \hat{s}(v)|}{\sqrt{\sum_{v=0}^{N-1} |\hat{s}(v)|^2}} \quad \text{Eq. 2.7}$$

is the momentary error signal magnitude normalized by the root mean square value of the reference signal power.

In [2] a different algorithm is proposed to calculate the error vector magnitude. In a first step the IQ-offset in the I-branch

$$\hat{o}_I = \frac{1}{N} \sum_{v=0}^{N-1} \text{REAL}\{r(v)\} \quad \text{Eq. 2.8}$$

and the IQ-offset of the Q-branch

$$\hat{o}_Q = \frac{1}{N} \sum_{v=0}^{N-1} \text{IMAG}\{r(v)\} \quad \text{Eq. 2.9}$$

are estimated separately, where $r(v)$ is the measurement signal which has been corrected with the estimates of the timing-, frequency- and phase offset, but not with the estimates of the IQ-imbalance and IQ-offset. With these values the IQ-imbalance of the I-branch

$$\hat{g}_I = \frac{1}{N} \sum_{v=0}^{N-1} |\text{REAL}\{r(v) - \hat{o}_I\}| \quad \text{Eq. 2.10}$$

and the IQ-imbalance of the Q-branch

$$\hat{g}_Q = \frac{1}{N} \sum_{v=0}^{N-1} |\text{IMAG}\{r(v) - \hat{o}_Q\}| \quad \text{Eq. 2.11}$$

are estimated in a non-linear estimation in a second step. Finally, the mean error vector magnitude

$$V_{\text{err}}(v) = \frac{\sqrt{\frac{1}{2} \sum_{v=0}^{N-1} [\text{REAL}\{r(v) - \hat{o}_I - \hat{g}_I\}]^2 + \frac{1}{2} \sum_{v=0}^{N-1} [\text{IMAG}\{r(v) - \hat{o}_Q - \hat{g}_Q\}]^2}}{\sqrt{\frac{1}{2} \cdot [\hat{g}_I^2 + \hat{g}_Q^2]}} \quad \text{Eq. 2.12}$$

can be calculated with a non data aided calculation. The instant error vector magnitude

$$V_{\text{err}}(v) = \frac{\sqrt{\frac{1}{2} [\text{REAL}\{r(v) - \hat{o}_I - \hat{g}_I\}]^2 + \frac{1}{2} [\text{IMAG}\{r(v) - \hat{o}_Q - \hat{g}_Q\}]^2}}{\sqrt{\frac{1}{2} \cdot [\hat{g}_I^2 + \hat{g}_Q^2]}} \quad \text{Eq. 2.13}$$

is the error signal magnitude normalized by the root mean square value of the estimate of the measurement signal power. The advantage of this method is that no estimate of the reference signal is needed, but the IQ-offset and IQ-imbalance values are not estimated in a joint estimation procedure. Therefore, each estimation parameter is disturbing the estimation of the other parameter and the accuracy of the estimates is lower than the accuracy of the estimations achieved by Eq. 2.14. If the EVM value is dominated by Gaussian noise this method yields similar results as Eq. 2.15.

Literature

- [1] Institute of Electrical and Electronic Engineers, *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*, IEEE Std 802.11–1999, Institute of Electrical and Electronic Engineers, Inc., 1999.
- [2] Institute of Electrical and Electronic Engineers, *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher–Speed Physical Layer Extensions in the 2.4 GHz Band*, IEEE Std 802.11b–1999, Institute of Electrical and Electronic Engineers, Inc., 1999.

802.11b RF carrier suppression

Definition

The RF carrier suppression, measured at the channel center frequency, shall be at least 15 dB below the peak $\text{SIN}(x)/x$ power spectrum. The RF carrier suppression shall be measured while transmitting a repetitive 01 data sequence with the scrambler disabled using DQPSK modulation. A 100 kHz resolution bandwidth shall be used to perform this measurement.

Measurement with R&S spectrum analyzers

The RF carrier suppression as defined in the standard is a determination of peak ratios. The unscrambled 01 data sequence provides a spectrum with distinct peaks enveloped by the transmit filter spectrum. An IQ offset leads to an additional peak at the center frequency.

The following measurement sequence can be used in normal spectrum mode:

1. Use power trigger or external trigger
2. Use gated sweep with gate delay at payload start and gate length = payload length (Delay–Comp ON and RBW = 50 MHz for gate settings)
3. Set RBW = 100 kHz
4. Set Sweep Time = 100 ms
5. Set Span = 20 MHz
6. Set Detector = RMS
7. Set Marker 1 to center frequency
8. Use Marker 2 as Delta Marker and set it to max. peak

Fig. 2–31 is a screenshot of this measurement. The delta marker shows directly the RF carrier suppression in dB (white circled value).

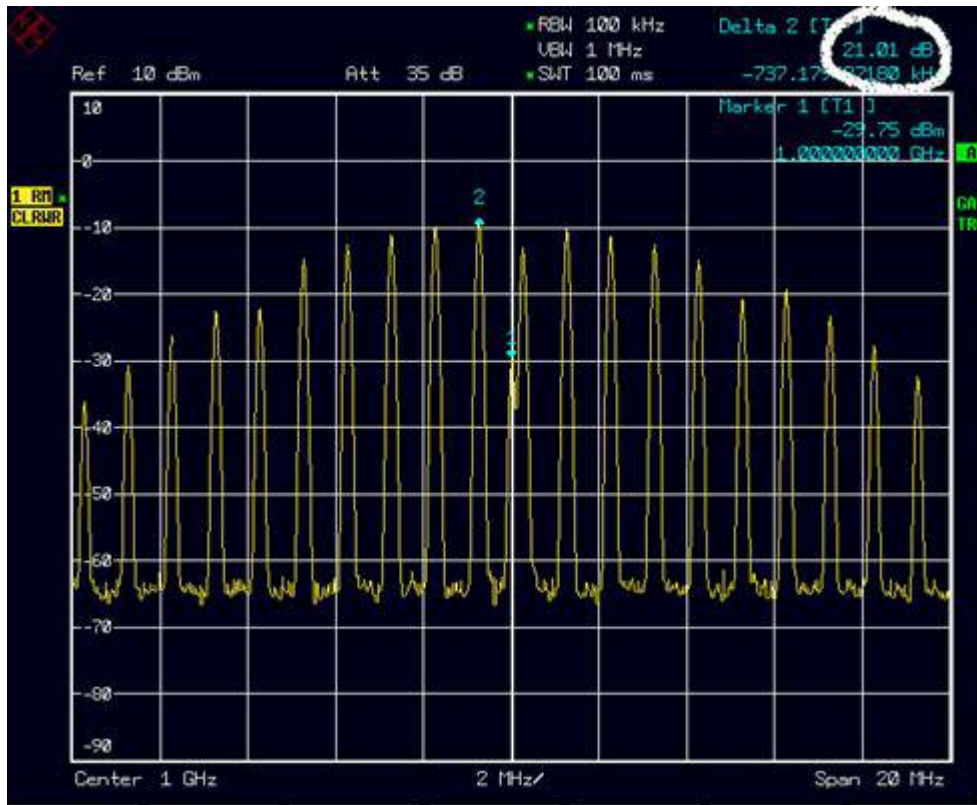


Fig. 2-31 RF carrier suppression measurement

Comparison to IQ offset measurement in K91 list mode

The IQ offset measurement in K91 returns the actual carrier feed through normalized to the mean power at the symbol timings. This measurement doesn't need a special test signal and is independent of the transmit filter shape.

The RF carrier suppression measured according to the standard is inversely proportional to the IQ offset measured in K91 list mode. The difference (in dB) between the two values depends on the transmit filter shape and should be determined with one reference measurement.

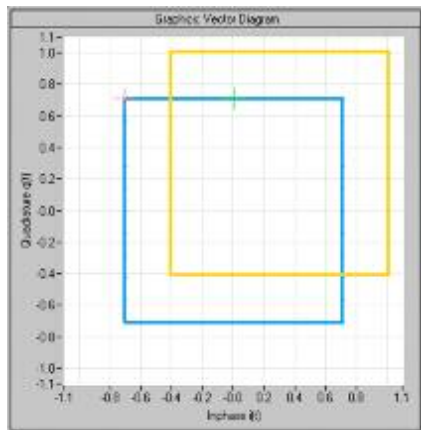
The following table lists exemplary the difference for three transmit filter shapes (± 0.5 dB):

| Transmit filter | -IQ-Offset [dB] - RF-Carrier-Suppression [dB] |
|--|---|
| Rectangular | 11 dB |
| Root Raised Cosine, $\alpha = 0.22$ | 10 dB |
| Gaussian, $\alpha = 0.3$ | 9 dB |

IQ Impairments

IQ Offset

An IQ–Offset indicates a carrier offset with fixed amplitude. This results in a constant shift of the IQ axes. The offset is normalized by the mean symbol power and displayed in dB.



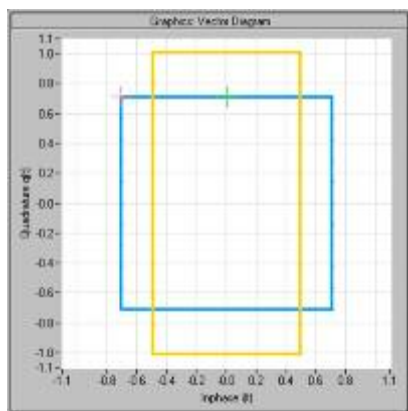
Gain Imbalance

An ideal I/Q modulator amplifies the I and Q signal path by exactly the same degree. The imbalance corresponds to the difference in amplification of the I and Q channel and therefore to the difference in amplitude of the signal components. In the vector diagram, the length of the I vector changes relative to the length of the Q vector.

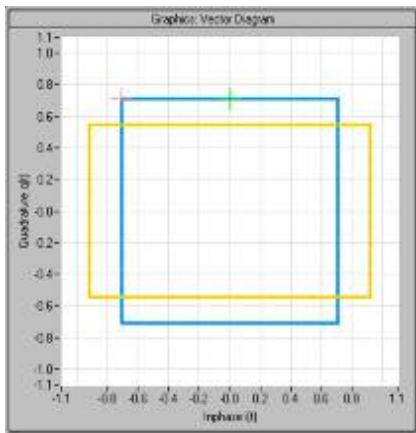
The entry is displayed in dB and %, where 1 dB offset is roughly 12 % according to the following:

$$\text{Imbalance [dB]} = 20\log (| \text{Gain}_Q | / | \text{Gain}_I |)$$

Positive values mean that the Q vector is amplified more than the I vector by the corresponding percentage:



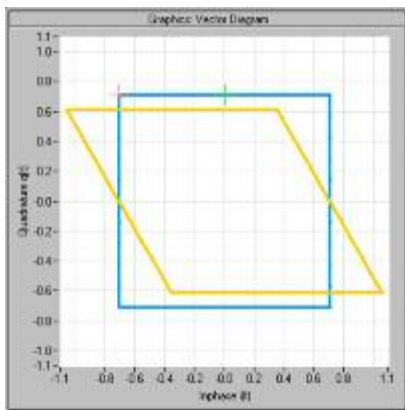
Negative values mean that the I vector is amplified more than the Q vector by the corresponding percentage:



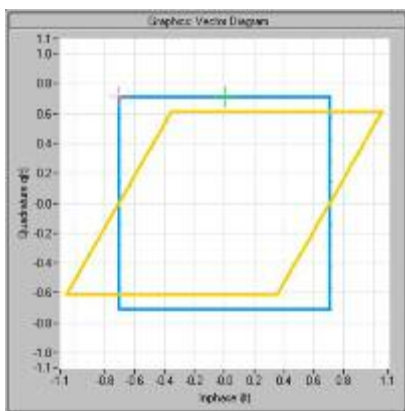
Quadrature Error

An ideal I/Q modulator sets the phase angle to exactly 90 degrees. With a quadrature error, the phase angle between the I and Q vector deviates from the ideal 90 degrees, the amplitudes of both components are of the same size. In the vector diagram, the quadrature error causes the coordinate system to shift.

A positive quadrature error means a phase angle greater than 90 degrees:



A negative quadrature error means a phase angle less than 90 degrees:



3 Manual Control

For details refer to the Quick Start Guide chapters 4, "Basic Operations".

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4 Instrument Functions

This chapter describes the analyzer functions and all basic settings functions of the R&S FSL in detail.

Instrument Functions – Analyzer

In this section, all analyzer functions of the R&S FSL and their application are explained in detail. The basic settings functions are described in section "Instrument Functions – Basic Settings".

For every key a table is provided in which all submenus and corresponding commands are listed. The description of the submenus and commands follows the order of the table. The commands for the optional remote control (if any) are indicated for each softkey. The description is divided into the following topics:

- ["Measurement Parameters"](#) on page 4.2
This section describes how to reset the instrument, to set up specific measurements and to set the measurement parameters. Examples of basic operations are provided in the Quick Start Guide, chapter 5 "Basic Measurement Examples". Advanced examples are described in chapter "Advanced Measurement Examples".
- ["Measurement Functions"](#) on page 4.39
This section informs about how to select and configure the measurement functions. Examples of basic operations are provided in the Quick Start Guide, chapter 5 "Basic Measurement Examples". Advanced examples are described in chapter "Advanced Measurement Examples".
- ["Measurement Modes"](#) on page 4.85
This section describes the provided measurement modes, the change of measurement modes and the access to the menus of all active measurement modes.
- ["Models and Options"](#) on page 4.85
This section informs about optional functions and their application that are included in the standard instrument configuration.

More basic information on operation is given in the Quick Start Guide. The front and the rear view of the instrument together with a table of all available keys and a short description are provided in chapter "Front and Rear Panel". Chapter "Preparing for Use" informs how to start working with the instrument for the first time. A brief introduction on handling the instrument is given in chapter "Basic Operations". This includes also the description of the keys for basic operations like switching the instrument on and off or starting a measurement.

Measurement Parameters

In this section all menus necessary for setting measurement parameters are described. This includes the following topics and keys. For details on changing the mode refer to "[Measurement Mode Selection – MODE Key](#)" on page 4.86.

- "[Initializing the Configuration – PRESET Key](#)" on page 4.3
- "[Selecting the Frequency and Span – FREQ Key](#)" on page 4.5
- "[Setting the Frequency Span – SPAN Key](#)" on page 4.10
- "[Setting the Level Display and Configuring the RF Input – AMPT Key](#)" on page 4.12
- "[Setting the Bandwidths and Sweep Time – BW Key](#)" on page 4.15
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- "[Triggering the Sweep – TRIG Key](#)" on page 4.23
- "[Setting Traces – TRACE Key](#)" on page 4.29

Table 1: Sweep Range Variables

| Abbreviation | Definition | Value R&S FSL3 | Value R&S FSL6 |
|----------------------|---------------------------------|----------------|----------------|
| f_{\max} | max. frequency | 3 GHz | 6 GHz |
| f_{\min} | min. frequency available | 0 Hz | 0 Hz |
| span_{\min} | smallest selectable span > 0 Hz | 10 Hz | 10 Hz |

Initializing the Configuration – PRESET Key

The **PRESET** key resets the instrument to the default setting and therefore provides a defined initial state as a known starting point for measurements.

*Note: If the **LOCAL LOCKOUT** function is active in the remote control mode, the **PRESET** key is disabled.*

Further information

- ["Initial configuration"](#) on page 4.3

Task

- [To preset the instrument](#)

To preset the instrument

- Press the **PRESET** key to trigger a preset.

If the initial configuration has been customized, the customized data sets are retrieved.

If the initial configuration has been retained unchanged, the originally provided data sets, as shown in the table below, are retrieved.

- ➔ Remote: *RST or SYSTem:PRESet (for details refer to chapter "Remote Control – Commands", section "Common Commands" or section "SYSTem Subsystem").

Initial configuration

The initial configuration is selected in a way that the RF input is always protected against overload, provided that the applied signal levels are in the allowed range for the instrument.

The parameter set of the initial configuration can be customized by using the **Startup Recall** softkey in the file menu. For further information refer to section "Instrument Functions – Basic Settings", "Saving and Recalling Data Sets – FILE Key".

Table 2: Initial Configuration

| Parameter | Settings |
|----------------------------|------------------------------|
| Mode | Spectrum Analysis |
| Center frequency | $f_{\max} / 2$ |
| Center frequency step size | 0.1 * center frequency |
| Span | 3 GHz / 6 GHz (R&S FSL–3/–6) |
| RF attenuation | auto (0 dB) |
| Reference level | –20 dBm |
| Level range | 100 dB log |
| Level unit | dBm |
| Sweep time | auto |
| Resolution bandwidth | auto (3 MHz) |

| Parameter | Settings |
|------------------------------------|-----------------|
| Video bandwidth | auto (10 MHz) |
| FFT filters | off |
| Span / RBW | 50 |
| RBW / VBW | 0.33 |
| Sweep | cont |
| Trigger | free run |
| Trace 1 | clr write |
| Trace 2/3/4 | blank |
| Detector | auto peak |
| Frequency offset | 0 Hz |
| Reference level offset | 0 dB |
| Reference level position | 100 % |
| Grid | abs |
| Cal correction | on |
| Noise source | off |
| Input | RF |
| Tracking generator (models 13, 16) | off |

Selecting the Frequency and Span – *FREQ* Key

The **FREQ** key is used to specify the frequency axis, and to set the frequency offset and the signal track function. The frequency axis can be specified either by the start and stop frequency or by the center frequency and the span.

To open the frequency menu

- Press the **FREQ** key.

The frequency menu is displayed. The **Frequency Center** edit dialog box is displayed.

Menu and softkey description

- ["Softkeys of the frequency menu"](#) on page 4.6

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Tasks

- [To specify the frequency axis by the start and stop frequency](#)
- [To specify the frequency axis by the center frequency and the span](#)
- [To specify the step size for the arrow keys and the rotary knob](#)
- [To modify the frequency axis by an offset](#)
- [To track signals \(only possible when span >0\)](#)

To specify the frequency axis by the start and stop frequency

1. Press the **Start** softkey and enter a start frequency.
2. Press the **Stop** softkey and enter a stop frequency.

To specify the frequency axis by the center frequency and the span

1. Press the **FREQ** key and enter a center frequency in the **Frequency Center** edit dialog box.
2. Press the **SPAN** key and enter the bandwidth you want to analyze.

Note: Entering a value of 0 Hz will cause a change to the zero span analysis mode.

To specify the step size for the arrow keys and the rotary knob

1. Press the **CF Stepsize** softkey.

The softkeys are displayed according to the selected frequency span (zero span or span > 0).

2. To define the step size of the center frequency:
 - Only when span > 0: Press **0.1*Span**, **0.5*Span** or **x*Span** to define the step size for the center frequency as percentage of the span.
 - Only when span = 0: Press **0.1*RBW**, **0.5*RBW** or **x*RBW** to define the step size for the center frequency as percentage of the resolution bandwidth.

- Press the **Center** softkey to set the step size to the value of the center frequency and to remove the dependency of the step size to span or resolution bandwidth.
- Press the **=Marker** softkey to set the step size to the value of the marker and to remove the dependency of the step size to span or resolution bandwidth.
- Press the **Manual** softkey and enter a fixed step size for the center frequency.

Note: The step size assigned to arrow keys corresponds to the selected value; the step size of the rotary knob is $1/10$ of it.

To modify the frequency axis by an offset

- Press the **Frequency Offset** softkey and enter the offset to shift the displayed frequency span.

To track signals (only possible when span >0)

1. Press the **Signal Track** softkey.
 The softkeys of this submenu are displayed to start and stop signal tracking with specified parameters.
2. Press the **Track On/Off** softkey to switch signal tracking on or off.
3. Press the **Track BW** softkey and enter a bandwidth for signal tracking.
4. Press the **Track Threshold** softkey and enter the threshold for signal tracking.
5. Press the **Select Trace** softkey and select the trace for signal tracking.

Softkeys of the frequency menu

The following table shows all softkeys available in the frequency menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|------------------|------------------|
| Center | |
| Start | |
| Stop | |
| CF Stepsize ↓ | 0.1*Span/0.1*RBW |
| | 0.5*Span/0.5*RBW |
| | x*Span/x*RBW |
| | Center |
| | =Marker |
| | Manual |
| Frequency Offset | |
| Signal Track ↓ | Track On/Off |
| | Track BW |
| | Track Threshold |
| | Select Trace |

Center

Opens an edit dialog box to enter the center frequency. The allowed range of values for the center frequency depends on the frequency span.

$$\text{span} > 0: \text{span}_{min} / 2 \leq f_{center} \leq f_{max} - \text{span}_{min} / 2$$

$$\text{span} = 0: 0 \text{ Hz} \leq f_{center} \leq f_{max}$$

→ Remote: `FREQ:CENT 100MHz`

Start

Opens an edit dialog box to define the start frequency. The following range of values is allowed:

$$f_{min} \leq f_{start} \leq f_{max} - \text{span}_{min}$$

→ Remote: `FREQ:STAR 20MHz`

Stop

Opens an edit dialog box to define the stop frequency. The following range of values for the stop frequency is allowed:

$$f_{min} + \text{span}_{min} \leq f_{stop} \leq f_{max}$$

→ Remote: `FREQ:STOP 2000MHz`

CF Stepsize

Opens a submenu to set the step size of the center frequency. In addition to the **Center**, **=Marker** and **Manual** softkeys, the other softkeys are displayed depending on the selected frequency span.

The step size can be coupled to the span (span > 0) or the resolution bandwidth (span = 0) or it can be manually set to a fixed value.

0.1*Span (span > 0)

Sets the step size for the center frequency to 10% of the span.

→ Remote: `FREQ:CENT:STEP:LINK SPAN`

→ Remote: `FREQ:CENT:STEP:LINK:FACT 10PCT`

0.1*RBW (zero span)

Sets the step size for the center frequency to 10% of the resolution bandwidth. This is the default setting.

→ Remote: `FREQ:CENT:STEP:LINK RBW`

→ Remote: `FREQ:CENT:STEP:LINK:FACT 10PCT`

0.5*Span (span > 0)

Sets the step size for the center frequency to 50% of the span.

- Remote: `FREQ:CENT:STEP:LINK SPAN`
- Remote: `FREQ:CENT:STEP:LINK:FACT 50PCT`

0.5*RBW (zero span)

Sets the step size for the center frequency to 50% of the resolution bandwidth.

- Remote: `FREQ:CENT:STEP:LINK RBW`
- Remote: `FREQ:CENT:STEP:LINK:FACT 50PCT`

x*Span (span > 0)

Opens an edit dialog box to set the step size for the center frequency as % of the span.

- Remote: `FREQ:CENT:STEP:LINK SPAN`
- Remote: `FREQ:CENT:STEP:LINK:FACT 20PCT`

x*RBW (zero span)

Opens an edit dialog box to set the step size for the center frequency as % of the resolution bandwidth. Values between 1 and 100% in steps of 1% are allowed. The default setting is 10%.

- Remote: `FREQ:CENT:STEP:LINK RBW`
- Remote: `FREQ:CENT:STEP:LINK:FACT 20PCT`

Center

Sets the step size to the value of the center frequency and removes the coupling of the step size to span or resolution bandwidth. This function is especially useful during measurements of the signal harmonic content because by entering the center frequency each stroke of the arrow key selects the center frequency of another harmonic.

=Marker

Sets the step size to the value of the current marker and removes the coupling of the step size to span or resolution bandwidth. This function is especially useful during measurements of the signal harmonic content at the marker position because by entering the center frequency each stroke of the arrow key selects the center frequency of another harmonic.

Manual

Opens an edit dialog box to enter a fixed step size for the center frequency.

- Remote: `FREQ:CENT:STEP 120MHz`

Frequency Offset

Opens an edit dialog box to enter a frequency offset that shifts the displayed frequency range by the specified offset. The allowed values range from –100 GHz to 100 GHz. The default setting is 0 Hz.

→ Remote: `FREQ:OFFS 10 MHz`

Signal Track (span > 0)

Opens a submenu to modify the parameters for signal tracking: search bandwidth, threshold value and trace.

The search bandwidth and the threshold value are shown in the diagram by two vertical lines and one horizontal line, which are labeled as **TRK**. After each sweep the center frequency is set to the maximum signal found within the searched bandwidth. If no maximum signal above the set threshold value is found in the searched bandwidth, the track mechanism stops.

→ Remote: `CALC:MARK:FUNC:STR OFF`

Track On/Off (span > 0)

Switches the signal tracking on or off.

→ Remote: `CALC:MARK:FUNC:STR OFF`

Track BW (span > 0)

Opens an edit dialog box to set the search bandwidth for signal tracking. The frequency range is calculated as a function of the center frequency.

→ Remote: `CALC:MARK:FUNC:STR:BAND 1MHZ`

Track Threshold (span > 0)

Opens an edit dialog box to set the threshold value for signal tracking.

→ Remote: `CALC:MARK:FUNC:STR:THR -70DBM`

Select Trace (span > 0)

Opens an edit dialog box to select the trace on which the signal is tracked.

→ Remote: `CALC:MARK:FUNC:STR:TRAC 1`

Setting the Frequency Span – SPAN Key

The **SPAN** key is used to set the frequency span to be analyzed.

To open the span menu

- Press the **SPAN** key.

The span menu is displayed. For span > 0 an edit dialog box to enter the frequency is displayed.
For zero span, an edit dialog box to enter the sweep time is displayed.

Menu and softkey description

- ["Softkeys of the span menu"](#) on page 4.10

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help.
To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Task

- [To specify the span \(alternatives\)](#)

To specify the span (alternatives)

1. To set the span, use the **Span Manual**, **Full Span**, **Zero Span** and **Last Span** softkeys.
2. To define a frequency range, use the **Start Frequency** and **Stop Frequency** softkeys.
3. For zero span, press the **Sweeptime Manual** softkey and enter a sweep time.

Softkeys of the span menu

The following table shows all softkeys available in the span menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Command |
|----------------------------------|
| Span Manual |
| Sweeptime Manual |
| Start Frequency |
| Stop Frequency |
| Full Span |
| Zero Span |
| Last Span |

Span Manual

Opens an edit dialog box to enter the frequency span. The center frequency is kept constant.
The following range is allowed:

$$span = 0: 0 \text{ Hz}$$

$$span > 0: span_{min} \leq f_{span} \leq f_{max}$$

➔ Remote: `FREQ:SPAN 2GHz`

Start Frequency

Opens an edit dialog box to enter the start frequency. For details see **Start** softkey in the frequency menu.

→ Remote: `FREQ:STAR 20MHz`

Stop Frequency

Opens an edit dialog box to enter the stop frequency. For details see **Stop** softkey in the frequency menu.

→ Remote: `FREQ:STOP 2000MHz`

Full Span

Sets the span to the full frequency range of the R&S FSL, useful for overview measurements.

→ Remote: `FREQ:SPAN:FULL`

Zero Span

Sets the span to 0 Hz (zero span). The x axis becomes the time axis with the grid lines corresponding to 1/10 of the current sweep time (**SWT**).

→ Remote: `FREQ:SPAN 0Hz`

Last Span

Sets the span to the previous value. With this function e.g. a fast change between overview measurement and detailed measurement is possible.

Setting the Level Display and Configuring the RF Input – AMPT Key

The **AMPT** key is used to set the reference level, the level range and unit, the scaling and the RF attenuation.

To open the amplitude menu

- Press the **AMPT** key.

The amplitude menu is displayed. The **Reference Level** dialog box is displayed.

Menu and softkey description

- ["Softkeys of the amplitude menu"](#) on page 4.12

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Task

- [To specify the amplitude](#)

To specify the amplitude

1. Set the reference level, offset and position, using the **Ref Level**, **Ref Level Offset** and **Ref Level Position** softkeys.
2. Select the level range and the unit for the level axis, using the **Range Log** and **Unit** softkeys.
3. Set the scaling, using the **Range Linear** and/or **Grid Abs / Rel** softkeys.
4. Set the attenuation, using the **RF Atten Manual** or **RF Atten Auto** softkeys.

Softkeys of the amplitude menu

The following table shows all softkeys available in the amplitude menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Command |
|------------------------------------|
| Ref Level |
| Range Log |
| Range Linear |
| Preamp On/Off |
| RF Atten Manual |
| RF Atten Auto |
| More ↓ |
| Ref Level Offset |
| Ref Level Position |
| Grid Abs / Rel |
| Unit |
| Input 50 Ω / 75 Ω |

Ref Level

Opens an edit dialog box to enter the reference level in the currently active unit (dBm, dB μ V, etc).

The reference level value is the maximum value the AD converter can handle without distortion of the measured value. Signal levels above this value will not be measured correctly, which is indicated by the status display **IFOVL**.

→ Remote: `DISP:TRAC:Y:RLEV -60dBm`

Range Log

Opens the **Range Log** dialog box to select a value for the level range.

→ Remote: `DISP:TRAC:Y:SPAC LOG`

→ Remote: `DISP:TRAC:Y 120DB`

Range Linear

Opens the **Range Linear** dialog box to select a value for the level range.

→ Remote: `DISP:TRAC:Y:SPAC LIN | LDB`

Preamp On/Off (option RF Preamplifier, B22)

Switches the preamplifier on or off.

→ Remote: `INP:GAIN ON`

RF Atten Manual

Opens an edit dialog box to enter the attenuation, irrespective of the reference level.

The attenuation can be set in 5 dB steps between 0 and 30 dB. If the defined reference level cannot be set for the set RF attenuation, the reference level will be adjusted accordingly.

The RF attenuation defines the level at the input mixer according to the formula:

$$level_{mixer} = level_{input} - RF\ attenuation$$

The maximum mixer level allowed is –10 dBm. Mixer levels above this value may lead to incorrect measurement results, which are indicated by the **OVL** status display.

→ Remote: `INP:ATT 30 DB`

RF Atten Auto

Sets the RF attenuation automatically as a function of the selected reference level. This ensures that the optimum RF attenuation is always used. It is the default setting.

→ Remote: `INP:ATT:AUTO ON`

Ref Level Offset

Opens an edit dialog box to enter the arithmetic level offset. This offset is added to the measured level irrespective of the selected unit. The scaling of the y axis is changed accordingly. The setting range is ± 200 dB in 0.1 dB steps.

→ Remote: `DISP:WIND:TRAC:Y:RLEV:OFFS -10dB`

Ref Level Position

Opens an edit dialog box to enter the reference level position, i.e. the position of the maximum AD converter value on the level axis. The setting range is from -200 to $+200\%$, 0% corresponding to the lower and 100% to the upper limit of the diagram.

→ Remote: `DISP:WIND:TRAC:Y:RPOS 100PCT`

Grid Abs / Rel (not available with Range Linear)

Switches between absolute and relative scaling of the level axis.

| | |
|------------------|--|
| Absolute scaling | The labeling of the level lines refers to the absolute value of the reference level. Absolute scaling is the default setting. |
| Relative scaling | The upper line of the grid is always at 0 dB. The scaling is in dB whereas the reference level is always in the set unit (for details on unit settings see Unit softkey). |

→ Remote: `DISP:WIND:TRAC:Y:MODE ABS`

Unit

Opens the **Unit** dialog box to select the unit for the level axis. The default setting is dBm. If a transducer is switched on, the softkey is not available.

In general, the spectrum analyzer measures the signal voltage at the RF input. The level display is calibrated in RMS values of an unmodulated sinewave signal. In the default state, the level is displayed at a power of 1 mW (= dBm). Via the known input impedance (50 Ω or 75 Ω), conversion to other units is possible. The units dBm, dBmV, dB μ V, V and W are directly convertible.

→ Remote: `CALC:UNIT:POW DBM`

Input 50 Ω / 75 Ω

Changes the input impedance from 50 Ω to 75 Ω and vice versa. Default setting is 50 Ω .

The setting 75 Ω should be selected, if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The correction value in this case is 1.76 dB = $10 \log (75 \Omega / 50 \Omega)$.

All levels specified in this Operating Manual refer to the default setting of the instrument (50 Ω).

→ Remote: `INP:IMP 50OHM`

Setting the Bandwidths and Sweep Time – BW Key

The **BW** key is used to set the resolution bandwidth, video bandwidth (VBW) and sweep time (SWT). The values available for resolution bandwidth and video bandwidth depend on the selected filter type. For details on channel filters see also "[List of available RRC and channel filters](#)" on page 4.16.

To open the bandwidth menu

- Press the **BW** key.

The bandwidth menu is displayed.

Menu and softkey description

- "[Softkeys of the bandwidth menu](#)" on page 4.17

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- "[List of available RRC and channel filters](#)" on page 4.16

Tasks

- [To specify the bandwidth](#)
- [To choose the appropriate filter type](#)

To specify the bandwidth

1. Set the resolution bandwidth using the **Res BW Manual** or **Res BW Auto** softkey.
2. Set the video bandwidth using the **Video BW Manual** or **Video BW Auto** softkey.
3. Set the sweep time using the **SweepTime Manual** or **SweepTime Auto** softkey.
4. Press the **Filter Type** softkey and select the appropriate filters.

To choose the appropriate filter type

Analog and digital filters are used. All resolution bandwidths up to 3 MHz are realized using digital band-passes. As far as the attenuation characteristic is concerned they behave like analog filters but have a much higher measurement speed than comparable analog filters. This is due to the fact that the transient response can be compensated as a result of an accurately defined filter behavior.

Note: Due to the LO feedthrough the overload display **OVL** responds for digital filters if the following combinations are set:
 $RBW < 100 \text{ kHz}$ and start frequency $< 6 * \text{resolution bandwidth}$, or
 $RBW = 100 \text{ kHz}$ and start frequency $< 3 \text{ MHz}$.

The video filters serve for smoothing the displayed trace. Using video bandwidths that are small compared to the resolution bandwidth, only the signal average is displayed and noise peaks and pulsed signals are repressed. If pulsed signals are to be measured, it is recommended to use a video bandwidth that is large compared to the resolution bandwidth ($VBW * 10 \times RBW$) for the amplitudes of pulses to be measured correctly.

The following filter types are available:

- 4 pole filters
available bandwidths: 10 Hz to 3 MHz. This is the default setting.
- FFT filters
available bandwidths: 1 Hz to 30 kHz (alternative to analog filters)

The FFT algorithm offers considerably higher measurement speeds with all the other settings remaining the same. The reason is that for analog filters the sweep time required for a particular span is proportional to $(\text{Span}/\text{RBW}^2)$. When using the FFT algorithm, however, the sweep time is proportional to (Span/RBW) .

FFT filters are particularly suitable for stationary signals (sinusoidal signals or signals that are continuously modulated in time). For burst signals (TDMA) or pulsed signals, normal filters are preferable. When the tracking generator is used as signal source for the DUT, filtering with the FFT algorithm is not useful. The **FFT** option is thus not available if the tracking generator is switched on.

If the FFT filters are activated, the sweep time display field (SWT) is replaced by the acquisition time (AQT) display field. The sweep time is defined by the selected bandwidth and span, and cannot be changed. The video bandwidth is not defined and therefore cannot be set.

The sample detector and the peak detector are available. If the **Detector Auto Select** softkey in the trace menu is activated, the peak detector is selected.

- channel filters
details see "[List of available RRC and channel filters](#)"
- RRC filters
details see "[List of available RRC and channel filters](#)"

List of available RRC and channel filters

For power measurement a number of especially steep-edged channel filters are available (see the following table).

For filters of type RRC (Root Raised Cosine), the filter bandwidth indicated describes the sampling rate of the filter. For all other filters (CFILter) the filter bandwidth is the 3 dB bandwidth.

Table 3: Filter Types

| Filter Bandwidth | Filter Type | Application |
|------------------|-------------|---------------|
| 100 Hz | CFILter | A0 |
| 200 Hz | CFILter | |
| 300 Hz | CFILter | |
| 500 Hz | CFILter | |
| 1 kHz | CFILter | SSB |
| 1.5 kHz | CFILter | |
| 2 kHz | CFILter | |
| 2.4 kHz | CFILter | |
| 2.7 kHz | CFILter | |
| 3 kHz | CFILter | |
| 3.4 kHz | CFILter | |
| 4 kHz | CFILter | DAB, Satelite |

| Filter Bandwidth | Filter Type | Application |
|--------------------------|-------------|--|
| 4.5 kHz | CFILter | ETS300 113 (12.5 kHz channels) AM Radio |
| 5 kHz | CFILter | |
| 6 kHz | CFILter | |
| 8.5 kHz | CFILter | |
| 9 kHz | CFILter | |
| 10 kHz | CFILter | CDMAone ETS300 113 (20 kHz channels) |
| 12.5 kHz | CFILter | |
| 14 kHz | CFILter | ETS300 113 (25 kHz channels) TETRA |
| 15 kHz | CFILter | |
| 16 kHz | CFILter | |
| 18 kHz, $\alpha=0.35$ | RRC | PDC IS 136 |
| 20 kHz | CFILter | |
| 21 kHz | CFILter | CDPD, CDMAone |
| 24.3 kHz, $\alpha=0.35$ | RRC | |
| 25 kHz | CFILter | |
| 30 kHz | CFILter | |
| 50 kHz | CFILter | |
| 100 kHz | CFILter | FM Radio PHS |
| 150 kHz | CFILter | |
| 192 kHz | CFILter | J.83 (8-VSB DVB, USA) |
| 200 kHz | CFILter | |
| 300 kHz | CFILter | |
| 500 kHz | CFILter | |
| 1.0 MHz | CFILter | CDMAone |
| 1,28 MHz | RRC | |
| 1.2288 MHz | CFILter | CDMAone DAB |
| 1.5 MHz | CFILter | |
| 3.0 MHz | CFILter | W-CDMA 3GPP W-CDMA NTT DOCoMo |
| 3.75 MHz | CFILter | |
| 3.84 MHz, $\alpha=0.22$ | RRC | |
| 4.096 MHz, $\alpha=0.22$ | RRC | |
| 20 MHz | CFILter | |

Softkeys of the bandwidth menu

The following table shows all softkeys available in the bandwidth menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| |
|------------------|
| Command |
| Res BW Manual |
| Res BW Auto |
| Video BW Manual |
| Video BW Auto |
| Sweeptime Manual |
| Sweeptime Auto |
| Filter Type |

Res BW Manual

Opens an edit dialog box to enter a value for the resolution bandwidth. The resolution bandwidth can be set in 1, 3, 10 steps in the range between 300 Hz and 3 MHz (10 Hz to 3 MHz with option Narrow IF Filters, R&S FSL–B7). For details on the correlation between resolution bandwidth and filter type refer to "[To choose the appropriate filter type](#)" on page 4.15.

Numeric input is always rounded to the nearest possible bandwidth. For rotary knob or **UP/DNARROW** key inputs, the bandwidth is adjusted in steps either upwards or downwards.

The manual input mode of the resolution bandwidth is indicated by a green asterisk (*) at the **RBW** display.

- Remote: BAND:AUTO OFF
 - Remote: BAND 1MHz
-

Res BW Auto (span > 0)

Couples the resolution bandwidth to the selected span. If the span is changed, the resolution bandwidth is automatically adjusted.

This setting is recommended, when a favorable setting of the resolution bandwidth in relation to the selected span is desired.

- Remote: BAND:AUTO ON
-

Video BW Manual (not available for FFT filter)

Opens an edit dialog box to enter the video bandwidth. The video bandwidth can be selected in 1, 3, 10 steps in the range between 1 Hz and 10 MHz.

Numeric input is always rounded to the nearest possible bandwidth. For rotary knob or UP/DOWN key inputs, the bandwidth is adjusted in steps either upwards or downwards.

The manual input mode of the video bandwidth is indicated by a green asterisk (*) at the **VBW** display.

- Remote: BAND:VID:AUTO OFF
 - Remote: BAND:VID 10 kHz
-

Video BW Auto (not available for FFT filter)

Couples the video bandwidth to the resolution bandwidth. If the resolution bandwidth is changed, the video bandwidth is automatically adjusted.

This setting is recommended, when a minimum sweep time is required for a selected resolution bandwidth. Narrow video bandwidths require longer sweep times due to the longer settling time. Wide bandwidths reduce the signal/noise ratio.

→ Remote: BAND:VID:AUTO ON

Sweptime Manual (not available for FFT filter)

Opens an edit dialog box to enter the sweep time.

| Sweep time | Option TV Trigger, B6 (available from version 1.10) |
|--|---|
| absolute max. sweep time value: 16000 s | 100 µs (zero span) |
| absolute min. sweep time value: 1 µs (zero span) | 25 µs (zero span) |
| 2.5 ms (span > 0) | – |

Allowed values depend on the ratio of span to RBW and RBW to VBW.

Numeric input is always rounded to the nearest possible sweep time. For rotary knob or UP/DOWN key inputs, the sweep time is adjusted in steps either downwards or upwards.

The manual input mode of the sweep time is indicated by a green asterisk (*) at the **SWT** display. If the selected sweep time is too short for the selected bandwidth and span, level measurement errors will occur due to a too short settling time for the resolution or video filters. In this case, the R&S FSL displays the error message **UNCAL** and marks the indicated sweep time with a red asterisk (*).

→ Remote: SWE:TIME:AUTO OFF

→ Remote: SWE:TIME 10s

Sweptime Auto (not available for FFT filter and zero span)

Couples the sweep time to the span, video bandwidth (VBW) and resolution bandwidth (RBW). If the span, resolution bandwidth or video bandwidth are changed, the sweep time is automatically adjusted.

The R&S FSL always selects the shortest sweep time that is possible without falsifying the signal. The maximum level error is < 0.1 dB, compared to using a longer sweep time.

→ Remote: SWE:TIME:AUTO ON

Filter Type

Opens the **Filter Type** dialog box to select the filter type.

For detailed information on filters see "[To choose the appropriate filter](#)" on page 4.15 and "[List of available RRC and channel filters](#)" on page 4.16.

→ Remote: BAND:TYPE NORM

Configuring the Sweep Mode – SWEEP Key

The **SWEEP** key is used to configure the sweep mode. Continuous sweep or single sweep are possible. The sweep time and the number of measurement points are set.

To open the sweep menu

- Press the **SWEEP** key.
The sweep menu is displayed.

Menu and softkey description

- ["Softkeys of the sweep menu"](#) on page 4.20

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Task

- [To specify the sweep settings](#)

To specify the sweep settings

1. Press the **Sweep Count** softkey and enter the sweep count.
2. Set the sweep time by using the **Sweeptime Manual** or **Sweeptime Auto** softkey.
3. Press the **Sweep Points** softkey and enter the number of sweep points.
4. Select the sweep mode using the **Continuous Sweep** or **Single Sweep** softkey.
5. To repeat the single sweep, press the **Continue Single Sweep** softkey.

Softkeys of the sweep menu

The following table shows all softkeys available in the sweep menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Command |
|---------------------------------------|
| Continuous Sweep |
| Single Sweep |
| Continue Single Sweep |
| Sweeptime Manual |
| Sweeptime Auto |
| Sweep Count |
| Sweep Points |

Continuous Sweep

Sets the continuous sweep mode: the sweep takes place continuously according to the trigger settings. This is the default setting. The trace averaging is determined by the sweep count value (see **Sweep Count** softkey).

→ Remote: INIT:CONT ON

Single Sweep

Sets the single sweep mode: after triggering, starts the number of sweeps that are defined by using the **Sweep Count** softkey. The measurement stops after the defined number of sweeps has been performed.

→ Remote: INIT:CONT OFF

Continue Single Sweep

Repeats the number of sweeps set by using the **Sweep Count** softkey, without deleting the trace of the last measurement.

This is particularly of interest when using the trace configurations **Average** or **Max Hold** to take previously recorded measurements into account for averaging / maximum search. For details on trace configuration refer to "[Setting Traces – TRACE Key](#)" on page 4.29.

→ Remote: INIT:CONM

Sweeptime Manual

Opens an edit dialog box to enter the sweep time. For details see **Sweeptime Manual** softkey in the bandwidth menu.

→ Remote: SWE:TIME 10s

Sweeptime Auto

Sets the automatic sweep time mode. For details see **Sweeptime Auto** softkey in the bandwidth menu.

→ Remote: SWE:TIME:AUTO ON

Sweep Count

Opens an edit dialog box to enter the number of sweeps to be performed in the single sweep mode. Values from 0 to 32767 are allowed. If the values 0 or 1 are set, one sweep is performed. The sweep count is applied to all the traces in a diagram.

The sweep count set in the sweep menu is the same as that in the trace menu (see **Sweep Count** softkey). If the trace configurations **Average**, **Max Hold** or **Min Hold** are set, the sweep count value also determines the number of averaging or maximum search procedures (for details on trace configuration see "[Setting Traces – TRACE Key](#)" on page 4.29).

Example:

TRACE key – **Trace Mode** softkey – **Trace Mode** dialog box: select **Max Hold**

SWEEP key – **Sweep Count** softkey – **Average Sweep Count** dialog box: enter 10

Single Sweep softkey: R&S FSL performs the **Max Hold** function over 10 sweeps.

→ Remote: SWE:COUN 64

Sweep Points

Opens an edit dialog box to enter the number of measurement points to be collected during one sweep.

The following values are possible: 125, 251, 501 (default), 1001, 2001, 4001, 8001, 16001, 32001. If a value \neq 501 is set, the auto peak detector will be turned off automatically.

→ Remote: SWE:POIN 501

Triggering the Sweep – TRIG Key

The **TRIG** key is used to set trigger mode, trigger threshold, trigger delay, trigger polarity and for gated sweep the gate configuration.

To open the trigger menu

- Press the **TRIG** key.
The trigger menu is displayed.

Menu and softkey description

- ["Softkeys of the trigger menu"](#) on page 4.26

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- ["Trigger mode overview"](#) on page 4.26

Tasks

- [To specify the trigger settings](#)
- [To use gated sweep operation \(option Gated Sweep, B8\)](#)
- [To trigger on TV signals \(zero span and option TV Trigger, B6\)](#)

To specify the trigger settings

1. Press the **Trg / Gate Source** softkey to select the trigger mode (for details see ["Trigger mode overview"](#) on page 4.26).
2. Press the **Trg / Gate Level** softkey to set the trigger level.
3. Press the **Trigger Offset** softkey to set the trigger offset.
4. For details on gated sweep operation, see ["To use gated sweep operation \(option Gated Sweep, B8\)"](#) on page 4.23.
5. For details on TV signal triggering, see ["To trigger on TV signals \(zero span and option TV Trigger, B6\)"](#).

To use gated sweep operation (option Gated Sweep, B8)

By using a gate in sweep mode and stopping the measurement while the gate signal is inactive, the spectrum for pulsed RF carriers can be displayed without the superposition of frequency components generated during switching. Similarly, the spectrum can also be examined for an inactive carrier. The sweep can be controlled by an external gate or by the internal power trigger.

Gated sweep operation is also possible for span = 0. This enables – e.g. in burst signals – level variations of individual slots to be displayed versus time.

1. Press the **Gate Settings** submenu softkey to define the settings of the gate mode.
At the center frequency a transition to zero span is made and the time parameters gate delay and gate length are displayed as vertical lines to adjust them easily.

When quitting the **Gate Settings** submenu, the original span is retrieved so the desired measurement can be performed with the accurately set gate.

2. To set the parameters gate delay and gate length highly accurate, press the **Sweep Time** softkey to alter the x axis in a way that the signal range concerned (e.g. one full burst) is displayed.
3. Press the **Gate Delay** softkey to set the sampling time in a way that the desired portion of the signal is shown.
4. Press the **Gate Mode Lvl/Edge** softkey to set the gate mode.
5. If the **Edge** gate mode has been selected, press the **Gate Length** softkey to set the sampling duration in a way that the desired portion of the signal is shown.
6. Press the **Trg / Gate Polarity Pos/Neg** softkey to set the polarity of the trigger source.
7. Press the **Gated Trigger** softkey to activate the gated sweep mode.

To indicate that a gate is used for the sweep, the enhancement label **GAT** is displayed on the screen. This label appears to the right of the window for which the gate is configured.

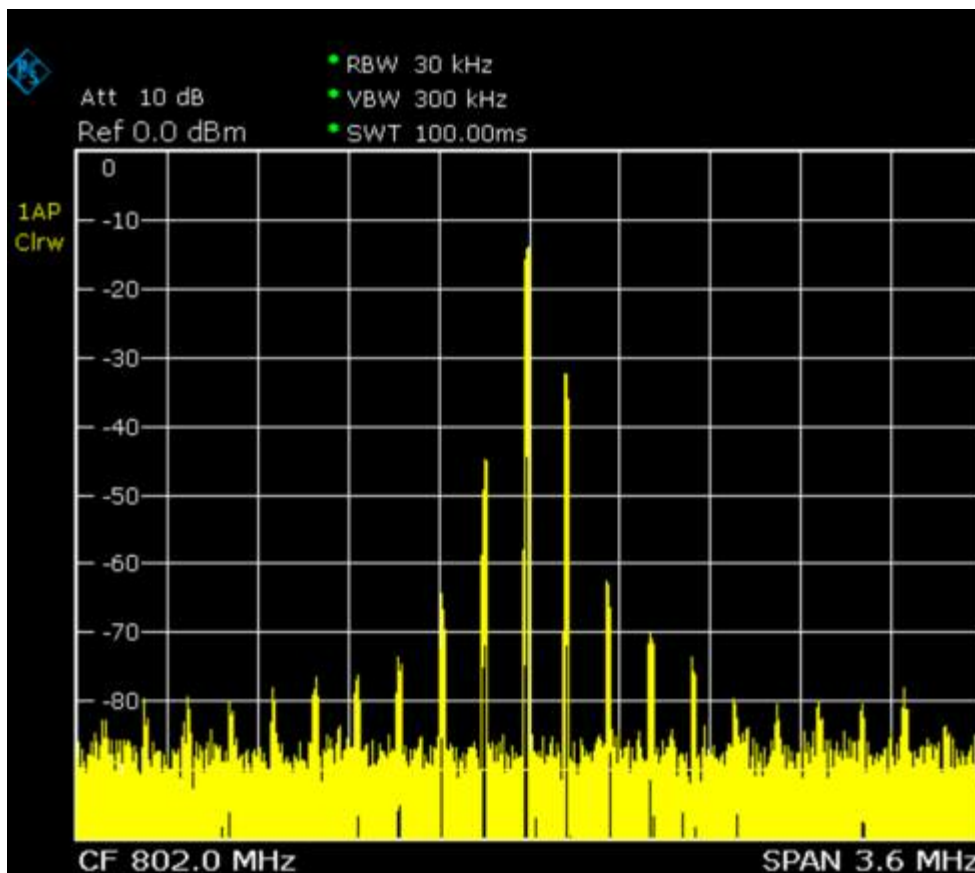


Fig. 4-1: TDMA signal with GATE OFF

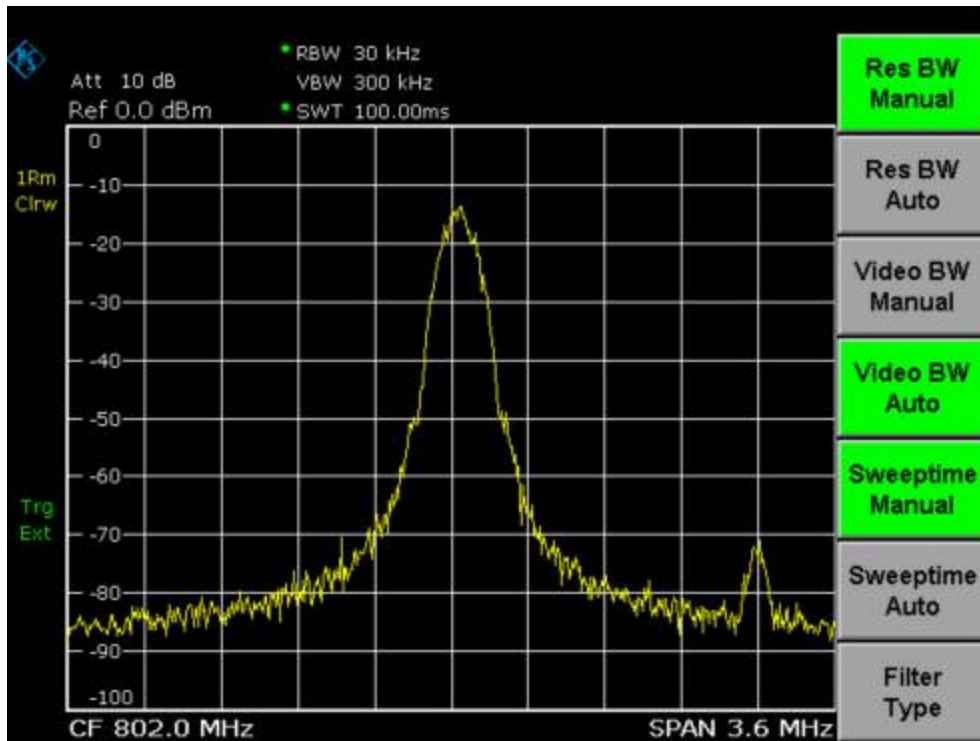


Fig. 4–2: Pulsed signal with GATE ON

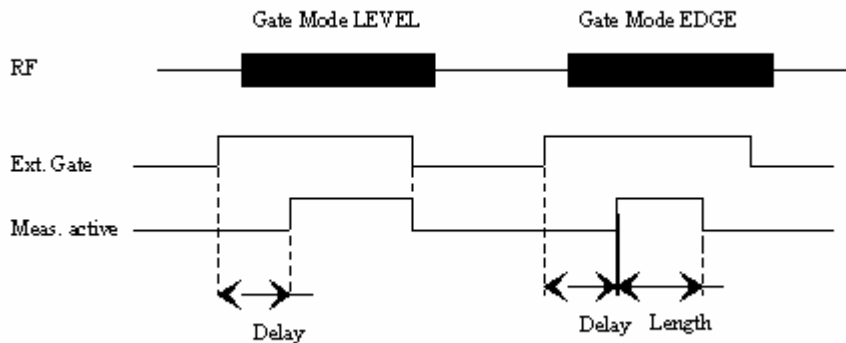


Fig. 4–3: Timing diagram for GATE, GATE DELAY and GATE LENGTH

To trigger on TV signals (zero span and option TV Trigger, B6)

1. Press the **TV Trig Settings** submenu softkey to switch the TV trigger on and define the settings for triggering on TV signal.
2. To configure the TV trigger, press the **Vert Sync**, **Vert Sync Odd Field**, **Vert Sync Even Field** or **Hor Sync** softkey.
3. Press the **Video Pol Pos/Neg** softkey to set the polarity of the video signal.
4. Press the **Lines 625/525** softkey to set the line system to be used.

Option TV Trigger, B6, is available from firmware version 1.10.

Trigger mode overview

The R&S FSL offers the following trigger modes:

- **Free Run**

The start of a sweep is not triggered. Once a measurement is completed, another is started immediately.

- **Video**

Triggering by the displayed voltage.

A horizontal trigger line is shown in the diagram. It is used to set the trigger threshold from 0% to 100% of the diagram height.

- **IF Power**

Triggering of the measurement via signals which are outside the measurement channel.

For this purpose, the R&S FSL uses a level detector at the second intermediate frequency. Its threshold can be set in a range between –30 dBm and –10 dBm at the input mixer. The resulting trigger level at the RF input is calculated via the following formula:

$$Mixerlevel_{min} + RFAtt - PreampGain \leq Input\ Signal \leq Mixerlevel_{max} + RFAtt - PreampGain$$

The bandwidth at the intermediate frequency is 20 MHz. The R&S FSL is triggered as soon as the trigger threshold is exceeded within a 10 MHz range around the selected frequency (= start frequency in the frequency sweep).

Thus, the measurement of spurious emissions, e.g. for pulsed carriers, is possible even when the carrier lies outside the selected frequency span.

- **Extern**

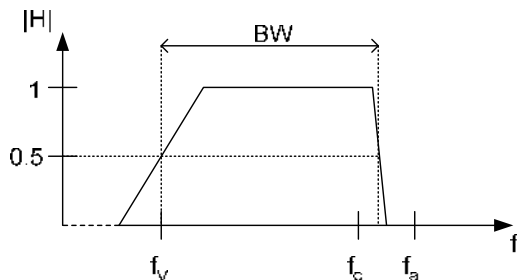
Triggering via a TTL signal at the input connector **EXT TRIG / GATE IN** on the rear panel.

- **TV Trigger** (option TV Trigger, B6)

Option TV Trigger, B6, is available from firmware version 1.10 for triggering on TV signals.

In order to display different sections of a TV video signal, the R&S FSL derives several trigger signals from the video signals. This allows triggering as well on the frame repetition as on each line of the TV video signal.

The filter bandwidth is constant: 4.0 MHz for standards with 525 lines or 5.0 MHz for standards with 625 lines. The position of the filter is determined by the firmware in order to place the 3 dB filter bandwidth on the center frequency, as shown in the diagram below. For the center frequency, the value of the vision carrier frequency should be set.



fv = vision carrier frequency

fa = aural carrier frequency

fc = chrominance sub-carrier frequency

BW = –3dB filter bandwidth

Fig. 4–4: 3 dB Filter bandwidth (option TV Trigger, B6, available from firmware version 1.10)

Softkeys of the trigger menu

The following table shows all softkeys available in the trigger menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|-----------------------------|-----------------------------|
| Trg / Gate Source | |
| Trg / Gate Level | |
| Trg / Gate Polarity Pos/Neg | |
| Trigger Offset | |
| Gated Trigger | |
| Gate Settings ↓ | Gate Mode Lvl/Edge |
| | Gate Delay |
| | Gate Length |
| | Trg / Gate Source |
| | Trg / Gate Level |
| | Trg / Gate Polarity Pos/Neg |
| | Sweep Time |
| TV Trig Settings | Vert Sync |
| | Vert Sync Odd Field |
| | Vert Sync Even Field |
| | Hor Sync |
| | Video Pol Pos/Neg |
| | Lines 625/525 |

Trg / Gate Source

Opens the **Trigger / Gate Source** dialog box to select the trigger / gate mode. For detailed information on trigger modes see "[Trigger mode overview](#)" on page 4.26.

The gate-related settings are only available with option Gated Sweep, R&S FSL-B8. As gate modes, all modes apart from the TV Trigger mode (option TV Trigger, B6, available from firmware version 1.10) are available. For details see also "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

The default setting is **Free Run**. If a trigger mode other than **Free Run** has been set, the enhancement label **TRG** is displayed.

- Remote: TRIG:SOUR IMM | VID | IFP | EXT | TV (Free Run, Video, IF Power, Extern, TV Trigger)
- Remote: SWE:EGAT:SOUR EXT (Extern)

Trg / Gate Level

Opens an edit dialog box to enter the trigger / gate level. The gate-related settings are only available with option Gated Sweep, R&S FSL-B8. For details see also "[Trigger mode overview](#)" on page 4.26 and "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

- Remote: TRIG:LEV:VID 50PCT
- Remote: TRIG:LEV:IFP -20DBM

Trg / Gate Polarity Pos/Neg

Sets the polarity of the trigger / gate source. The gate-related settings are only available with option Gated Sweep, R&S FSL-B8.

The sweep starts after a positive or negative edge of the trigger signal. The default setting is **Pos**. The setting applies to all modes with the exception of the **Free Run** mode.

| | |
|------------------|---|
| level triggering | In the setting Pos the sweep is stopped by the logic '0' signal and restarted by the logical '1' signal after the gate delay time has elapsed. |
| edge triggering | The sweep is continued on a '0' to '1' transition for the gate length duration after the gate delay time has elapsed. |

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

- Remote: TRIG:SLOP POS
- Remote: SWE:EGAT:POL POS

Trigger Offset

Opens an edit dialog box to enter the time offset between the trigger signal and the start of the sweep. The time may be entered in multiples of 125 ns in the range -100 s to 100 s (default 0 s).

- offset > 0: start of the sweep is delayed
- offset < 0: sweep starts earlier (pre-trigger)
 - only possible for span = 0 and gated trigger switched off
 - not possible when RMS or average detector activated
 - maximum allowed range and the maximum resolution limited by the sweep time:

$$range_{max} = - 499/500 \times sweep\ time$$

$$resolution_{max} = sweep\ time/500$$

Note: For the option TV Trigger, B6 (available from firmware version 1.10), the allowed offset ranges from -50 μs to +50 μs. If the trigger source is changed to TV trigger and the set trigger offset is out of range, the trigger offset is adopted to the closest value allowed.

In the **External** or **IF Power** trigger mode, a common input signal is used for both trigger and gate. Therefore changes to the gate delay will affect the trigger delay (trigger offset) as well.

- Remote: TRIG:HOLD 10US

Gated Trigger (option Gated Sweep, B8)

Switches the sweep mode with gate on or off .

This softkey requires the **External** or **IF Power** trigger mode. If a different mode is active, the **IF Power** trigger mode is automatically selected.

When the gate is switched on, a gate signal applied to the rear panel connector EXT TRIGGER/GATE or the internal IF power detector controls the sweep of the analyzer.

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

- Remote: SWE:EGAT ON
- Remote: SWE:EGAT:SOUR IFP | EXT

Gate Settings (option Gated Sweep, B8)

Opens a submenu to make all the settings required for gated sweep operation.

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

Gate Mode Lvl/Edge (option Gated Sweep, B8)

Sets the gate mode. As settings level-triggered or edge-triggered gate mode can be selected.

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

→ Remote: SWE:EGAT:TYPE EDGE

Gate Delay (option Gated Sweep, B8)

Opens an edit dialog box to enter the gate delay time between the gate signal and the continuation of the sweep. Values between 125 ns and 100 s are allowed. The delay position on the time axis in relation to the sweep is indicated by a line labeled **GD**.

This is useful for e.g. taking into account a delay between the gate signal and the stabilization of an RF carrier.

As a common input signal is used for both trigger and gate when selecting the **External** or **IF Power** trigger mode, changes to the gate delay will affect the trigger delay (trigger offset) as well.

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

→ Remote: SWE:EGAT:HOLD 1US

Gate Length (Gate Mode Edge)

Opens an edit dialog box to enter the gate length. Values between 125 ns and 100 s are allowed. The gate length in relation to the sweep is indicated by a line labeled **GL**.

The length of the gate signal defines when the sweep is to be interrupted. Only in the edge-triggered mode the gate length can be set, while in the level-triggered the gate length depends on the length of the gate signal.

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

→ Remote: SWE:EGAT:LENG 100US

Sweep Time (option Gated Sweep, B8)

Opens an edit dialog box to change the sweep time in order to obtain a higher resolution for positioning gate delay and gate length. When quitting the **Gate Settings** submenu, the original sweep time is retrieved.

For details also see "[To use gated sweep operation \(option Gated Sweep, B8\)](#)" on page 4.23.

TV Trig Settings (zero span and option TV Trigger, B6)

Switches the TV trigger on and opens a submenu to configure the TV signal parameters.

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:SOUR TV

Vert Sync (zero span and option TV Trigger, B6)

Sets the trigger on the vertical sync signal. The R&S FSL triggers on the frame repetition signal without distinction between the two fields.

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:VID:FIEL:SEL ALL

Vert Sync Odd Field (zero span and option TV Trigger, B6)

Sets the trigger on the vertical sync signal of the first field.

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:VID:FIEL:SEL ODD

Vert Sync Even Field (zero span and option TV Trigger, B6)

Sets the trigger on the vertical sync signal of the second field.

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:VID:FIEL:SEL EVEN

Hor Sync (zero span and option TV Trigger, B6)

Sets the trigger on the horizontal sync signal and opens an edit dialog box to enter the corresponding line. Depending on the selected line system (for details see **Lines 625/525** softkey), values from 1 to 525 or 1 to 625 are allowed. If the range is exceeded, the maximum possible line number will be set.

The default setting is 17, which is used to trigger according to CCIR 473–4 on test line 17.

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:VID:LINE:NUM 17

Video Pol Pos/Neg (zero span and option TV Trigger, B6)

Sets the polarity of the video signal. Default setting is **Neg**.

Positive video polarity is to be selected e.g. for standard L signals, negative video polarity for signals according to the standards B/G/I/M (color standard PAL or NTSC).

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:VID:SSIG:POL NEG

Lines 625/525 (zero span and option TV Trigger, B6)

Sets the line system to be used. Default setting is 625 lines.

Option TV Trigger, B6, is available from firmware version 1.10.

→ Remote: TRIG:VID:FORM:LPFR 625

Setting Traces – TRACE Key

The **TRACE** key is used to configure the data acquisition for measurement and the analysis of the measurement data.

The R&S FSL is capable of displaying up to four different traces at a time in a diagram. A trace consists of a maximum of 501 measurement points on the horizontal axis (frequency or time). If more measured values than measurement points are available, several measured values are combined in one measurement point.

The trace functions are subdivided as follows:

- Display mode of trace (**Clear Write**, **View** and **Blank**). For details on trace modes see "[Trace mode overview](#)" on page 4.32.
- Evaluation of the trace as a whole (**Average**, **Max Hold** and **Min Hold**). For details on trace modes see "[Trace mode overview](#)" on page 4.32. For details on averaging see "[Description of the averaging method](#)" on page 4.33.
- Evaluation of individual measurement points of a trace. For details on detectors see "[Detector overview](#)" on page 4.33.

To open the trace menu

- Press the **TRACE** key.

The trace menu is displayed. The **Trace Configuration** dialog box is displayed.

Menu and softkey description

- "[Softkeys of the trace menu](#)" on page 4.34

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- "[Trace mode overview](#)" on page 4.32
- "[Detector overview](#)" on page 4.33
- "[Description of the averaging method](#)" on page 4.33
- "[ASCII file export file format](#)" on page 4.37

Task

- [To specify the trace settings](#)

To specify the trace settings

1. Press the **Trace 1 2 3 4** softkey to select the trace.
2. Press the **Trace Mode** softkey to select the trace mode for the selected trace (for details see "[Trace mode overview](#)" on page 4.32).
3. Press the **Detector Auto Select** softkey for automatic detector selection or press the **Detector Manual Select** softkey to select a detector (for details see "[Detector overview](#)" on page 4.33).
4. To change the sweep count setting, which also determines trace averaging, press the **Sweep Count** softkey.

5. To deactivate the reset of the traces in Min Hold and Max Hold mode after some specific parameter changes, press the **Hold/Cont** softkey.
6. To copy a trace into another trace memory, press the **Copy Trace** softkey.
Upon copying, the contents of the selected memory are overwritten and the new contents are displayed in the **View** mode.
7. To export the active trace in ASCII format:
 - Press the **More** softkey.
 - If necessary, press the **Decim Sep** softkey to change the decimal separator with floating–point numerals.
 - Press the **ASCII File Export** softkey to enter the ASCII file export name.The active trace is saved in ASCII format on a floppy disk.

Trace mode overview

The traces can individually be activated for a measurement or frozen after completion of a measurement. Traces that are not activated are hidden. Each time the trace mode is changed, the selected trace memory is cleared.

The R&S FSL offers 6 different trace modes:

- **Clear Write**

Overwrite mode: the trace is overwritten by each sweep. All available detectors can be selected. This is the default setting.

- **Max Hold**

The maximum value is determined over several sweeps and displayed. The R&S FSL saves the sweep result in the trace memory only if the new value is greater than the previous one. The detector is automatically set to **Positive Peak**.

This mode is especially useful with modulated or pulsed signals. The signal spectrum is filled up upon each sweep until all signal components are detected in a kind of envelope.

- **Min Hold**

The minimum value is determined from several measurements and displayed. The R&S FSL saves for each sweep the smallest of the previously stored/currently measured values in the trace memory. The detector is automatically set to **Negative Peak**.

This mode is useful e.g. for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed whereas a CW signal is recognized by its constant level.

- **Average**

The average is formed over several sweeps. All available detectors can be selected. If the detector is automatically selected, the sample detector is used. For details see also "[Description of the averaging method](#)" on page 4.33.

- **View**

The current contents of the trace memory is frozen and displayed.

If a trace is frozen, the instrument settings, apart from level range and reference level (see below), can be changed without impact on the displayed trace. The fact that the trace and the current instrument setting do not correspond any more is indicated by the enhancement label "*" at the left edge of the grid.

If level range or reference level are changed, the R&S FSL automatically adapts the measured data to the changed display range. This allows an amplitude zoom to be made after the measurement in order to show details of the trace.

- **Blank**

Hides the selected trace.

Description of the averaging method

Averaging is carried out over the measurement points derived from the measurement samples. Several measured values may be combined in a measurement point. This means that with linear level display the average is formed over linear amplitude values. The settings continuous or single sweep (for details see "[Configuring the Sweep Mode – SWEEP Key](#)" on page 4.20) and running averaging apply to the average display analogously.

There are two methods for calculating the average. For a sweep count = 0 , a continuous average is calculated according to the following formula:

$$TRACE = \frac{9 * TRACE + meas. value}{10}$$

Due to the weighting between the new measured value and the trace average, past values have practically no influence on the displayed trace after about ten sweeps. With this setting, signal noise is effectively reduced without need for restarting the averaging process after a change of the signal.

If the sweep count is >1, averaging takes place over the selected number of sweeps. In this case the displayed trace is calculated during averaging according to the following formula:

$$Trace_n = \frac{1}{n} \left[\sum_{i=1}^{n-1} (T_i) + meas. value_n \right]$$

where n is the number of the current sweep. No averaging is carried out for the first sweep but the measured value is stored in the trace memory. With increasing n, the displayed trace is increasingly smoothed since there are more single sweeps for averaging.

After the selected number of sweeps the average trace is saved in the trace memory. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, i.e. when the averaging length defined by sweep count is attained, continuous averaging is resumed with continuous sweep . The display "Sweep N of N" does not change any more until a new start is triggered. The displayed trace is calculated according to the following formula:

$$Trace = \frac{(N - 1) \cdot Trace_{old} + meas. value}{N}$$

with *Trace*: new; *Trace_{old}*: old trace; *N*: sweep count

The same holds true for single sweep operation if the **Continue Single Sweep** softkey is pressed.

In the single sweep mode, a specific number of sweeps is set. The sweeps are stopped when the selected number of sweeps is attained. The number of the current sweep and the total number of sweeps are shown on the display: "Sweep 3 of 200".

Detector overview

The measurement detector for the individual display modes can be selected directly by the user or set automatically by R&S FSL. The detector activated for the specific trace is identified in the respective trace display field in form of an abbreviation (for details see detector list).

The detectors of the R&S FSL are implemented as pure digital devices. They collect signal power data within each measured point during a sweep. The default number of sweep points is 501. The following detectors are available:

| Detector | Indicator | Function |
|---|-----------|---|
| peak detector (Positive Peak) | Pk | determines the maximum value within a measurement point |
| min peak detector (Negative Peak) | Mi | determines the minimum value within a measurement point |
| RMS detector (RMS) | Rm | determines the root mean square power within a measurement point |
| average detector (Average) | Av | determines the linear average power within a measurement point |
| sample detector (Sample) | Sa | selects a random value within a measurement point |
| quasi peak detector (Quasi Peak) | QP | determines the quasipeak power within a measurement point for EMI measurements (available from firmware version 1.10) |

The result obtained from the selected detector within a measurement point is displayed as the power value at this measurement point.

All detectors work in parallel in the background, which means that the measurement speed is independent of the detector combination used for different traces.

Note: During a frequency sweep, R&S FSL increments the 1st local oscillator in steps that are smaller than approximately 1/10 of the bandwidth. This makes sure that the oscillator step speed is conforming to the hardware settling times and does not affect the precision of the measured power.

The number of measurement points taken during a sweep is independent of the number of oscillator steps. It is always selected as a multiple or a fraction of 501 (= default number of trace points displayed on the screen). Choosing less than 501 measurement points (e.g. 125 or 251) will lead to an interpolated measurement curve, choosing more than 501 points (e.g. 1001, 2001 ...) will result in several measurement points being overlaid at the same frequency position.

Softkeys of the trace menu

The following table shows all softkeys available in the trace menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Command |
|------------------------|
| Trace 1 2 3 4 |
| Trace Mode |
| Detector Auto Select |
| Detector Manual Select |
| Sweep Count |
| Hold/Cont |
| More ↓ |
| Trace 1 2 3 4 |

| |
|-------------------|
| Command |
| Copy Trace |
| ASCII File Export |
| Decim Sep |

Trace 1 2 3 4

Selects the active trace (1, 2, 3, 4). The default setting is trace 1 in the overwrite mode (see **Clear Write** mode), the other traces are switched off (see **Blank** mode).

→ Remote: (selected via numeric suffix of :TRACe<1 . . . 4>)

Trace Mode

Opens the dialog box **Trace Mode** to select the trace mode. For details see "[Trace mode overview](#)" on page 4.32.

→ Remote: DISP:WIND:TRAC:MODE WRIT | MAXH | MINH | AVER | VIEW (Clear Write, Max Hold, Min Hold, Average, View)

→ Remote: DISP:WIND:TRAC OFF (Blank)

Detector Auto Select

Selects the optimum detector for the selected trace and filter mode. This is the default setting. For details see also "[Detector overview](#)" on page 4.33.

| Trace mode | Detector (band-pass filter) | Detector (FFT filter) |
|-------------|-----------------------------|-----------------------|
| Clear/Write | Auto Peak | Max Peak |
| Average | Sample | Sample |
| Max Hold | Max Peak | Max Peak |
| Min Hold | Min Peak | Max Peak |

→ Remote: DET:AUTO ON

Detector Manual Select

Opens the dialog box **Detector** to select the detector. For details see "[Detector overview](#)" on page 4.33.

→ Remote: DET APE | POS | NEG | RMS | AVER | SAMP | QPE (Auto Peak, Max Peak, Min Peak, RMS, AVG, Sample, Quasi Peak)

Sweep Count

Opens an edit dialog box to enter the number of sweeps used for averaging. Values from 0 to 32767 are allowed. The default setting is 0. The sweep count is applied to all the traces in a diagram. The sweep count set in the trace menu is the same as that in the sweep menu (see **Sweep Count** softkey).

In the continuous sweep mode, the sweep count value determines the trace averaging:

- sweep count = 0: continuous averaging
- sweep count = 1: no averaging
- sweep count > 1: averaging over the selected number of sweeps; in the continuous sweep mode averaging is performed until the set number of sweeps is attained and is then continued as continuous averaging (see also "[Description of the averaging method](#)" on page 4.33).

→ Remote: SWE: COUN 64

Hold/Cont

Switches on or off the reset of the traces in Min Hold, Max Hold and Average mode after some specific parameter changes have been made. The default setting is off.

Normally, the measurement is started anew after parameter changes, before the measurement results are evaluated (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

→ Remote: DISP: WIND: TRAC: MODE: HCON ON

Copy Trace

Opens an edit dialog box to enter the number of the trace memory, in which the currently selected trace shall be copied.

→ Remote: TRAC: COPY TRACE1, TRACE2

ASCII File Export

Opens an edit dialog box to enter the ASCII File Export Name and saves the active trace in ASCII format on a floppy disk.

The file consists of the header containing important scaling parameters and a data section containing the trace data. For details on an ASCII file see "[ASCII file export file format](#)" on page 4.37.

This format can be processed by spreadsheet calculation programs, e.g. MS–Excel. It is necessary to define ';' as a separator for the data import. Different language versions of evaluation programs may require a different handling of the decimal point. It is therefore possible to select between separators '.' (decimal point) and ',' (comma) using the **Decim Sep** softkey.

→ Remote: FORM ASC

→ Remote: MMEM: STOR: TRAC 1, 'TRACE.DAT'

Decim Sep

Selects the decimal separator with floating–point numerals for the ASCII file export to support evaluation programs (e.g. MS–Excel) in different languages. The values '.' (decimal point) and ',' (comma) can be set. For details see also **ASCII File Export** softkey.

→ Remote: FORM: DEXP: DSEP POIN

ASCII file export file format

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the keyword "Trace <n>" (<n> = number of stored trace), followed by the measured data in one or several columns (depending on measurement) which are also separated by a semicolon.

| File contents: header | Description |
|---|---|
| Type;FSL; Version;1.00; Date;01.Jul 2004; Mode;Spectrum; Center Freq;55000;Hz Freq Offset;0;Hz Span;90000;Hz x–Axis;LIN; Start;10000;Hz Stop;100000;Hz Ref.Level;–30;dBm Level Offset;0;dB Ref Position;75;% y–Axis;LOG; Level Range;100;dB RF Att;20;dB RBW;100000;Hz VBW;30000;Hz SWT;0.005;s Trace Mode;AVERAGE; Detector;SAMPLE; Sweep Count;20; | Instrument model Firmware version Date of data set storage Instrument mode Center frequency Frequency offset Frequency range (0 Hz in zero span and statistics measurements) Scaling of x axis linear (LIN) or logarithmic (LOG) Start/stop of the display range. Unit: Hz for span > 0, s for span = 0, dBm/dB for statistics measurements Reference level Level offset Position of reference level referred to diagram limits (0% = lower edge) Scaling of y axis linear (LIN) or logarithmic (LOG) Display range in y direction. Unit: dB with x axis LOG, % with x axis LIN Input attenuation Resolution bandwidth Video bandwidth Sweep time Display mode of trace: CLR/WRITE,AVERAGE,MAXHOLD,MINHOLD Detector set: AUTOPEAK,MAXPEAK,MINPEAK,AVERAGE, RMS,SAMPLE,QUASISPEAK Number of sweeps set |
| File contents: data section of the file | Description |
| Trace 1;; x–Unit;Hz; y–Unit;dBm; | Selected trace Unit of x values: Hz with span > 0; s with span = 0; dBm/dB with statistics measurements Unit of y values: |

| File contents: header | Description |
|--|--|
| <p>Values; 501;</p> <p>10000;-10.3;-15.7</p> <p>10180;-11.5;-16.9</p> <p>10360;-12.0;-17.4</p> <p>...;...;</p> | <p>dB*/V/A/W depending on the selected unit with y axis LOG or % with y axis LIN</p> <p>Number of measurement points</p> <p>Measured values: <x value>, <y1>, <y2></p> <p><y2> being available only with detector AUTOPEAK and containing in this case the smallest of the two measured values for a measurement point.</p> |

Measurement Functions

In this section all menus necessary for setting measurement functions are described. This includes the following topics and keys:

- ["Using Markers and Delta Markers – MKR Key"](#) on page 4.40
- ["Changing Settings via Markers – MKR-> Key"](#) on page 4.49
- ["Power Measurements – MEAS Key"](#) on page 4.56
- ["Using Limit Lines and Display Lines – LINES Key"](#) on page 4.76

Using Markers and Delta Markers – MKR Key

The markers are used for marking points on traces, reading out measurement results and for quickly selecting a display section. The R&S FSL provides four markers per display window.

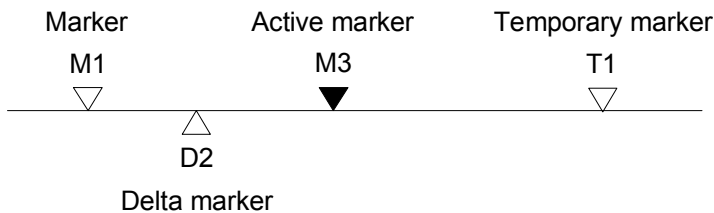


Fig. 4–5: Marker types

All markers can be used either as markers or delta markers. The marker that can be moved by the user is defined in the following as the active marker. Temporary markers are used in addition to the markers and delta markers to evaluate the measurement results. They disappear when the associated function is deactivated.

The measurement results of the active marker (also called marker values) are displayed in the marker field. The marker field at the upper right corner of the display shows the marker location (here, frequency), the level and the currently selected trace [1].

```
M1[T1]          -33.09 dBm
                3.000000000 GHz
```

Fig. 4–6: Marker values

The **MKR** key is used to select and position the absolute and relative measurement markers (markers and delta markers). In addition, the functions for frequency counter, fixed reference point for relative measurement markers and enlargement of the measurement area are assigned to this key.

Also the following measurements can be carried out:

- Noise density (**Noise Meas On/Off** softkey; see also "[Measurement of noise density](#)" on page 4.42)
- Frequency measurement (**Sig Count On/Off** softkey; see also "[Frequency measurement with the frequency counter](#)" on page 4.42)
- Filter or signal bandwidth (**n dB down** softkey)
- AF demodulation (**Marker Demod** softkey; see also "[AF demodulation](#)" on page 4.42)

For further information on markers see also "[Changing Settings via Markers – MKR→ Key](#)" on page 4.49.

To open the marker menu

- Press the **MKR** key.

The marker menu is displayed. If no marker is active, marker 1 will be activated and a peak search on the trace carried out. Otherwise, the edit dialog box for the last activated marker is opened and the current frequency / time value is displayed.

Menu and softkey description

- "[Softkeys of the marker menu](#)" on page 4.43

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- ["AF demodulation"](#) on page 4.42
- ["Frequency measurement with the frequency counter"](#) on page 4.42
- ["Measurement of noise density"](#) on page 4.42

Tasks

- [To define the basic marker settings](#)
- [To set a fixed reference point \(phase noise measurement\)](#)
- [To set the demodulation mode and duration](#)

To define the basic marker settings

1. Press the **MKR** key to open the marker menu.

Marker 1 is activated and positioned on the maximum value of the trace as normal marker. When several traces are being displayed, the marker is set to the maximum value (peak) of the trace which has the lowest number (1 to 3) and is not frozen (View mode). In case a marker is already located there, it will be set to the frequency of the next lowest level (next peak).

2. To change to another trace, press the **Marker to Trace** softkey and enter the number of the trace on which the marker is to be placed.

The marker changes to selected trace, but remains on the previous frequency or time. If a trace is turned off, the corresponding markers and marker functions are also deactivated.

3. To switch on a delta marker, press the **Marker 2** softkey.

Marker 2 is switched on as a delta marker. The frequency and level of marker 2 are displayed in relation to marker 1 in the marker field.

4. To change the marker type of marker 2, press the **Marker Norm/Delta** softkey.

Marker 2 becomes a normal marker. The frequency and level of marker 2 are displayed as absolute values in the marker field.

5. To switch off marker 2, press the **Marker 2** softkey again.

Marker 2 is deactivated. Marker 1 becomes the active marker for entry. The frequency and level of marker 1 are displayed in the marker field.

To set a fixed reference point (phase noise measurement)

1. Press the **Phase Noise/Ref Fixed** softkey.

The submenu with the **Phase Noise On/Off** softkey switched on is displayed. The level and frequency or time values of marker 1 immediately become the reference point.

2. To set the maximum of the selected trace as reference point, press the **Peak Search** softkey.

3. To define the values for the reference point, proceed as follows:

- Press the **Ref Point Level** softkey and enter a reference level value.
- If span > 0, press the **Ref Point Frequency** softkey and enter a frequency reference value.
- If span = 0, press the **Ref Point Time** softkey and enter a reference time value.

To set the demodulation mode and duration

1. Press the **Marker Demod** softkey.
The submenu with the **Mkr Demod On/Off** softkey switched on is displayed.
2. To change the demodulation mode, press the **AM** or **FM** softkey.
For details see "[AF demodulation](#)" on page 4.42.
3. To modify the demodulation time for span > 0, press the **Mkr Stop Time** softkey.
4. To change to continuous demodulation for span > 0, press the **Cont Demod** softkey.
5. To tune the volume for acoustic monitoring, press the **Volume** softkey.

AF demodulation

The R&S FSL provides demodulators for AM and FM signals. With these demodulators, a displayed signal can be identified acoustically by using headphones.



CAUTION

Check the volume setting carefully before putting on the headphones in order to protect your hearing.

When span > 0, the demodulation is not continuous. The frequency at which the demodulation takes place is set by the active marker. If the level of the selected frequency is above the threshold line, the sweep stops for the selected time (stop time) and the RF signal is demodulated. When span = 0, the demodulation is continuously active irrespective of the stop time set.

Frequency measurement with the frequency counter

In order to accurately determine the frequency of a signal, the R&S FSL is equipped with a frequency counter which measures the frequency of the RF signal at the intermediate frequency. Using the measured IF, the R&S FSL calculates the frequency of the RF input signal by applying the known frequency conversion factors.

The frequency measurement uncertainty depends only upon the accuracy of the frequency reference used (external or internal reference). Although the R&S FSL always operates synchronously irrespective of the set span, the frequency counter delivers a more exact result than a measurement performed with a marker. This is due to the following:

- The marker measures only the position of the point on the trace and infers from this value the signal frequency. The trace, however, contains only a limited number of points. Depending upon the selected span, each point may contain many measurement values, which therefore limits the frequency resolution.
- The resolution, with which the frequency can be measured with a marker, is dependant on the selected resolution bandwidth which in return affects the necessary measurement time. For this reason, the bandwidth is normally made as wide as possible and the sweep time as short as possible. This results in a loss of frequency resolution. For the measurement with the frequency counter, the sweep is stopped at the reference marker, the frequency is counted with the desired resolution and then the sweep is allowed to continue.

Measurement of noise density

During noise measurement, the noise power density is measured at the position of the marker. When span = 0, all points of the trace are used to determine the noise power density. When span > 0, two points to the right and left of the marker are used for the measurement to obtain a stable result.

The noise power density is indicated in the marker field. With logarithmic amplitude units (dBm, dBmV, dBm μ V, dB μ A), the noise power density is output in dBm/Hz, i.e. as level in 1 Hz bandwidth with reference to 1 mW. With linear amplitude units (V, A, W), the noise voltage density is evaluated in μ V/Hz, the noise current density in μ A/Hz or the noise power density in μ W/Hz.

In the default setting, the R&S FSL uses the sample detector for the noise function.

With the sample detector, the trace can additionally be set to AVERAGE to stabilize the measured values. With RMS detector used, trace averaging must not be used since in this case it produces too low noise levels which cannot be corrected. Instead, the sweep time can be increased to obtain stable measurement results.

The following settings have to be made to ensure that the power density measurement yields correct values:

- Detector: Sample or RMS
- Video bandwidth:
 - ≤ 0.1 resolution bandwidth with sample detector
 - ≥ 3 x resolution bandwidth with RMS detector
- Trace averaging:

With the sample detector, the trace can additionally be set to average to stabilize the measured values. With RMS detector used, trace averaging must not be used since in this case it produces too low noise levels which cannot be corrected. Instead, the sweep time can be increased to obtain stable measurement results.

The R&S FSL uses the following correction factors to evaluate the noise density from the marker level:

- Since the noise power is indicated with reference to 1 Hz bandwidth, the bandwidth correction value is deducted from the marker level. It is $10 \times \lg(1 \text{ Hz}/\text{BWNoise})$, where BWNoise is the noise or power bandwidth of the set resolution filter (RBW).
- RMS detector: With the exception of bandwidth correction, no further corrections are required since this detector already indicates the power with every point of the trace.
- Sample detector: As a result of video filter averaging and trace averaging, 1.05 dB is added to the marker level. This is the difference between the average value and the RMS value of white noise. With a logarithmic level axis, 1.45 dB is added additionally. Logarithmic averaging is thus fully taken into account which yields a value that is 1.45 dB lower than that of linear averaging.
- To allow a more stable noise display the adjacent (symmetric to the measurement frequency) points of the trace are averaged.
- When span > 0, the measured values are averaged versus time (after a sweep).

Note: The R&S FSL noise figure can be calculated from the measured power density level. It is calculated by deducting the set RF attenuation (RF Att) from the displayed noise level and adding 174 to the result.

Softkeys of the marker menu

The following table shows all softkeys available in the marker menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Submenu / Command | Command |
|-------------------------|--|--|
| Marker 1 | | |
| Marker 2 | | |
| Marker Norm/Delta | | |
| Noise Meas On/Off | | |
| Phase Noise/Ref Fixed ↓ | Phase Noise On/Off | |
| | Ref Point Level | |
| | Ref Point Frequency/ Ref Point Time | |
| | Peak Search | |
| | Phase Noise 1 2 3 4 Δ | |
| | Reference Fixed | Reference Fixed On/Off |
| | | Ref Point Level |
| | | Ref Point Frequency/ Ref Point Time |
| | | Peak Search |
| Sig Count On/Off | | |
| More ↓ | | |
| Marker 3 | | |
| Marker 4 | | |
| Marker to Trace | | |
| Marker Demod ↓ | Mkr Demod On/Off | |
| | AM | |
| | FM | |
| | Mkr Stop Time | |
| | Cont Demod | |
| | Volume | |
| n dB down | | |
| Marker Zoom | | |
| All Marker Off | | |

Marker 1/Marker 2/Marker 3/Marker 4Marker Norm/Delta

The **Marker <no>** softkey activates the corresponding marker and opens an edit dialog box to enter a value for the marker to be set to. Pressing the softkey again deactivates the selected marker.

Marker 1 is always the reference marker for relative measurements. If activated, markers 2 to 4 are delta markers that refer to marker 1. These markers can be converted into markers with absolute value display by means of the **Marker Norm/Delta** softkey. When marker 1 is the active marker, pressing the **Marker Norm/Delta** softkey switches on an additional delta marker.

- Remote: CALC:MARK ON
 - Remote: CALC:MARK:X <value>
 - Remote: CALC:MARK:Y?
 - Remote: CALC:DELT ON
 - Remote: CALC:DELT:X <value>
 - Remote: CALC:DELT:X:REL?
 - Remote: CALC:DELT:Y?
-

Noise Meas On/Off

Switches the noise measurement for the active marker on or off. The corresponding marker becomes the normal marker. For more details on noise measurement see "[Measurement of noise density](#)" on page 4.42.

- Remote: CALC:MARK:FUNC:NOIS ON
 - Remote: CALC:MARK:FUNC:NOIS:RES?
-

Phase Noise/Ref Fixed

The function of this softkey depends on the setting of the **Noise Meas** softkey:

- **Noise Meas On:** activates phase noise measurements.
 - **Noise Meas Off:** freezes the current position of marker 1 as a reference for relative measurements. Additionally it opens a submenu to set all values of a reference point. Instead of using the current values of the reference marker (marker 1) as reference point for the delta markers, level and frequency or time are set to fixed values and used as reference point.
-

Phase Noise On/Off

Switches the relative measurement to a fixed reference value on or off. The level and frequency or time values of marker 1 immediately become the reference point, but can be altered using the corresponding softkeys (**Ref Point Level**, **Ref Point Frequency**, **Ref Point Time** and **Peak Search**).

- Remote: CALC:DELT2:FUNC:FIX ON
-

Ref Point Level

Opens an edit dialog box to enter a reference level value. All relative level values of the delta markers refer to this reference level.

- Remote: CALC:DELT2:FUNC:FIX:RPO:Y -10dBm
-

Ref Point Frequency (span > 0) / Ref Point Time (zero span)

Opens an edit dialog box to enter a frequency reference or time value. All relative frequency or time values of the delta markers refer to this frequency reference. For phase noise measurement, input of reference time is not possible..

- Remote: CALC:DELT2:FUNC:FIX:RPO:X 10.7MHz
- Remote: CALC:DELT2:FUNC:FIX:RPO:X 5MS

Peak Search

Sets the maximum value of the selected trace as the reference point.

- Remote: CALC:DELT:FUNC:FIX:RPO:MAX

Phase Noise 1 2 3 4 Δ

Selects the normal marker or the delta markers, activates the marker and opens an edit dialog box to enter a value for the marker to be set to. Δ stands for delta marker 1.

Reference Fixed

Opens a submenu for relative measurement to a fixed reference value.

Reference Fixed On/Off

Switches the relative measurement to a fixed reference value on or off. The level and frequency or time values of marker 1 immediately become the reference point, but can be altered using the corresponding softkeys (**Ref Point Level**, **Ref Point Frequency**, **Ref Point Time** and **Peak Search**).

- Remote: CALC:DELT2:FUNC:FIX ON

Sig Count On/Off

Switches the frequency counter on/off. The frequency is counted at the position of the reference marker (marker 1). If no marker is activated, marker 1 is switched on and set at the largest signal.

The sweep stops at the reference marker until the frequency counter has delivered a result. The result is displayed in the marker field (see "[Fig. 4–6: Marker values](#)" on page 4.40), labeled with [Tx CNT]. For more details see "[Frequency measurement with the frequency counter](#)" on page 4.42.

- Remote: CALC:MARK1:COUN ON
- Remote: CALC:MARK:COUN:FREQ?

Marker to Trace

Opens an edit dialog box to enter the number of the trace, on which the marker is to be placed.

- Remote: CALC:MARK1:TRAC 1
- Remote: CALC:DELT:TRAC 1

n dB down

Activates the temporary markers T1 and T2, and opens an edit dialog box to enter the value n. If a positive value is entered, the markers T1 and T2 are placed below the active reference marker. If a negative value (e.g. for notch filter measurements) is entered, the markers T1 and T2 are placed above the active reference marker. Marker T1 is placed to the left and marker T2 to the right of the reference marker. The default setting is 3 dB.

| Settings | Result displayed in marker field |
|---|--|
| span > 0 | frequency spacing of the two temporary markers |
| span = 0 | pulse width between the two temporary markers |
| not possible to form the frequency spacing for the n dB value (e.g. because of noise display) | dashes instead of a measured value |

- Remote: CALC:MARK1:FUNC:NDBD:STAT ON
- Remote: CALC:MARK1:FUNC:NDBD 3dB
- Remote: CALC:MARK1:FUNC:NDBD:RES?
- Remote: CALC:MARK1:FUNC:NDBD:FREQ? (span > 0)
- Remote: CALC:MARK1:FUNC:NDBD:TIME? (span = 0)

Marker Zoom (span > 0)

Opens an edit dialog box to enter a display range for the zoom. The area around marker 1 is expanded accordingly and more details of the spectrum can be seen. If no marker is activated, marker 1 is switched on and set at the largest signal..

The following sweep is stopped at the position of the reference marker. The frequency of the signal is counted and the measured frequency becomes the new center frequency. The zoomed display range is then configured and the new settings are used by the R&S FSL for further measurements.

As long as switching to the new frequency display range has not yet taken place, pressing the softkey will abort the procedure. If an instrument setting is changed while using this function, the procedure is aborted.

- Remote: CALC:MARK1:FUNC:ZOOM 1kHz

Marker Demod

Opens a submenu to set the demodulation mode and duration. For more details see also "[AF demodulation](#)" on page 4.42.

Mkr Demod On/Off

Switches the demodulation on/off. For more details see also "[AF demodulation](#)" on page 4.42.

- Remote: CALC:MARK1:FUNC:DEM ON

AM

Sets AM as demodulation mode. This is the default setting. For more details see also "[AF demodulation](#)" on page 4.42.

→ Remote: CALC:MARK1:FUNC:DEM:SEL AM

FM

Sets FM as demodulation mode. Default setting is AM. For more details see also "[AF demodulation](#)" on page 4.42.

→ Remote: CALC:MARK1:FUNC:DEM:SEL FM

Mkr Stop Time

Opens an edit dialog box to enter the demodulation stop time for span > 0. For more details see also "[AF demodulation](#)" on page 4.42.

→ Remote: CALC:MARK1:FUNC:DEM:HOLD 3s

Cont Demod (span > 0)

Switches the continuous demodulation on or off. If the sweep time is long enough, the set frequency range can be monitored acoustically. For more details see also "[AF demodulation](#)" on page 4.42.

→ Remote: CALC:MARK1:FUNC:DEM:CONT ON

Volume

Opens an edit dialog box to regulate the volume for acoustic monitoring. For more details see also "[AF demodulation](#)" on page 4.42.

→ Remote: SYST:SPE:VOL 0.5

All Marker Off

Switches all markers off.

→ Remote: CALC:MARK:AOFF

Changing Settings via Markers – MKR→ Key

The **MKR→** key is used for search functions of measurement markers, assignment of the marker frequency as center frequency, restriction of the search area and characterization of maxima and minima. For details on markers in general, see ["Using Markers and Delta Markers – MKR Key"](#) on page 4.40.

To open the marker→ menu

- Press the **MKR→** key.

The marker→ menu is displayed. If no marker is active, marker 1 will be activated and a peak search on the trace carried out. Otherwise, the edit dialog box for the last activated marker is opened and the current frequency / time value is displayed.

Menu and softkey description

- ["Softkeys of the marker→ menu"](#) on page 4.52

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- ["Effect of different peak excursion settings \(example\)"](#) on page 4.50

Tasks

- [To search for a maximum](#)
- [To search for a minimum](#)
- [To specify the search limits](#)
- [To specify the search range](#)
- [To examine a signal at the center in detail](#)
- [To specify the suitable peak excursion](#)

To search for a maximum

1. To search the highest maximum, press the **Peak** softkey.
2. To define the search mode for the next maximum, use the **Next Peak Mode < abs >** softkey.
3. To start the search, press **Next Peak** the softkey.

To search for a minimum

1. To search the minimum, press the **Min** softkey.
2. To define the search mode for the next maximum, use the **Next Min Mode < abs >** softkey.
3. To start the search, press the **Next Min** softkey.

To specify the search limits

1. To define the lower limit, press the **Left Limit** softkey.

2. To define the upper limit, press the **Right Limit** softkey.
3. To define the threshold, press the **Threshold** softkey.
4. To switch the search limits off, press the **Search Lim Off** softkey.

To specify the search range

- Press the **Exclude LO** softkey to include the frequency 0 Hz in the marker search functions.

To examine a signal at the center in detail

1. Press the **PRESET** key to set the R&S FSL to the default setting.
2. Press the **MKR→** key to open the marker→ menu.
3. Marker 1 is activated and set to the largest signal of the trace.
4. Press the **Center =Mkr Freq** softkey to set to the marker frequency.
5. The span is adapted in such a way that the minimum frequency (= 0 Hz) or the maximum frequency is not exceeded.
6. Press the **Ref Lvl =Mkr Lvl** softkey to set the reference level to the measured marker level.
7. Press the **SPAN** key.
8. The edit dialog box to enter a frequency span is displayed.
9. Reduce the span, e.g. using the rotary knob.

To specify the suitable peak excursion

1. If the next peak mode **abs** of softkey **Next Peak Mode < abs > / Next Min Mode < abs >** is used, the default value is sufficient, since, in this mode, the next lower maximum or next higher minimum will always be detected.
2. If the next peak mode **< or >** of softkey **Next Peak Mode < abs > / Next Min Mode < abs >** is used, the 6 dB level change set as a default value may be attained already by the inherent noise of the instrument. To avoid identifying noise peaks as maxima or minima, enter a peak excursion value that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Effect of different peak excursion settings (example)

The following figure shows a trace to be examined.

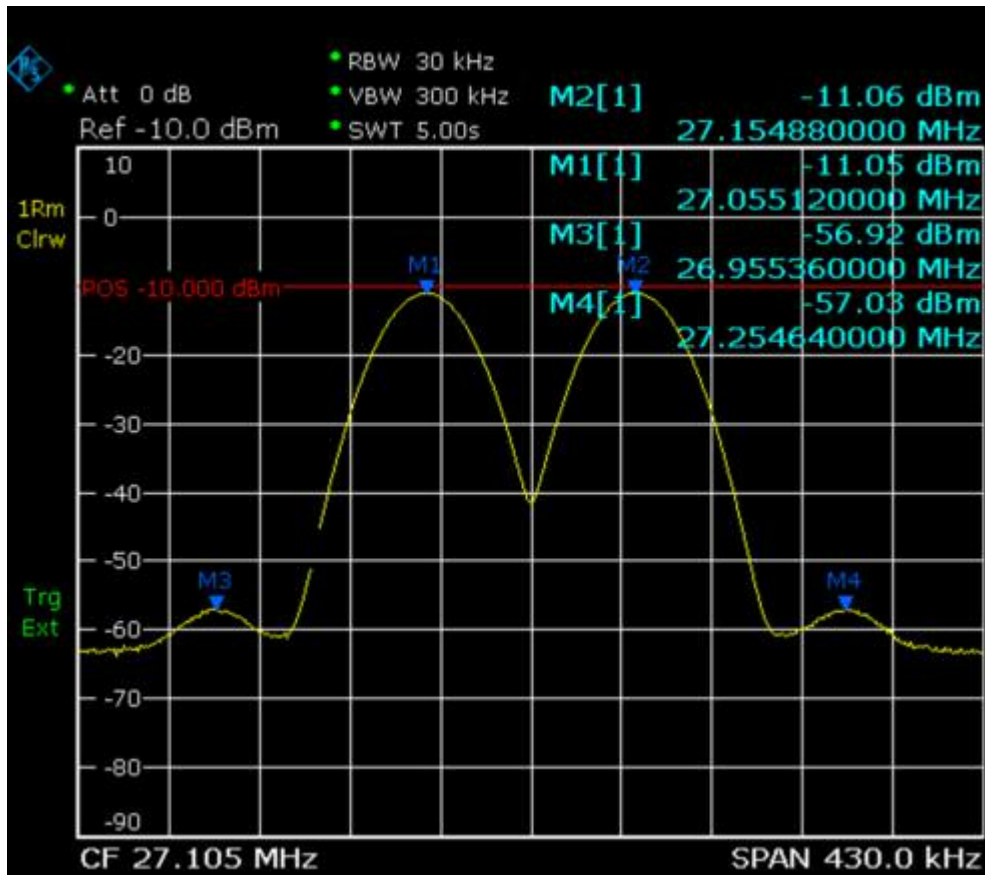


Fig. 4–7: Trace example

The following table lists the signals as indicated by the marker numbers in the diagram above, as well as the minimum of the amplitude decrease to both sides of the signal:

| signal # | min. amplitude decrease to both sides of the signal |
|----------|---|
| 1 | 30 dB |
| 2 | 29.85 dB |
| 3 | 7 dB |
| 4 | 7 dB |

The detected signals and their order are different depending on the peak excursion setting and the peak search method (whether the next lower maximum or the next relative maximum are searched). The following results are obtained. All tests start with the marker set to signal 1 by pressing the softkey **Peak**.

- 40 dB peak excursion

Result: With both methods apart from signal 1 no signal is detected, as the signal level does not decrease by more than 30 dB to either side of any signal.

| next lower maximum | next relative maximum |
|--|---|
| next peak mode abs : signal 1 (no further signal detected) | next peak mode < : signal 1 (no further signal detected) |
| | next peak mode > : signal 1 |

| next lower maximum | next relative maximum |
|--------------------|------------------------------|
| | (no further signal detected) |

- 20 dB peak excursion

Result: With both methods apart from signal 1 signal 2 is detected, as the signal level decreases at least by 29.85 dB to either side of this signal, which is now greater than the peak excursion.

| next lower maximum | next relative maximum |
|--|--|
| next peak mode abs : signal 2 | next peak mode <: signal 1 (no further signal detected) |
| next peak mode abs : signal 2 (no further signal detected) | next peak mode >: signal 2 |
| | next peak mode >: signal 2 (no further signal detected) |

- 6 dB peak excursion

Result: With both methods all signals are detected.

| next lower maximum | next relative maximum |
|--------------------------------------|----------------------------|
| next peak mode abs : signal 2 | next peak mode <: signal 3 |
| next peak mode abs : signal 3 | next peak mode >: signal 1 |
| next peak mode abs : signal 4 | next peak mode >: signal 2 |
| | next peak mode >: signal 4 |

Softkeys of the marker→ menu

The following table shows all softkeys available in the marker→ menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|------------------------|----------------|
| Select 1 2 3 4 Δ | |
| Peak | |
| Next Peak | |
| Next Peak Mode < abs > | |
| Center =Mkr Freq | |
| Ref Lvl =Mkr Lvl | |
| More ↓ | |
| Select 1 2 3 4 Δ | |
| Min | |
| Next Min | |
| Next Min Mode < abs > | |
| Search Limits ↓ | Left Limit |
| | Right Limit |
| | Threshold |
| | Search Lim Off |

| Menu / Command | Command |
|----------------|---------|
| Peak Excursion | |
| Exclude LO | |

Select 1 2 3 4 Δ

Selects the normal marker or the delta markers, activates the marker and opens an edit dialog box to enter a value for the marker to be set to. Δ stands for delta marker 1.

- Remote: CALC:MARK1 ON
- Remote: CALC:MARK1:X <value>
- Remote: CALC:MARK1:Y?

Peak

Sets the active marker/delta marker to the highest maximum of the trace.

- Remote: CALC:MARK:MAX
- Remote: CALC:DELT:MAX

Next Peak

Sets the active marker/delta marker to the next maximum of the selected trace according to the mode selected using the **Next Peak Mode < abs >** softkey.

- Remote: CALC:MARK:MAX:NEXT
- Remote: CALC:DELT:MAX:NEXT

Next Peak Mode < abs >

Selects the mode of the **Next Peak** softkey. Three settings are available:

- < Sets the active marker/delta marker to the next maximum left to the marker of the selected trace.
- abs Sets the active marker/delta marker to the next lower maximum of the selected trace.
- > Sets the active marker/delta marker to the next maximum right to the marker of the selected trace.

- Remote: CALC:MARK:MAX:RIGH
- Remote: CALC:DELT:MAX:RIGH

Center =Mkr Freq (span > 0)

Sets the center frequency to the current marker or delta marker frequency. A signal can thus be set to as center frequency, for example to examine it in detail with a smaller span.

Remote: CALC:MARK:FUNC:CENT

Ref Lvl =Mkr Lvl

Sets the reference level to the current marker level.

→ Remote: CALC:MARK:FUNC:REF

Min

Sets the active marker/delta marker to the minimum of the selected trace.

→ Remote: CALC:MARK:MIN

→ Remote: CALC:DELT:MIN

Next Min

Sets the active marker/delta marker to the next minimum of the selected trace according to the mode selected using the **Next Min Mode < abs >** softkey.

→ Remote: CALC:MARK:MIN:NEXT

→ Remote: CALC:DELT:MIN:NEXT

Next Min Mode < abs >

Selects the mode of the **Next Min** softkey. Three settings are available:

< Sets the active marker/delta marker to the next minimum left to the marker of the selected trace.

abs Sets the active marker/delta marker to the next higher minimum of the selected trace.

> Sets the active marker/delta marker to the next minimum right to the marker of the selected trace.

→ Remote: CALC:MARK:MAX:LEFT

→ Remote: CALC:DELT:MAX:LEFT

Search Limits

Opens a submenu to set the limits for maximum or minimum search in the x and y direction.

→ Remote: CALC:MARK:X:SLIM ON

Left Limit

Opens an edit dialog box to enter a value for the lower limit (left vertical line: S1 for span > 0; T1 for zero span). The search is performed between the lines of the left and right limit (see also **Right Limit** softkey).

→ Remote: CALC:MARK:X:SLIM:LEFT 1MHZ

Right Limit

Opens an edit dialog box to enter a value for the upper limit (left vertical line: S2 for span > 0; T2 for zero span). The search is performed between the lines of the left and right limit (see also **Left Limit** softkey). If no value is set, the upper limit corresponds to the stop frequency.

→ Remote: CALC:MARK:X:SLIM:RIGH 10MHZ

Threshold

Opens an edit dialog box to define the threshold line. The threshold line represents the lower level limit for a **Peak** search and the upper level limit for a **Min** search.

Opens an edit dialog box to define the threshold line. The threshold line represents the lower limit of the peak search level range.

→ Remote: CALC:THR -20dBm

→ Remote: CALC:THR ON

Search Lim Off

Deactivates all limits of the search range.

→ Remote: CALC:MARK:X:SLIM OFF

→ Remote: CALC:THR:STAT OFF

Peak Excursion

Opens – for level measurements – an edit dialog box to enter the minimum level value by which a signal must rise or fall so that it will be identified as a maximum or a minimum by the search functions. Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

For details see also "[To specify the suitable peak excursion](#)" on page 4.50 and "[Effect of different peak excursion settings \(example\)](#)" on page 4.50.

→ Remote: CALC:MARK:PEXC 10dB

Exclude LO

Switches the frequency range limit for the marker search functions on or off.

activated

minimum frequency $\geq 6 \times$ resolution bandwidth (RBW)

Because of the interference by the first local oscillator to the first intermediate frequency at the input mixer, the LO is represented as a signal at 0 Hz. To avoid the marker jumping to the LO at 0 Hz with the peak function when setting the display range, this frequency is excluded.

deactivated

no restriction to the search range. The frequency 0 Hz is included in the marker search functions.

→ Remote: CALC:MARK:LOEX ON

Power Measurements – MEAS Key

With its power measurement functions the R&S FSL is able to measure all the necessary parameters with high accuracy in a wide dynamic range.

A modulated carrier is almost always used (except e.g. SSB–AM) for high–frequency transmission of information. Due to the information modulated upon the carrier, the latter covers a spectrum which is defined by the modulation, the transmission data rate and the signal filtering. Within a transmission band each carrier is assigned a channel taking into account these parameters. In order to ensure error–free transmission, each transmitter must be conforming to the specified parameters. These include among others:

- the output power
- the occupied bandwidth, i.e. the bandwidth which must contain a defined percentage of the power
- the power dissipation allowed in the adjacent channels

The **MEAS** key is used for complex measurement functions as power measurements, occupied bandwidth, signal statistic, carrier to noise spacing, AM modulation depth, third–order intercept point, harmonics and spurious emissions. For measurement examples refer to chapter "Advanced Measurement Examples" and to the Quick Start Guide, chapter 5, "Basic Measurement Examples".

The following measurements can be performed:

- Power in zero span (**Time Domain Power** softkey; for details see "[Power measurement](#)" on page 4.58)
- Channel power and adjacent–channel power with span > 0 and with a single or several carriers (**CP, ACP, MC–ACP** softkey)
- Occupied bandwidth (**OBW** softkey, for details see "[Measurement of occupied bandwidth](#)" on page 4.58)
- Carrier–to–noise ratio (**C/N, C/No** softkey)
- Amplitude probability distribution (**APD** and **CCDF** softkeys, for details refer to chapter "Advanced Measurement Examples", "Amplitude Distribution Measurement")
- Modulation depth (**AM Mod Depth** softkey)
- 3rd order intercept (**TOI** softkey, for details refer to chapter "Advanced Measurement Examples", "Intermodulation Measurements")

To open the power measurement menu

- Press the **MEAS** key.

The power measurement menu is displayed.

Menu and softkey description

- "[Softkeys of the power measurement menu](#)" on page 4.61

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- "[Power measurement in zero span](#)" on page 4.58
- "[Measurement of occupied bandwidth](#)" on page 4.58

- ["Predefined CP / ACP standards"](#) on page 4.59
- ["Settings of CP / ACP test parameters"](#) on page 4.60

Tasks

- To measure the power in zero span
- To set the channel configuration
- To measure the occupied bandwidth
- To measure signal statistics
- To measure the carrier-to-noise ratio

To measure the power in zero span

1. Press the **Time Domain Power** softkey to activate the power measurement.
The corresponding submenu is displayed.
2. To limit the power evaluation range, switch on the limits (**Limits On/Off** softkey) and enter the limits by using the **Left Limit** and **Right Limit** softkeys.
3. Select the type of power measurement by using the **Mean** or **RMS** softkey. (RMS or mean power), the settings for max hold and averaging as well as the definition of limits.
4. To calculate and display the peak value, press the **Peak** softkey.
5. To calculate and display the standard deviation from the mean value, press the **Std Dev** softkey.

To set the channel configuration

1. Press the **CP, ACP, MC-ACP** softkey to active channel or adjacent-channel power measurement.
The corresponding submenu is displayed.
2. To use a predefined standard for measurement, press the **CP / ACP Standard** softkey (for details on available standards see ["Predefined CP / ACP standards"](#) on page 4.59).
3. To configure the parameters independently of the predefined standards, press the **CP / ACP Config** softkey (for details see ["Settings of CP / ACP test parameters"](#) on page 4.60).
4. To enter the sweep time, press the **Sweep Time** softkey.
5. To display the whole diagram, press the **Full Size Diagram** softkey.
6. To adjust the reference level to the measured channel power, press the **Adjust Ref Level** softkey.

To measure the occupied bandwidth

1. Press the **OBW** softkey to activate the measurement of the occupied bandwidth (for details see also ["Measurement of occupied bandwidth"](#) on page 4.58).
The corresponding submenu is displayed.
2. Press the **% Power Bandwidth** softkey to enter the percentage of power.
3. To change the channel bandwidth for the transmission channel, press the **Channel Bandwidth** softkey.
4. To optimize the settings for the selected channel configuration, press the **Adjust Settings** softkey (for details see also ["Settings of CP / ACP test parameters"](#) on page 4.60).
5. To adjust the reference level to the measured total power after the first sweep, press the **Adjust Ref Lvl** softkey.

To measure signal statistics

- To activate and configure the measurement of the amplitude probability distribution (APD), press the **APD** softkey (for details refer to chapter "Advanced Measurement Examples", "Amplitude Distribution Measurement").

The corresponding submenu is displayed.

- To activate and configure the measurement of the complementary cumulative distribution (CCDF), press the **CCDF** softkey (for details refer to chapter "Advanced Measurement Examples", "Amplitude Distribution Measurement").

The corresponding submenu is displayed.

To measure the carrier-to-noise ratio

1. Press the **C/N**, **C/No** softkey to configure the carrier-to-noise ratio measurement.

The corresponding submenu is displayed.

2. To activate the measurements without reference to the bandwidth, press the **C/N** softkey.
3. To activate the measurements with reference to the bandwidth, press the **C/No** softkey.
4. To change the channel bandwidth for the transmission channel, press the **Channel Bandwidth** softkey.
5. To optimize the settings for the selected channel configuration, press the **Adjust Settings** softkey (for details see also "[Settings of CP / ACP test parameters](#)" on page 4.60).

Power measurement in zero span

With the aid of the power measurement function, the R&S FSL determines the power of the signal in zero span by summing up the power at the individual measurement points and dividing the result by the number of measurement points. In this way it is possible to measure for example the power of TDMA signals during transmission or during the muting phase. Both the mean power and the RMS power can be measured by means of the individual power values.

The result is displayed in the marker field. The measured values are updated after each sweep or averaged over a user-defined number of sweeps in order to determine e.g. the mean power over several bursts. For determination of the peak value the maximum value from several sweeps is displayed.

If both the on and off phase of a burst signal are displayed, the measurement range can be limited to the transmission or to the muting phase with the aid of vertical lines. The ratio between signal and noise power of a TDMA signal for instance can be measured by using a measurement as a reference value and after that varying the measurement range.

Upon switching on power measurement the sample detector is activated.

Measurement of occupied bandwidth

An important characteristic of a modulated signal is its occupied bandwidth. In a radio communications system for instance the occupied bandwidth must be limited to enable distortion-free transmission in adjacent channels. The occupied bandwidth is defined as the bandwidth containing a defined percentage of the total transmitted power. A percentage between 10% and 99.9% can be set.

The measurement principle is the following: The bandwidth containing 99% of the signal power is to be determined, for example. The routine first calculates the total power of all displayed points of the trace. In the next step, the points from the right edge of the trace are summed up until 0.5% of the total power is reached. Auxiliary marker 1 is positioned at the corresponding frequency. Then the points from the left edge of the trace are summed up until 0.5% of the power is reached. Auxiliary marker 2 is

positioned at this point. 99% of the power is now between the two markers. The distance between the two frequency markers is the occupied bandwidth which is displayed in the marker field.

To ensure correct power measurement, especially for noise signals, and to obtain the correct occupied bandwidth, the following prerequisites and settings are necessary:

- Only the signal to be measured is displayed on the screen. An additional signal would falsify the measurement.
- $RBW \ll \text{occupied bandwidth}$
(approx. 1/20 of occupied bandwidth, for voice communication type 300 Hz or 1 kHz)
- $VBW \geq 3 \times RBW$
- RMS–Detector
- $\text{Span} \geq 2 \text{ to } 3 \times \text{occupied bandwidth}$

Some of the measurement specifications (e.g. PDC, RCR STD–27B) require measurement of the occupied bandwidth using a peak detector. The detector setting of the R&S FSL has to be changed accordingly then.

Predefined CP / ACP standards

The test parameters for the channel and adjacent–channel measurements are set according to the mobile radio standard. The available standards are listed below.

- NADC IS136
- TETRA
- PDC
- PHS
- CDPD
- CDMA IS95A FWD
- CDMA IS95A REV
- CDMA IS95C Class 0 FWD
- CDMA IS95C Class 0 REV
- CDMA J–STD008 FWD
- CDMA J–STD008 REV
- CDMA IS95C Class 1 FWD
- CDMA IS95C Class 1 REV
- W–CDMA 4.096 FWD
- W–CDMA 4.096 REV
- W–CDMA 3GPP FWD
- W–CDMA 3GPP REV
- CDMA 2000 DS
- CDMA 2000 MC1
- CDMA 2000 MC3
- TD–SCDMA
- WLAN

Note: For the R&S FSL, the channel spacing is defined as the distance between the center frequency of the adjacent channel and the center frequency of the transmission channel. The definition of the adjacent–channel spacing in standards IS95 B / C, IS97 B / C, IS98 B / C and CDMA 2000 DS / MC1 / MC3 is different. These standards define the adjacent–channel spacing from the center of the transmission channel to the closest border of the adjacent channel. This definition is also used for the R&S FSL when the standard settings marked with a dagger are selected.

Settings of CP / ACP test parameters

- **Frequency span**

The frequency span must at least cover the channels to be measured plus a measurement margin of approx. 10%.

Note: If the frequency span is large in comparison to the channel bandwidth (or the adjacent–channel bandwidths) being examined, only a few points on the trace are available per channel. This reduces the accuracy of the waveform calculation for the channel filter used, which has a negative effect on the measurement accuracy. It is therefore strongly recommended that the formulas mentioned be taken into consideration when selecting the frequency span.

For channel power measurements the **Adjust Settings** softkey sets the frequency span as follows:

(No. of transmission channels – 1) x transmission channel spacing + 2 x transmission channel bandwidth + measurement margin

For adjacent–channel power measurements, the **Adjust Settings** softkey sets the frequency span as a function of the number of transmission channels, the transmission channel spacing, the adjacent–channel spacing, and the bandwidth of one of adjacent–channels ADJ, ALT1 or ALT2, whichever is furthest away from the transmission channels:

(No. of transmission channels – 1) x transmission channel spacing + 2 x (adjacent–channel spacing + adjacent–channel bandwidth) + measurement margin

The measurement margin is approx. 10% of the value obtained by adding the channel spacing and the channel bandwidth.

- **Resolution bandwidth (RBW)**

To ensure both, acceptable measurement speed and required selection (to suppress spectral components outside the channel to be measured, especially of the adjacent channels), the resolution bandwidth must not be selected too small or too large. As a general approach, the resolution bandwidth is to be set to values between 1% and 4% of the channel bandwidth.

A larger resolution bandwidth can be selected if the spectrum within the channel to be measured and around it has a flat characteristic. In the standard setting, e.g. for standard IS95A REV at an adjacent channel bandwidth of 30 kHz, a resolution bandwidth of 30 kHz is used. This yields correct results since the spectrum in the neighborhood of the adjacent channels normally has a constant level. For standard NADC/IS136 this is not possible for example, since the spectrum of the transmit signal penetrates into the adjacent channels and a too large resolution bandwidth causes a too low selection of the channel filter. The adjacent–channel power would thus be measured too high.

With the exception of the IS95 CDMA standards, the **Adjust Settings** softkey sets the resolution bandwidth (RBW) as a function of the channel bandwidth:

RBW ≤ 1/40 of channel bandwidth

The maximum possible resolution bandwidth (with respect to the requirement $RBW \leq 1/40$) resulting from the available RBW steps (1, 3) is selected.

- **Video bandwidth (VBW)**

For a correct power measurement, the video signal must not be limited in bandwidth. A restricted bandwidth of the logarithmic video signal would cause signal averaging and thus result in a too low indication of the power (–2.51 dB at very low video bandwidths). The video bandwidth should therefore be selected at least three times the resolution bandwidth:

$$VBW \geq 3 \times RBW$$

The **Adjust Settings** softkey sets the video bandwidth (VBW) as a function of the channel bandwidth (see formula above) and the smallest possible VBW with regard to the available step size will be selected.

- **Detector**

The **Adjust Settings** softkey selects the RMS detector. This detector is selected since it correctly indicates the power irrespective of the characteristics of the signal to be measured. The whole IF envelope is used to calculate the power for each measurement point. The IF envelope is digitized using a sampling frequency which is at least five times the resolution bandwidth which has been selected. Based on the sample values, the power is calculated for each measurement point using the following formula:

$$P_{RMS} = \sqrt{\frac{1}{N} \cdot \sum_{i=1}^N s_i^2}$$

s_i = linear digitized video voltage at the output of the A/D converter

N = number of A/D converter values per measurement point

P_{RMS} = power represented by a measurement point

When the power has been calculated, the power units are converted into decibels and the value is displayed as a measurement point.

In principle, the sample detector would be possible as well. Due to the limited number of measurement points used to calculate the power in the channel, the sample detector would yield less stable results.

- **Trace averaging**

The **Adjust Settings** softkey switches off this function. Averaging, which is often performed to stabilize the measurement results, leads to a too low level indication and should therefore be avoided. The reduction in the displayed power depends on the number of averages and the signal characteristics in the channel to be measured.

- **Reference level**

The **Adjust Settings** softkey does not influence the reference level. It can be separately adjusted using the **Adjust Settings** softkey.

Softkeys of the power measurement menu

The following table shows all softkeys available in the power measurement menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Submenu / Command | Submenu / Command | Command |
|-------------------|-------------------|-------------------|---------|
| All Functions Off | | | |
| TOI ↓ | Marker 1 | | |
| | Marker 2 | | |
| | Marker 3 | | |

| Menu / Command | Submenu / Command | Submenu / Command | Command |
|---------------------|---------------------------|--------------------|-------------------|
| | Marker 4 | | |
| | Search Signals | | |
| AM Mod Depth ↓ | same contents as TOI menu | | |
| Time Domain Power ↓ | Peak | | |
| | RMS | | |
| | Mean | | |
| | Std Dev | | |
| | Limits On/Off | | |
| | Left Limit | | |
| | Right Limit | | |
| C/N, C/No ↓ | C/N | | |
| | C/No | | |
| | Channel Bandwidth | | |
| | Adjust Settings | | |
| CP, ACP, MC-ACP ↓ | CP / ACP Standard | | |
| | CP / ACP Config ↓ | # of TX Chan | |
| | | # of Adj Chan | |
| | | Channel Settings ↓ | Channel Bandwidth |
| | | | Channel Spacing |
| | | | ACP Ref Settings |
| | | | Adjust Ref Level |
| | | | Adjust Settings |
| | | Limit Chk On/Off | |
| | | Edit ACP Limit | |
| | | Select Trace | |
| | | Adjust Settings | |
| | Sweep Time | | |
| | Fast ACP On/Off | | |
| | ACP Abs/Rel | | |
| | Adjust Ref Level | | |
| More ↓ | | | |
| All Functions Off | | | |
| OBW ↓ | % Power Bandwidth | | |
| | Channel Bandwidth | | |
| | Adjust Ref Lvl | | |
| | Adjust Settings | | |
| APD ↓ | Percent Marker | | |
| | Res BW | | |
| | # of Samples | | |
| | Scaling ↓ | x-Axis Ref Level | |
| | | x-Axis Range | |
| | | y-Axis Max Value | |

| Menu / Command | Submenu / Command | Submenu / Command | Command |
|-----------------------|---------------------------|-------------------|---------|
| | | y-Axis Min Value | |
| | | Adjust Settings | |
| | | Default Settings | |
| | Adjust Settings | | |
| | Cont Meas | | |
| | Single Meas | | |
| CCDF ↓ | same contents as APD menu | | |
| Harmonic Distortion ↓ | Harmonic On/Off | | |
| | No. of Harmonics | | |
| | Harmonic Sweep Time | | |
| | Harmonic RBW Auto | | |
| | Adjust Settings | | |
| Full Size Diagram | | | |

All Functions Off

Switches off all power measurement functions.

→ Remote: CALC:MARK:FUNC:<function> OFF

TOI

Opens a submenu and activates the measurement of the 3rd order intercept point.

A two-tone signal with equal carrier levels is expected at the R&S FSL input. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Marker 3 and marker 4 (both delta markers) are placed on the intermodulation products. When the function is enabled, the frequency entry is activated for the delta markers. They can be set manually.

The R&S FSL calculates the third order intercept point from the level spacing between normal markers and delta markers and displays it in the marker field.

→ Remote: CALC:MARK:FUNC:TOI ON

→ Remote: CALC:MARK:FUNC:TOI:RES?

Search Signals

Activates all markers.

→ Remote: CALC:MARK:FUNC:TOI:RES?

AM Mod Depth

Opens a submenu and activates the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for ensuring correct operation.

The level value of marker 1 is taken as the carrier level. When this function is activated, marker 2 and marker 3 are automatically set symmetrically to the carrier on the adjacent peak values of the trace as delta markers and marker 2 is activated for the entry.

When the position of marker 2 (delta) is changed, marker 3 (delta) is moved symmetrically with respect to the reference marker (marker 1).

If the edit dialog box is opened for marker 3, the latter can be moved for fine adjustment irrespective of marker 2.

The R&S FSL calculates the power at the marker positions from the measured levels. The AM modulation depth is calculated from the ratio between the power values at the reference marker and at the delta markers. When the powers of the two AM side bands are unequal, the mean value of the two power values is used for AM modulation depth calculation.

- Remote: CALC:MARK:FUNC:MDEP ON
 - Remote: CALC:MARK:FUNC:MDEP:RES?
-

Time Domain Power (zero span)

Activates the power measurement in zero span and opens a submenu to configure the power measurement. For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:FUNC:SUMM:STAT ON
-

Peak (zero span)

Activates the calculation of the peak value from the points of the displayed trace or a segment thereof. For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:FUNC:SUMM:PPE ON
 - Remote: CALC:MARK:FUNC:SUMM:PPE:RES?
-

RMS (zero span)

Activates the calculation of the RMS value from the points of the displayed trace or a segment thereof. For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:FUNC:SUMM:RMS ON
 - Remote: CALC:MARK:FUNC:SUMM:RMS:RES?
-

Mean (zero span)

Activates the calculation of the mean value from the points of the displayed trace or a segment thereof. The linear mean value of the equivalent voltages is calculated.

This can be used for instance to measure the mean power during a GSM burst.

For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:FUNC:SUMM:MEAN ON
 - Remote: CALC:MARK:FUNC:SUMM:MEAN:RES?
-

Std Dev (zero span)

Activates the calculation of the standard deviation of measurement points from the mean value and displays them as measured value. The measurement of the mean power is automatically switched on at the same time. For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:FUNC:SUMM:SDEV ON
- Remote: CALC:MARK:FUNC:SUMM:SDEV:RES?

Limits On/Off (zero span)

Switches the limitation of the evaluation range on or off. Default setting is off.

When switched off, the evaluation range is not limited. When switched on, the evaluation range is defined by the left and right limit. If only one limit is set, it corresponds to the left limit and the right limit is defined by the stop frequency. If the second limit is also set, it defines the right limit.

For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:X:SLIM OFF

Left Limit (zero span)

Opens an edit dialog box to enter a value for line 1. For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:X:SLIM:LEFT <value>

Right Limit (zero span)

Opens an edit dialog box to enter a value for line 2. For more details see also "[Power measurement in zero span](#)" on page 4.58.

- Remote: CALC:MARK:X:SLIM:RIGH <value>

C/N, C/No (span > 0)

Opens a submenu to configure the carrier/noise ratio measurement. Measurements without (C/N) and measurements with reference to the bandwidth (C/No) are possible.

C/N (span > 0)

Switches the measurement of the carrier/noise ratio on or off. If no marker is active, marker 1 is activated.

The measurement is performed on the trace where marker 1 is located. To shift marker 1 and measure another trace, use the **Marker to Trace** softkey in the marker menu. To determine the maximum value of the current trace, use the **Phase Noise/Ref Fixed** softkey in the marker menu.

- Remote: CALC:MARK:FUNC:POW:SEL CN
- Remote: CALC:MARK:FUNC:POW:RES? CN
- Remote: CALC:MARK:FUNC:POW OFF

C/No (span > 0)

Switches the measurement of the carrier/noise ratio with reference to a 1 Hz bandwidth on or off. If no marker is active, marker 1 is activated.

The measurement is performed on the trace where marker 1 is located. To shift marker 1 and measure another trace, use the **Marker to Trace** softkey in the marker menu. To determine the maximum value of the current trace, use the **Phase Noise/Ref Fixed** softkey in the marker menu.

- Remote: CALC:MARK:FUNC:POW:SEL CN0
 - Remote: CALC:MARK:FUNC:POW:RES? CN0
 - Remote: CALC:MARK:FUNC:POW OFF
-

Channel Bandwidth (span > 0)

Opens an edit dialog box to enter the measurement channel bandwidth. The default setting is 14 kHz.

- Remote: SENS:POW:ACH:BWID 14kHz
-

Adjust Settings (span > 0)

Enables the RMS detector (see also "[Detector overview](#)" on page 4.33) and adjusts the span to the selected channel bandwidth according to:

4 x channel bandwidth + measurement margin

The adjustment is performed once; if necessary, the setting can be changed later on.

- Remote: SENS:POW:ACH:PRES CN | CN0
-

CP, ACP, MC-ACP

Activates the active channel or adjacent-channel power measurement either for a single carrier signal or for several carrier signals, depending on the current measurement configuration, and opens a submenu to configure the channel power measurement. With default settings the measurement is performed by integrating the powers at the display points within the specified channels (IBW method).

When multi-carrier ACP measurement is activated, the number of measurement points is increased to ensure that adjacent-channel powers are measured with adequate accuracy.

- Remote: CALC:MARK:FUNC:POW:SEL CPOW|ACP|MCAC
 - Remote: CALC:MARK:FUNC:POW:RES? CPOW|ACP|MCAC
 - Remote: CALC:MARK:FUNC:POW OFF
-

CP / ACP Standard

Opens an edit dialog box to select the settings according to predefined standards. For details on the available standards see "[Predefined CP / ACP standards](#)" on page 4.59. By default no standard is set.

The selection of the standard influences the following parameters:

- channel spacing and adjacent-channel spacing
- channel bandwidth, adjacent-channel bandwidth, and type of filtering

- resolution bandwidth
- video bandwidth
- detector
- # of adjacent channels
- trace averaging (switched off)

→ Remote: CALC:MARK:FUNC:POW:PRES <standard>

CP / ACP Config

Opens a submenu to configure the channel power and adjacent channel power measurement independently of the predefined standards (for details see also "[To set the channel configuration](#)" on page 4.57 and "[Settings of CP / ACP test parameters](#)" on page 4.60).

of TX Chan (MC-ACP)

Opens an edit dialog box to enter the number of carrier signals to be taken into account in channel and adjacent-channel power measurements. Values from 1 to 12 are allowed.

→ Remote: POW:ACH:TXCH:COUN 4

of Adj Chan

Opens an edit dialog box to enter the number of adjacent channels to be considered in the adjacent-channel power measurement. Values from 0 to 3 are allowed.

The following measurements are performed depending on the number of the channels:

- 0 Only the channel powers are measured.
- 1 The channel powers and the power of the upper and lower adjacent channel are measured.
- 2 The channel powers, the power of the upper and lower adjacent channel and of the next higher and lower channel (alternate channel 1) are measured.
- 3 The channel power, the power of the upper and lower adjacent channel, the power of the next higher and lower channel (alternate channel 1) and of the next but one higher and lower adjacent channel (alternate channel 2) are measured.

→ Remote: POW:ACH:ACP 1

Channel Settings

Opens a submenu to define the channel settings.

Channel Bandwidth

Opens the **TX/ACP Channel Bandwidth** dialog box to enter the channel bandwidths for the transmission channels and the adjacent channels. The entry **TX** is only available for the multi-carrier ACP measurement.

The transmission-channel bandwidth is normally defined by the transmission standard. The correct bandwidth is set automatically for the selected standard (see **CP / ACP Standard** softkey).

Measurements in zero span (see **Fast ACP On/Off** softkey) are performed in the zero span mode. The channel limits are indicated by vertical lines. For measurements requiring channel bandwidths deviating from those defined in the selected standard the IBW method is to be used.

With the IBW method (see **Fast ACP On/Off** softkey), the channel bandwidth limits are marked by two vertical lines right and left of the channel center frequency. It can in this way be visually checked whether the entire power of the signal under test is within the selected channel bandwidth.

When measuring according to the IBW method (FAST ACP OFF) the bandwidths of the different adjacent channels are to be entered numerically. Since all adjacent channels often have the same bandwidth, the other channels Alt1 and Alt2 are set to the bandwidth of the adjacent channel on entering the adjacent-channel bandwidth (ADJ). Thus only one value needs to be entered in case of equal adjacent channel bandwidths. The same holds true for the ALT2 channels (alternate channels 2) when the bandwidth of the ALT1 channel (alternate channel 1) is entered.

For details on available channel filters see "[To choose the appropriate filter](#)" on page 4.15.

- Remote: SENS:POW:ACH:BWID 14kHz
 - Remote: SENS:POW:ACH:BWID:ACH 1kHz
 - Remote: SENS:POW:ACH:BWID:ALT1 14kHz
 - Remote: SENS:POW:ACH:BWID:ALT2 14kHz
-

Channel Spacing

Opens the **TX/ACP Channel Spacing** dialog box to enter the channel spacings.

The entry **TX** is only available for the multi-carrier ACP measurement.

Since all the adjacent channels often have the same distance to each other, the entry of the adjacent-channel spacing (ADJ) causes channel spacing ALT1 to be set to twice and channel spacing ALT2 to three times the adjacent-channel spacing. Thus only one value needs to be entered in case of equal channel spacing. The same holds true for the ALT2 channels when the bandwidth of the ALT1 channel is entered.

- Remote: SENS:POW:ACH:SPAC:CHAN 20kHz
 - Remote: SENS:POW:ACH:SPAC:ACH 20kHz
 - Remote: SENS:POW:ACH:SPAC:ALT1 40kHz
-

ACP Ref Settings (MC-ACP)

Opens an edit dialog box to select the transmission channel to which the adjacent-channel relative power values should be referenced.

| | |
|----------------------|--|
| TX Channel 1 – 12 | Selection of one of channels 1 to 12. |
| Min Power TX Channel | The transmission channel with the lowest power is used as a reference channel. |

| | |
|--------------------------|--|
| Max Power TX Channel | The transmission channel with the highest power is used as a reference channel. |
| Lowest & Highest Channel | The outer left-hand transmission channel is the reference channel for the lower adjacent channels, the outer right-hand transmission channel that for the upper adjacent channels. |

- Remote: SENS:POW:ACH:REF:TXCH:MAN 1
- Remote: SENS:POW:ACH:REF:TXCH:AUTO MIN

Limit Chk On/Off

Switches the limit check for the ACP measurement on or off.

- Remote: CALC:LIM:ACP ON
- Remote: CALC:LIM:ACP:ACH:RES?
- Remote: CALC:LIM:ACP:ALT:RES?

Edit ACP Limit

Opens the **ACP Limits** dialog box to define the limits for the ACP measurement.

The following rules apply for the limits:

- A separate limit can be defined for each adjacent channel. The limit applies to both the upper and the lower adjacent channel.
- A relative and/or absolute limit can be defined. The check of both limit values can be activated independently.
- The R&S FSL checks adherence to the limits irrespective of whether the limits are absolute or relative or whether the measurement is carried out with absolute or relative levels. If both limits are active and if the higher of both limit values is exceeded, the measured value is marked by a preceding asterisk.

- Remote: CALC:LIM:ACP ON
- Remote: CALC:LIM:ACP:<adjacent-channel> 0dB,0dB
- Remote: CALC:LIM:ACP:<adjacent-channel>:STAT ON
- Remote: CALC:LIM:ACP:<adjacent-channel>:ABS -10dBm,-10dBm
- Remote: CALC:LIM:ACP:<adjacent-channel>:ABS:STAT ON

For details refer to chapter "Remote Control – Commands", section "CALCulate:LIMit:ACPower Subsystem".

Select Trace

Opens an edit dialog box to enter the trace number on which the CP/ACP measurement is to be performed. Only activated traces can be selected (for details on trace modes see "[Trace mode overview](#)" on page 4.32).

- Remote: SENS:POW:TRAC 1

Adjust Settings

Optimizes automatically all instrument settings for the selected channel configuration (channel bandwidth, channel spacing) within a specific frequency range (channel bandwidth). The adjustment is carried out only once. If necessary, the instrument settings can be changed later.

For details on the settings of span, resolution bandwidth, video bandwidth, detector and trace averaging see "[Settings of CP / ACP test parameters](#)" on page 4.60.

→ Remote: SENS:POW:ACH:PRES ACP|CPOW|MCAC|OBAN|OBW|CN|CNO

Sweep Time

Opens an edit dialog box to enter the sweep time. With the RMS detector, a longer sweep time increases the stability of the measurement results.

The function of this softkey is identical to the **Sweeptime Manual** softkey in the bandwidth menu.

→ Remote: SWE:TIM <value>

Fast ACP On/Off

Switches between the IBW method (**Fast ACP Off**) and the zero span method (**Fast ACP On**).

When switched on, the R&S FSL sets the center frequency consecutively to the different channel center frequencies and measures the power with the selected measurement time (= sweep time/number of channels). The RBW filters suitable for the selected standard and frequency offset are automatically used (e.g. root raised cos with IS 136). For details on available channel filters see "[To choose the appropriate filter](#)" on page 4.15.

The RMS detector is used for obtaining correct power measurement results. Therefore this requires no software correction factors.

Measured values are output as a list. The powers of the transmission channels are output in dBm, the powers of the adjacent channels in dBm.

The sweep time is selected depending on the desired reproducibility of results. Reproducibility increases with sweep time since power measurement is then performed over a longer time period. As a general approach, it can be assumed that approx. 500 non-correlated measured values are required for a reproducibility of 0.5 dB (99% of the measurements are within 0.5 dB of the true measured value). This holds true for white noise. The measured values are considered as non-correlated when their time interval corresponds to the reciprocal of the measured bandwidth.

With IS 136 the measurement bandwidth is approx. 25 kHz, i.e. measured values at an interval of 40 μ s are considered as non-correlated. A measurement time of 40 ms is thus required per channel for 1000 measured values. This is the default sweep time which the R&S FSL sets in coupled mode. Approx. 5000 measured values are required for a reproducibility of 0.1 dB (99%), i.e. the measurement time is to be increased to 200 ms.

→ Remote: SENS:POW:HSP ON

ACP Abs/Rel

Switches between absolute and relative power measurement in the adjacent channels.

- | | |
|-----|--|
| Abs | The absolute power in the adjacent channels is displayed in the unit of the Y axis, e.g. in dBm, dB μ V. |
| Rel | The level of the adjacent channels is displayed relative to the level of the |

transmission channel in dBc.

→ Remote: SENS:POW:ACH:MODE ABS

Adjust Ref Level

Adjusts the reference level to the measured channel power. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSL or limiting the dynamic range by a too small S/N ratio. For details on manual settings see "[Settings of CP / ACP test parameters](#)" on page 4.60.

The reference level is not influenced by the selection of a standard. To achieve an optimum dynamic range, the reference level has to be set in a way that places the signal maximum close to the reference level without forcing an overload message. Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is still significantly below the reference level.

→ Remote: SENS:POW:ACH:PRES:RLEV

OBW (span > 0)

Activates measurement of the occupied bandwidth according to the current configuration and opens a submenu to configure the measurement. The occupied bandwidth is displayed in the marker display field and marked on the trace by temporary markers. For details see also "[Measurement of occupied bandwidth](#)" on page 4.58.

The measurement is performed on the trace with marker 1. In order to evaluate another trace, marker 1 must be placed on another trace (see **Marker to Trace** softkey in the marker menu).

→ Remote: CALC:MARK:FUNC:POW:SEL OBW
→ Remote: CALC:MARK:FUNC:POW:RES? OBW
→ Remote: CALC:MARK:FUNC:POW OFF

% Power Bandwidth (span > 0)

Opens an edit dialog box to enter the percentage of total power in the displayed frequency range which defines the occupied bandwidth. Values from 10% to 99.9% are allowed.

→ Remote: SENS:POW:BWID 99PCT

Channel Bandwidth (span > 0)

Opens an edit dialog box to enter the channel bandwidth for the transmission channel. The specified channel bandwidth is used for optimization of the test parameters (for details see "[Settings of CP / ACP test parameters](#)" on page 4.60). The default setting is 14 kHz.

For measurements in line with a specific transmission standard, the bandwidth specified by the standard for the transmission channel must be entered.

→ Remote: SENS:POW:ACH:BWID 14kHz

Adjust Ref Lvl (span > 0)

Adjusts the reference level to the measured total power of the signal. The softkey is activated after the first sweep with active measurement of the occupied bandwidth has been completed and the total power of the signal is thus known.

Adjusting the reference level ensures that the signal path will not be overloaded and the dynamic range not limited by too low a reference level. Since the measurement bandwidth for channel power measurements is significantly lower than the signal bandwidth, the signal path may be overloaded although the trace is distinctly below the reference level. If the measured channel power is equal to the reference level, the signal path cannot be overloaded.

→ Remote: SENS:POW:ACH:PRES:RLEV

APD

Activates the function to measure the amplitude probability density (APD) and opens a submenu.

→ Remote: CALC:STAT:APD ON

Percent Marker

Opens an edit dialog box to enter a probability value and to position marker 1. Thus, the power which is exceeded with a given probability can be determined very easily. If marker 1 is deactivated, it will be switched on automatically.

→ Remote: CALC:MARK:Y:PERC 0...100%

Res BW

Opens an edit dialog box to set the resolution bandwidth directly. The function of this softkey is identical to the **Res BW Manual** softkey in the bandwidth menu.

For correct measurement of the signal statistics the resolution bandwidth has to be wider than the signal bandwidth in order to measure the actual peaks of the signal amplitude correctly. In order not to influence the peak amplitudes the video bandwidth is automatically set to 10 MHz. The sample detector is used for detecting the video voltage.

→ Remote: BAND 3 MHz

of Samples

Opens an edit dialog box to set the number of power measurements that are taken into account for the statistics.

Apart from the number of measurements the overall measurement time depends also on the set resolution bandwidth as the resolution bandwidth directly influences the sampling rate.

→ Remote: CALC:STAT:NSAM <value>

Scaling

Opens a submenu to change the scaling parameters of x- and y-axis.

x–Axis Ref Level

Opens an edit dialog box to enter the reference level in the currently active unit (dBm, dB μ V, etc). The function of this softkey is identical to the **Ref Level** softkey in the amplitude menu.

For the APD function this value is mapped to the right diagram border. For the CCDF function there is no direct representation of this value on the diagram as the x–axis is scaled relatively to the measured mean power.

→ Remote: `CALC:STAT:SCAL:X:RLEV <value>`

x–Axis Range

Opens the **Range Log** dialog box to select a value for the level range to be covered by the statistics measurement selected. The function is identical to the **Range Log** softkey in amplitude menu.

→ Remote: `CALC:STAT:SCAL:X:RANG <value>`

y–Axis Max Value

Opens an edit dialog box to define the upper limit of the displayed probability range. Values on the y–axis are normalized which means that the maximum value is 1.0. As the y–axis scaling has a logarithmic axis the distance between max and min value must be at least one decade.

→ Remote: `CALC:STAT:SCAL:Y:UPP <value>`

y–Axis Min Value

Opens an edit dialog box to define the lower limit of the displayed probability range. As the y–axis scaling has a logarithmic axis the distance between max and min value must be at least one decade. Values in the range $0 < \text{value} < 1$ are allowed.

→ Remote: `CALC:STAT:SCAL:Y:LOW <value>`

Default Settings

Resets the x– and y–axis scalings to their preset values.

x–axis ref level: –20 dBm

x–axis range APD: 100 dB

x–axis range CCDF: 20 dB

y–axis upper limit: 1.0

y–axis lower limit: 1E–6

→ Remote: `CALC:STAT:PRES`

Adjust Settings

Adjusts the level settings according to the measured difference between peak and minimum power for APD measurement or peak and mean power for CCDF measurement in order to obtain maximum power resolution. Adapts the probability scale to the selected number of samples. Adjusts the reference level to the current input signal. For details see also **Adjust Ref Level** softkey.

→ Remote: CALC:STAT:SCAL:AUTO ONCE

Cont Meas

Starts to collect a new sequence of sample data and to calculate the APD or CCDF curve depending on the selected measurement. The next measurement is started automatically as soon as the indicated number of samples has been reached ("CONTinuous MEASurement").

→ Remote: INIT:CONT ON

→ Remote: INIT:IMM

Single Meas

Starts to collect a new sequence of sample data and to calculate the APD or CCDF curve depending on the selected measurement. At the beginning of the measurement previously obtained measurement results are discarded.

→ Remote: INIT:CONT OFF

→ Remote: INIT:IMM

CCDF

Activates the function to measure the complementary cumulative distribution function (CCDF) and opens a submenu.

→ Remote: CALC:STAT:CCDF ON

Harmonic Distortion

Opens a submenu to determine the settings for harmonics measurement and activates the harmonic distortion measurement. With this measurement it is possible to measure easily the harmonics e.g. from a VCO. In addition the THD (total harmonic distortion) is calculated in % and dB.

With span > 0 Hz, an automatic search for the first harmonic is carried out within the set frequency range. Also the level is adjusted. In zero span, the center frequency is unchanged.

In the upper pane, the zero span sweeps on all harmonics are shown, separated by display lines. This provides a very good overview about the measurement. In the lower pane, the mean RMS results are displayed in numerical values. The THD values are displayed in the marker information area.

This softkey is available from firmware version 1.10.

→ Remote: CALC:MARK:FUNC:HARM:STAT ON

→ Remote: CALC:MARK:FUNC:HARM:DIST? TOT

→ Remote: CALC:MARK:FUNC:HARM:LIST?

Harmonic On/Off

Activates/deactivates the harmonic distortion measurement.

This softkey is available from firmware version 1.10.

→ Remote: CALC:MARK:FUNC:HARM:STAT ON

No. of Harmonics

Sets the number of harmonics that shall be measured. The range is from 1 to 26.

This softkey is available from firmware version 1.10.

→ Remote: CALC:MARK:FUNC:HARM:NHAR 2

Harmonic Sweep Time

For details refer to the **Sweeptime Manual** softkey in the bandwidth menu.

This softkey is available from firmware version 1.10.

Harmonic RBW Auto

Enables/disables the automatic adjustment of the resolution bandwidth. The automatic adjustment is carried out according to:

$$RBW_n = RBW_1 * n$$

If RBW_n is not available, the next higher value is used.

This softkey is available from firmware version 1.10.

→ Remote: CALC:MARK:FUNC:HARM:BAND:AUTO OFF

Adjust Settings

Activates the frequency search in the frequency range that was set before starting the harmonic measurement (if harmonic measurement was with span > 0) and adjusts the level.

This softkey is available from firmware version 1.10.

→ Remote: CALC:MARK:FUNC:HARM:PRES

Full Size Diagram (span > 0)

Displays the diagram in full screen size.

→ Remote: DISP:SIZE LARG|SMAL

Using Limit Lines and Display Lines – LINES Key

The **LINES** key is used to configure limit and display lines.

To open the lines menu

- Press the **LINES** key.

The lines menu and the **Select Limit Line** dialog box are displayed. For details on the **Select Limit Line** dialog box refer to "[To select a limit line](#)" on page 4.77.

Menu and softkey description

- "[Softkeys of the lines menu](#)" on page 4.81

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- "[Display Lines](#)" on page 4.80
- "[Limit Lines](#)" on page 4.80

Task

- [To work with display lines](#)
- [To select a limit line](#)
- [To create a new limit line](#)
- [To edit an existing limit line](#)
- [To create a new limit line based upon an existing limit line](#)
- [To activate/deactivate a limit line](#)

To work with display lines

Initial situation: The line is switched on (softkey with highlighted background) or off (softkey without highlighted background), for example the Display Line 1.

1. Press the **Display Lines** softkey.
2. Press the **Display Line 1** softkey for the first time.

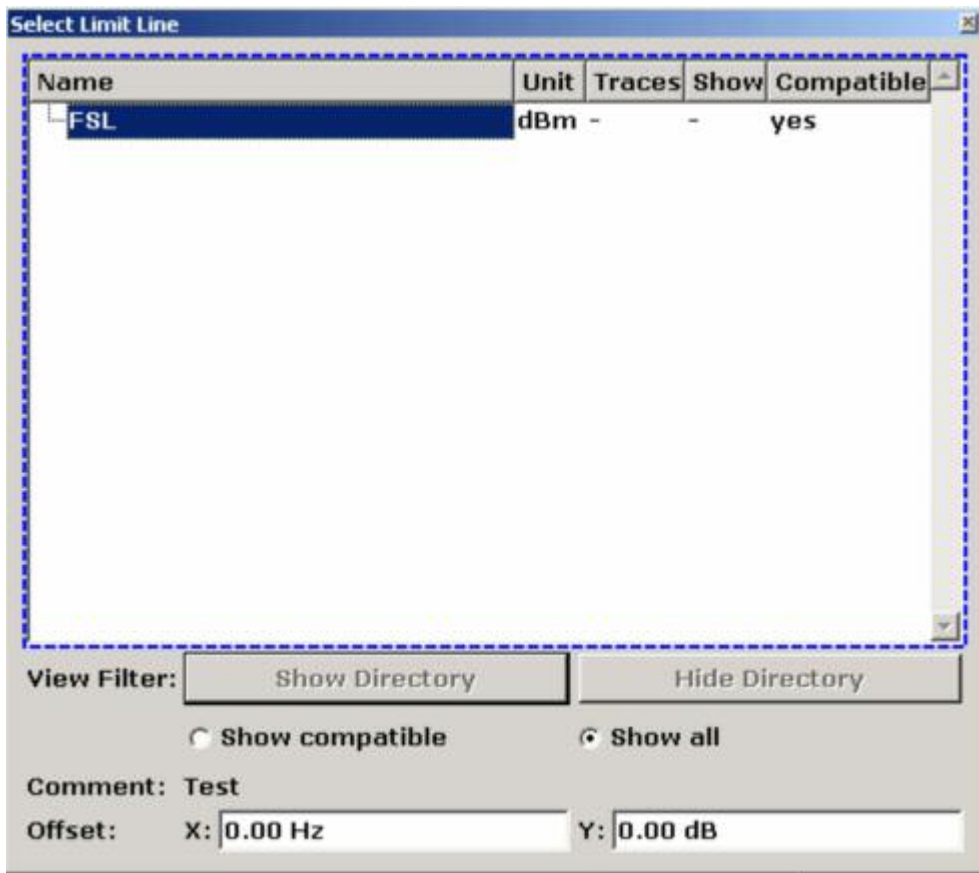
An edit dialog box is opened to enter the position of the display line (by rotary knob, step keys or numerical entry). If the line was switched off, it is switched on. If it was switched on, it remains switched on.

3. If another softkey is pressed, the edit dialog box for the **Display Line 1** softkey is closed, but the line remains switched on (softkey with highlighted background).
4. Press the **Display Line 1** softkey for the second time.
The edit dialog box for the display line will be opened again.
5. Press the **Display Line 1** softkey again.

The line is switched off (softkey without highlighted background).

To select a limit line

1. To display the **Select Limit Line** dialog box, press the **LINES** key or go to the main limit line menu.



All limit lines, saved in the default directory, and all subdirectories are displayed. For each limit line, the following information is given:

| | |
|-------------------|---|
| Unit | unit of the y-axis |
| Traces | selected traces to check |
| Show | limit line displayed in the measurement diagram or hidden |
| Compatible | compatibility of the limit line to the current measurement settings |

2. To display only the limit lines that are compatible, activate the **Show compatible** option. For details on compatibility refer to "[Limit Lines](#)" on page 4.80.
3. To navigate into a subdirectory, use the **Show Directory** and **Hide Directory** buttons.

To create a new limit line

1. Press the **New** softkey to define a new limit line.

The **Edit Limit Line** dialog box is displayed. For more details on limit lines refer also to "[Limit Lines](#)" on page 4.80.

2. Press the **Edit Name** softkey and enter a name, if you want to save the limit line in the main directory. To save the limit line in an existing subdirectory, enter the relative path. A new subdirectory can only be created using the **FILE** key (for details refer to section "Instrument Functions – Basic Settings", "Saving and Recalling Data Sets – FILE Key").

- To change the span setting, set the focus in the **X–Axis** field and change the unit via the rotary knob: **Hz** for span > 0 Hz or **s** for zero span.
- To change between absolute and relative scale mode for the x–axis, set the focus on the **abs** or **rel** option next to the **X–Axis** field and press the **CHECKMARK** key. Relative scaling is always suitable, if masks for bursts are to be defined in zero span, or if masks for modulated signals are required for span > 0 Hz.

absolute: The frequencies or times are interpreted as absolute physical units.

relative: In the data point table, the frequencies are referred to the currently set center frequency. In the zero span mode, the left boundary of the diagram constitutes the reference.

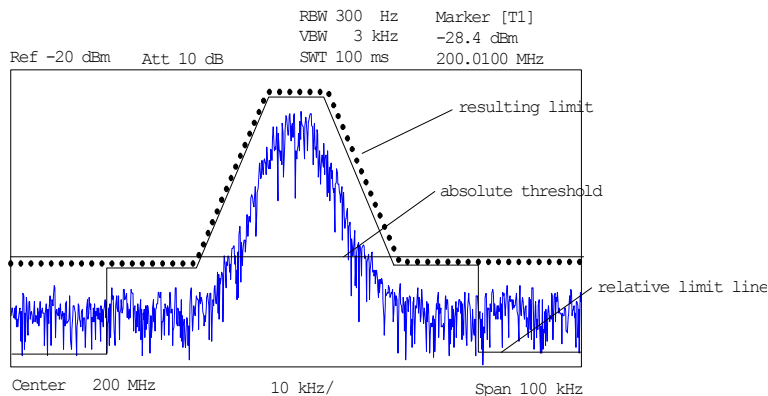
- To change the scaling of the y–axis, set the focus in the **Y–Axis** field and change the unit using the rotary knob.
- To change between absolute and relative units for the y–axis, set the focus on the **abs** or **rel** option next to the **Y–Axis** field and press the **CHECKMARK** key.

absolute: The limit values refer to absolute levels or voltages.

relative: The limit values refer to the reference level (Ref Level). Limit values with the unit dB are always relative values.

- To define the limit line as upper or lower limit line, set the focus on the **Upper** or **Lower** option and press the **CHECKMARK** key.
- To change between linear or logarithmic scale of the x–axis, set the focus on the **lin** or **log** option and press the **CHECKMARK** key.
- If the scaling of the y–axis is relative, you can define an absolute threshold value that works as a lower limit for the relative limit values (see figure below). Set the focus in the **Threshold** field and enter a value.

The function is especially useful for mobile radio applications provided the limit values are defined in relation to the carrier power as long as they are above an absolute limit value.



- To define a signal–level distance to the limit line, press the **Edit Margin** softkey and enter a value.
If the limit line is defined as an upper limit, the margin means that the level is below the limit line. If the limit line is defined as a lower limit, the margin means that the level is above the limit line.
- To enter a comment, press the **Edit Comment** and enter a comment, e.g. a description of the application.
- To enter a new data point:
 - Press the **Insert Value Above** softkey.
 - Enter the new x and y value in the successive displayed edit dialog boxes.

13. To change a data point:
 - Set the focus on the x and y value to be changed and press the **Value** softkey.
 - Enter the new x or y value in the displayed edit dialog box.
14. To delete a data point, select the corresponding entry and press the **Delete Value** softkey.
15. To shift the complete limit line parallel in the horizontal direction, select the **Shift x** button and enter a x shift value.
16. To shift the complete limit line parallel in the vertical direction, select the **Shift y** button and enter an y shift value.
17. Press the **Save Limit Line** softkey.

If an existing name is used, a message box is displayed. You have to confirm before the limit line is overwritten.

To edit an existing limit line

1. In the **Select Limit Line** dialog box, select the limit line you want to alter. For details see also "[To select a limit line](#)" on page 4.77.
2. Press the **Edit** softkey.
3. Edit the data as described in "[To select a limit line](#)" on page 4.77.
4. Save the limit line (**Save Limit Line** softkey).

To create a new limit line based upon an existing limit line

1. In the **Select Limit Line** dialog box, select the limit line you want to use as a basis for a new limit line. For details see also "[To select a limit line](#)" on page 4.77.
2. Press the **Copy to** softkey to transfer the data of the limit line into the **Edit Limit Line** dialog box.
3. Press the **Edit Name** softkey and enter a new name.
4. To shift the complete limit line parallel in the horizontal direction, select the **Shift x** button and enter an x shift value. In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally.
5. To shift the complete limit line parallel in the vertical direction, select the **Shift y** button and enter a y shift value. In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted in Y direction
6. If required, edit the data as described in "[To select a limit line](#)" on page 4.77.
7. Save the limit line (**Save Limit Line** softkey).

To activate/deactivate a limit line

Prerequisites:

- The x– and y–units of limit line and current measurement setting have to be compatible. For details refer to "[Limit Lines](#)" on page 4.80.
 - The limit line has to consist of 2 or more data points.
1. In the **Select Limit Line** dialog box, select the limit line you want to activate/deactivate. For details see also "[To select a limit line](#)" on page 4.77.
 2. To activate or deactivate a limit line for a trace, press the **Select Traces to check** softkey and select or deselect the trace(s) to which this limit line applies.
 3. To deactivate the limit line for all traces, press the **Deselect All** softkey.

Display Lines

Display lines help to evaluate a trace – as do markers. The function of a display line is comparable to that of a ruler that can be shifted on the trace in order to mark absolute values. They are exclusively used to optically mark relevant frequencies or points in time (span = 0) as well as constant level values. It is not possible to check automatically whether the points are below or above the marked level values.

The softkeys for setting and switching the display lines on/off work like triple switches. For details see "[To work with display lines](#)" on page 4.76.

Two different types of display lines are provided:

- Two horizontal level lines for marking levels – Display Line 1 and 2
The level lines are continuous horizontal lines across the entire width of a diagram and can be shifted in y direction.
- Two vertical frequency or time lines for marking frequencies or points in time – Frequency/Time Line 1 and 2
The frequency or time lines are continuous vertical lines across the entire height of the diagram and can be shifted in x direction.

Each line is identified by one of the following abbreviations:

- D1: Display Line 1
- D2: Display Line 2
- F1: Frequency Line 1
- F2: Frequency Line 2
- T1: Time Line 1
- T2: Time Line 2

Limit Lines

Limit lines are used to define amplitude curves or spectral distribution boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a device under test (DUT). For transmission of information in TDMA systems (e.g. GSM), the amplitude of the bursts in a timeslot must adhere to a curve that falls within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The instrument supports limit lines with a maximum of 50 data points. 8 of the limit lines stored in the instrument can be activated simultaneously. The number of limit lines stored in the instrument is only limited by the capacity of the flash disk used. For details see also "[To select a limit line](#)" on page 4.77.

Limit lines are compatible with the current measurement settings, if the following applies:

- The x unit of the limit line has to be identical to the current setting.
- The y unit of the limit line has to be identical to the current setting with the exception of dB based units; all dB based units are compatible with each other.

At the time of entry, the R&S FSL immediately checks that all limit lines are in accordance with the following guidelines:

- The frequencies/times for each data point must be entered in ascending order, however, for any single frequency/time, two data points may be entered (vertical segment of a limit line).
- The data points are allocated in order of ascending frequency/time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.

- The entered frequencies/times need not necessarily be selectable in R&S FSL. A limit line may also exceed the specified frequency or time range. The minimum frequency for a data point is –200 GHz, the maximum frequency is 200 GHz. For the time range representation, negative times may also be entered. The allowed range is –1000 s to +1000 s.

Softkeys of the lines menu

The following table shows all softkeys available in the lines menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|------------------------|--------------------------------------|
| Select Traces to check | |
| Deselect All | |
| New ↓ | Edit Name |
| | Edit Comment |
| | Edit Margin |
| | Value |
| | Insert Value Above |
| | Delete Value |
| | Save Limit Line |
| Edit ↓ | same contents as New Limit Line menu |
| Copy to ↓ | same contents as New Limit Line menu |
| Delete | |
| Display Lines ↓ | Display Line 1 |
| | Display Line 2 |
| | Frequency Line 1 |
| | Frequency Line 2 |
| | Time Line 1 |
| | Time Line 2 |

Select Traces to check

Opens the **Select Traces to Check** dialog box to activate the selected limit line for a trace. One limit line can be activated for several traces simultaneously. For details see also "[To activate/deactivate a limit line](#)" on page 4.79 .

This softkey is available from firmware version 1.10.

- Remote: CALC:LIM2:TRAC 3
- Remote: CALC:LIM:STAT ON

Deselect All

Deactivates the selected limit line for all assigned traces. For details see also "[To activate/deactivate a limit line](#)" on page 4.79 .

This softkey is available from firmware version 1.10.

- Remote: CALC:LIM:STAT OFF

New

Opens the **Edit Limit Line** dialog box and a submenu to define a new limit line. For details see also "[Limit Lines](#)" on page 4.80 and "[To select a limit line](#)" on page 4.77.

This softkey is available from firmware version 1.10.

Edit Name

Sets the focus on the **Name** field to enter or change the limit line name. A maximum of 8 characters is permitted for each name. All names must be compatible with the Windows XP conventions for file names. The limit line data are stored under this name. The instrument stores all limit lines with LIM as extension.

This softkey is available from firmware version 1.10.

→ Remote: CALC:LIM3:NAME "GSM1"

Edit Comment

Sets the focus on the **Comment** field to enter or change a comment for the limit line. The text must not exceed 40 characters.

This softkey is available from firmware version 1.10.

→ Remote: CALC:LIM5:COMM 'Upper limit for spectrum'

Edit Margin

Sets the focus on the **Margin** field to enter or change a margin for the limit line. The default setting is 0 dB (i.e. no margin).

This softkey is available from firmware version 1.10.

Value

Opens an edit dialog box to change an existing x or y value, depending on the selected column. The softkey is only available if an existing value is selected.

The desired data points are entered in ascending order (two repeated frequencies/time values are permitted).

This softkey is available from firmware version 1.10.

→ Remote: CALC:LIM3:CONT:DATA 1MHz, 3MHz, 30MHz

→ Remote: CALC:LIM3:UPP:DATA -10, 0, 0

→ Remote: CALC:LIM3:LOW:DATA -30, -40, -40

Insert Value Above

Creates an empty line above the selected data point to enter a new data point. This softkey corresponds to the **Insert** button in the dialog box.

It is also possible to add a data point at the end of the list, if the focus is set below the last entry line of the list.

The data points are entered in ascending order (two repeated frequencies/time values are permitted). If the entered values are not in accordance with the ascending order rule, an error message is displayed and the values are discarded.

This softkey is available from firmware version 1.10.

Delete Value

Deletes the selected data point (x and y value). All succeeding data points are shifted up accordingly. This softkey corresponds to the **Delete** button in the dialog box.

The softkey is only available if an existing value is selected.

This softkey is available from firmware version 1.10.

Save Limit Line

Saves the currently edited limit line under the name defined in the **Name** field.

This softkey is available from firmware version 1.10.

Edit

Opens a submenu to edit limit lines. For details see also "[Limit Lines](#)" on page 4.80 and "[To edit an existing limit line](#)" on page 4.79.

This softkey is available from firmware version 1.10.

→ Remote: For details refer to chapter "Remote Control – Commands", section "Definition of the limit line".

Copy to

Copies the data of the selected limit line and displays it in the **Edit Limit Line** dialog box. If the limit line is edited and saved under a new name, a new limit line can be easily generated by parallel translation or editing of an existing limit line.

For details see also "[Limit Lines](#)" on page 4.80 and "[To create a new limit line based upon an existing limit line](#)" on page 4.79.

This softkey is available from firmware version 1.10.

→ Remote: CALC:LIM3:COPY 2

Delete

Deletes the selected limit line.

This softkey is available from firmware version 1.10.

→ Remote: CALC:LIM3:DEL

Display Lines

Opens a submenu to enable, disable and set display lines. Which softkeys are available depends on the display mode (frequency or time range). For details see also "[Display Lines](#)" on page 4.80 and "[To work with display lines](#)" on page 4.76.

Display Line 1 and Display Line 2

Enable or disable the level lines 1/2 and open an edit dialog box to enter the position of the lines. For details see also "[Display Lines](#)" on page 4.80 and "[To work with display lines](#)" on page 4.76.

- Remote: CALC:DLIN:STAT ON
 - Remote: CALC:DLIN -20dBm
-

Frequency Line 1 and Frequency Line 2 (span > 0)

Enable or disable the frequency lines 1/2 and open an edit dialog box to enter the position of the lines. For details see also "[Display Lines](#)" on page 4.80 and "[To work with display lines](#)" on page 4.76.

- Remote: CALC:FLIN:STAT ON
 - Remote: CALC:FLIN 120MHz
-

Time Line 1 and Time Line 2 (zero span)

Enable or disable the time lines 1/2 and open an edit dialog box to enter the position of the lines. For details see also "[Display Lines](#)" on page 4.80 and "[To work with display lines](#)" on page 4.76.

- Remote: CALC:TLIN:STAT ON
 - Remote: CALC:TLIN 10ms
-

Measurement Modes

This section describes the provided measurement modes, the change of measurement modes and the access to the menus of all active measurement modes. For details refer to the following sections:

- ["Measurement Mode Selection – MODE Key"](#) on page 4.86
- ["Measurement Mode Menus– MENU key"](#) on page 4.87

Measurement Mode Selection – MODE Key

The **MODE** key provides a quick access to the menu of the current measurement mode and a fast change of the measurement mode. You can choose from the following measurement modes:

- [Spectrum Analyzer mode](#)
- [Analog Demodulation mode \(Analog Demodulation option, K7\)](#)
- [WLAN mode \(WLAN TX Measurements option, K91\)](#)

To change the measurement mode

1. Press the **MODE** key.

The menu of the current measurement mode is displayed and the **Measurement Modes** dialog box is opened.

2. To activate another mode, select the corresponding option and press the **CHECKMARK** key. More than one measurement mode can be activated simultaneously.
3. To deactivate an activated mode, select the corresponding option and press the **CHECKMARK** key.

Spectrum Analyzer mode

In the **Spectrum Analyzer** mode the functions provided correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the test signal over the selected frequency range with the selected resolution and sweep time, or, for a fixed frequency, displays the waveform of the video signal. This mode is set in the initial configuration.

Analog Demodulation mode (Analog Demodulation option, K7)

The **Analog Demodulation** mode requires an instrument equipped with the corresponding optional software. This mode provides measurement functions for demodulating AM, FM, or PM signals. For details refer to "[Analog Demodulation \(Option K7\)](#)" on page 4.94.

WLAN mode (WLAN TX Measurements option, K91)

The **WLAN** mode requires an instrument equipped with the corresponding optional software. This mode provides Wireless LAN TX measurement functions according to IEEE 802.11 a, b, g and j standards. For details refer to "[WLAN TX Measurements \(Option K91\)](#)" on page 4.116

Measurement Mode Menus– MENU key

The **MENU** key provides a quick access to the menu of the current measurement mode. For details on measurement modes refer to "[Measurement Mode Selection – MODE Key](#)" on page 4.86.

To access the main menu of an active measurement mode

- Press the **MENU** key.

The menu of the current measurement mode is displayed.

If the tracking generator and the power meter are available in the current measurement mode, softkeys for these functions are also provided. In the **Spectrum Analyzer** mode with active acoustic monitoring, the softkey **Marker Demod Volume** to control the volume control for acoustic monitoring is displayed.

Menu and softkey description

- "[Optional softkeys of the menu menu](#)" on page 4.87

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Optional softkeys of the menu menu

Apart from the softkeys of the current measurement mode, the following optional softkeys are available in the menu menu. It is possible that the standard instrument does not provide all these softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command |
|-------------------------------------|
| Tracking Generator |
| Power Meter |
| Marker Demod Volume |

Tracking Generator (models 13 and 16)

Displays the menu of the **Tracking Generator** measurement mode. For details refer to "[Tracking Generator \(Models 13 and 16\)](#)" on page 4.89.

Power Meter (option Power Sensor Support, K9)

Displays the menu of the **Power Meter** measurement mode. For details refer to "[Power Meter \(Option K9\)](#)" on page 4.112.

Marker Demod Volume (Spectrum Analyzer mode)

Opens a dialog box to regulate the volume for acoustic monitoring.

Models and Options

This section describes models and firmware options that are not included in the standard instrument configuration. If hardware options are controlled via the firmware, the provided softkeys are described in the corresponding menu section. The information, with which special option or model these softkeys are supplied, is delivered in the corresponding softkey description.

A list of all available hardware and firmware options is provided on CD. To check the options your instrument provides, refer to the Quick Start Guide, chapter 2 "Preparing for Use", section "Checking the Furnished Items". For details on models and firmware options refer to the following sections:

- ["Tracking Generator \(Models 13 and 16\)"](#) on page 4.89
- ["Analog Demodulation \(Option K7\)"](#) on page 4.94
- ["Power Meter \(Option K9\)"](#) on page 4.112
- ["WLAN TX Measurements \(Option K91\)"](#) on page 4.116

Tracking Generator (Models 13 and 16)

During operation the tracking generator emits a signal exactly at the input frequency of the R&S FSL.

The tracking generator can be used in all measurement modes. Acquisition of test setup calibration values (see **Source Cal** softkey) and normalization using these correction values (see **Normalize** softkey) is only possible in the tracking generator measurement mode. For details on measurement modes refer to "[Measurement Mode Selection – MODE Key](#)" on page 4.86.

FFT filters (for details see "[To choose the appropriate filter](#)" on page 4.15) are not available when the tracking generator is active.

For measurements with running tracking generator it is recommended to set the start frequency to 3 x resolution bandwidth in order to meet the data sheet accuracy.

Note: The RF characteristics of some DUTs are especially sensitive concerning the input VSWR. In such cases insertion of 10–20 dB attenuation between the DUT and the tracking generator output is recommended.

To open the tracking generator menu

1. Press the **MENU** key.
2. Press the **Tracking Generator** softkey.
The tracking generator menu is displayed.

Menu and softkey description

- "[Softkeys of the tracking generator menu](#)" on page 4.91

Further information

- "[Transmission measurement](#)" on page 4.90
- "[Reflection measurement](#)" on page 4.90
- "[Calibration mechanism](#)" on page 4.90

Tasks

- [To calibrate for transmission and reflection measurement](#)

To calibrate for transmission and reflection measurement

Prerequisite: The instrument is in tracking generator measurement mode (for details refer to "[Measurement Mode Selection – MODE Key](#)" on page 4.86).

1. Press the **Source Power** softkey to enter the generator output level.
If the tracking generator is off, it is switched on.
2. To enter a constant level offset for the tracking generator, press the **Power Offset** softkey.
3. Press the **Source Cal** softkey to open the submenu for calibration.
4. To record a reference trace for transmission measurement, press the **Cal Trans** softkey.

The recording of the reference trace and the completion of the calibration sweep are indicated by message boxes.

- To record a reference trace for reflection measurement, press the **Cal Refl Short** or **Cal Refl Open** softkey.

The recording of the reference trace and the completion of the calibration sweep are indicated by message boxes.

- Press the **Normalize** softkey to switch on the normalization.
- Press the **Ref Value Position** softkey to display the reference line.
- Press the **Ref Value** softkey to enter a value to shift the reference line.
- Press the **Recall** softkey to restore the settings used for source calibration.

Transmission measurement

This measurement will yield the transmission characteristics of a two-port network. The built-in tracking generator serves as a signal source. It is connected to the input connector of the DUT. The input of the R&S FSL is fed from the output of the DUT. A calibration can be carried out to compensate for the effects of the test setup (e.g. frequency response of connecting cables).

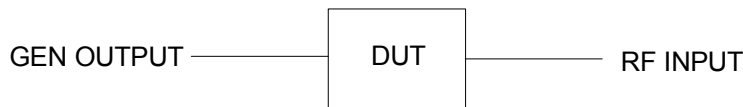


Fig. 4–8: Test setup for transmission measurement

Reflection measurement

Scalar reflection measurements can be carried out by means of a reflection-coefficient measurement bridge.

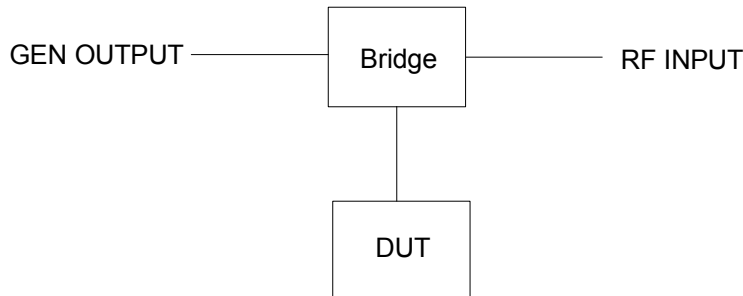


Fig. 4–9: Test setup for reflection measurement

Calibration mechanism

Calibration means a calculation of the difference between the currently measured power and a reference curve, independent of the selected type of measurement (transmission/reflection). The hardware settings used for measuring the reference curve are included in the reference dataset.

Even with normalization switched on, the device settings can be changed in a wide area without stopping the normalization. This reduces the necessity to carry out a new normalization to a minimum.

For this purpose the reference dataset (trace with 501 measured values) is stored internally as a table of 501 points (frequency/level).

Differences in level settings between the reference curve and the current device settings are taken into account automatically. If the span is reduced, a linear interpolation of the intermediate values is applied. If the span increases, the values at the left or right border of the reference dataset are extrapolated to the current start or stop frequency, i.e. the reference dataset is extended by constant values.

An enhancement label is used to mark the different levels of measurement accuracy. This enhancement label is displayed at the right diagram border when normalization is switched on and a deviation from the reference setting occurs. Three accuracy levels are defined:

Table 4: Measurement accuracy levels

| Accuracy | Enhancement label | Reason/Limitation |
|----------|-----------------------|--|
| high | NOR | no difference between reference setting and measurement |
| medium | APX (approximation) | change of the following settings: <ul style="list-style-type: none"> • coupling (RBW, VBW, SWT) • reference level, RF attenuation • start or stop frequency • output level of tracking generator • frequency offset of tracking generator • detector (max. peak, min. peak, sample, etc.) change of frequency: <ul style="list-style-type: none"> • max. 501 points within the set sweep limits (corresponds to a doubling of the span) |
| – | Aborted normalization | more than 500 extrapolated points within the current sweep limits (in case of span doubling) |

*Note: At a reference level of –10 dBm and at a tracking generator output level of the same value the R&S FSL operates without overrange reserve, i.e. the R&S FSL is in danger of being overloaded if a signal is applied whose amplitude is higher than the reference line. In this case, either the message **OVL** for overload or **IFOVL** for exceeded display range (clipping of the trace at the upper diagram border = overrange) is displayed in the status line.*

Overloading can be avoided as follows:

- Reducing the output level of the tracking generator (**Source Power** softkey in the tracking generator menu)
- Increasing the reference level (**Ref Level** softkey in the amplitude menu)

Softkeys of the tracking generator menu

The following table shows all softkeys available in the tracking generator menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|----------------|--------------------|
| Source On/Off | |
| Source Power | |
| Power Offset | |
| Source Cal ↓ | Cal Trans |
| | Cal Refl Short |
| | Cal Refl Open |
| | Normalize |
| | Ref Value Position |
| | Ref Value |
| | Recall |

Source On/Off

Switches the tracking generator on or off. Default setting is off.

→ Remote: `OUTP:STAT ON`

Source Power

Opens an edit dialog box to enter a tracking generator output power. The default output power is -20 dBm. Values from -20 dBm to 0 dBm in 1 dB steps are allowed.

If the tracking generator is off, it is automatically switched on when an output power value is entered.

→ Remote: `SOUR:POW -20dBm`

Power Offset

Opens an edit dialog box to enter a constant level offset for the tracking generator. Values from -200 dB to +200 dB in 1 dB steps are allowed. The default setting is 0 dB. Offsets are indicated by the enhancement label **LVL**.

With this offset for example attenuators or amplifiers at the output connector of the tracking generator can be taken into account for the displayed output power values on screen or during data entry. Positive offsets apply to an amplifier and negative offsets to an attenuator subsequent to the tracking generator.

→ Remote: `SOUR:POW:OFFS -10dB`

Source Cal

Opens a submenu to configure calibration for transmission and reflection measurement. For details on the test setups see "[Transmission measurement](#)" on page 4.90 and "[Reflection measurement](#)" on page 4.90.

Cal Trans

Starts a sweep that records a reference trace. This trace is used to calculate the difference for the normalized values.

→ Remote: `CORR:METH TRAN`

Cal Refl Short

Starts a sweep as reference trace for short-circuit calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration curve is calculated by averaging the two measurements and stored in the memory. The order of the two calibration measurements is free.

→ Remote: `CORR:METH REFL`

Cal Refl Open

Starts a sweep as reference trace the open-circuit calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration curve is calculated by averaging the two measurements and stored in the memory. The order of the two calibration measurements is free.

→ Remote: `CORR:COLL OPEN`

Normalize

Switches the normalization on or off. The softkey is only available if the memory contains a reference trace. For details on normalization see "[Calibration mechanism](#)" on page 4.90.

→ Remote: `CORR ON`

Ref Value Position

Switches the reference line on or off. The reference line marks the reference position at which the normalization result (calculated difference with a reference trace) is displayed. For details on the reference line see "[Calibration mechanism](#)" on page 4.90.

→ Remote: `DISP:WIND:TRAC:Y:RPOS 10PCT`

Ref Value

Opens an edit dialog box to enter a position value that shifts the reference line vertically. By default the reference line corresponds to a difference of 0 dB between the currently measured trace and the reference trace.

If, e.g. after a source calibration, a 10 dB attenuation is inserted into the signal path between DUT and R&S FSL input, the measurement trace will be moved by 10 dB down. Entering a reference value of -10 dB will shift the reference line also by 10 dB down and place the measurement trace on the reference line. The deviation from the nominal power level can be displayed with higher resolution (e.g. 1 dB/div). The power is still displayed in absolute values.

→ Remote: `DISP:WIND:TRAC:Y:RVAL -10dB`

Recall

Restores the settings that were used during source calibration. This can be useful if device settings were changed after calibration (e.g. center frequency, frequency deviation, reference level, etc).

→ Remote: `CORR:REC`

Analog Demodulation (Option K7)

The digital signal processing in the R&S FSL, used in the analyzer mode for digital IF filters, is also ideally suited for demodulating AM, FM, or PM signals. The firmware option FSL–K7 provides the necessary measurement functions.

The R&S FSL is equipped with a demodulator that is capable of performing AM, FM, and PM demodulation at a time. Additionally maximum, minimum and average or current values can be obtained parallelly over a selected number of measurements. In order to make it suitable for bursted signals, the demodulator can be configured in terms of pretrigger time, sample rate and record length.

By sampling (digitization) already at the IF and digital down–conversion to the baseband (I/Q), the demodulator achieves maximum accuracy and temperature stability. There is no evidence of typical errors of an analog down–conversion and demodulation like AM to FM conversion and vice versa, deviation error, frequency response or frequency drift at DC coupling.

This option is available from firmware version 1.10.

To open the analog demodulation menu

- If the **Analog Demodulation** mode is not the active measurement mode, press the **MODE** key and activate the **Analog Demodulation** option.
- If the **Analog Demodulation** mode is already active, press the **MENU** key.

The analog demodulation menu is displayed. If the tracking generator (models 13 and 16) or the power meter (option Power Sensor Support, K9) is available, softkeys for these functions are also provided.

Menu and softkey description

- ["Softkeys of the analog demodulation menu"](#) on page 4.97
- ["Softkeys of the frequency menu \(Analog Demodulation mode\)"](#) on page 4.104
- ["Softkeys of the span menu \(Analog Demodulation mode\)"](#) on page 4.105
- ["Softkeys of the amplitude menu \(Analog Demodulation mode\)"](#) on page 4.106
- ["Softkeys of the bandwidth menu \(Analog Demodulation mode\)"](#) on page 4.109
- ["Softkeys of the sweep menu \(Analog Demodulation mode\)"](#) on page 4.109
- ["Softkeys of the trigger menu \(Analog Demodulation mode\)"](#) on page 4.110

Apart from the power measurement menu that is not available in the **Analog Demodulation** mode, all other menus are provided as described for the base unit. For details refer to the corresponding menu descriptions.

Further information

- ["Circuit description – block diagrams"](#) on page 4.94
- ["Demodulation bandwidth"](#) on page 4.96
- ["AF trigger"](#) on page 4.96
- ["Stability of measurement results"](#) on page 4.96
- ["Sample rate, measurement time and trigger offset"](#) on page 4.97

Circuit description – block diagrams

The software demodulator runs on the main processor of the analyzer. The demodulation process is shown in Fig. 4–10: Block diagram of software demodulator. All calculations are performed

simultaneously with the same I/Q data set. Magnitude (= amplitude) and phase of the complex I/Q pairs are determined. The frequency result is obtained from the differential phase.

For details on the analyzer signal processing refer to chapter "Remote Control – Commands", section "TRACe:IQ Subsystem".

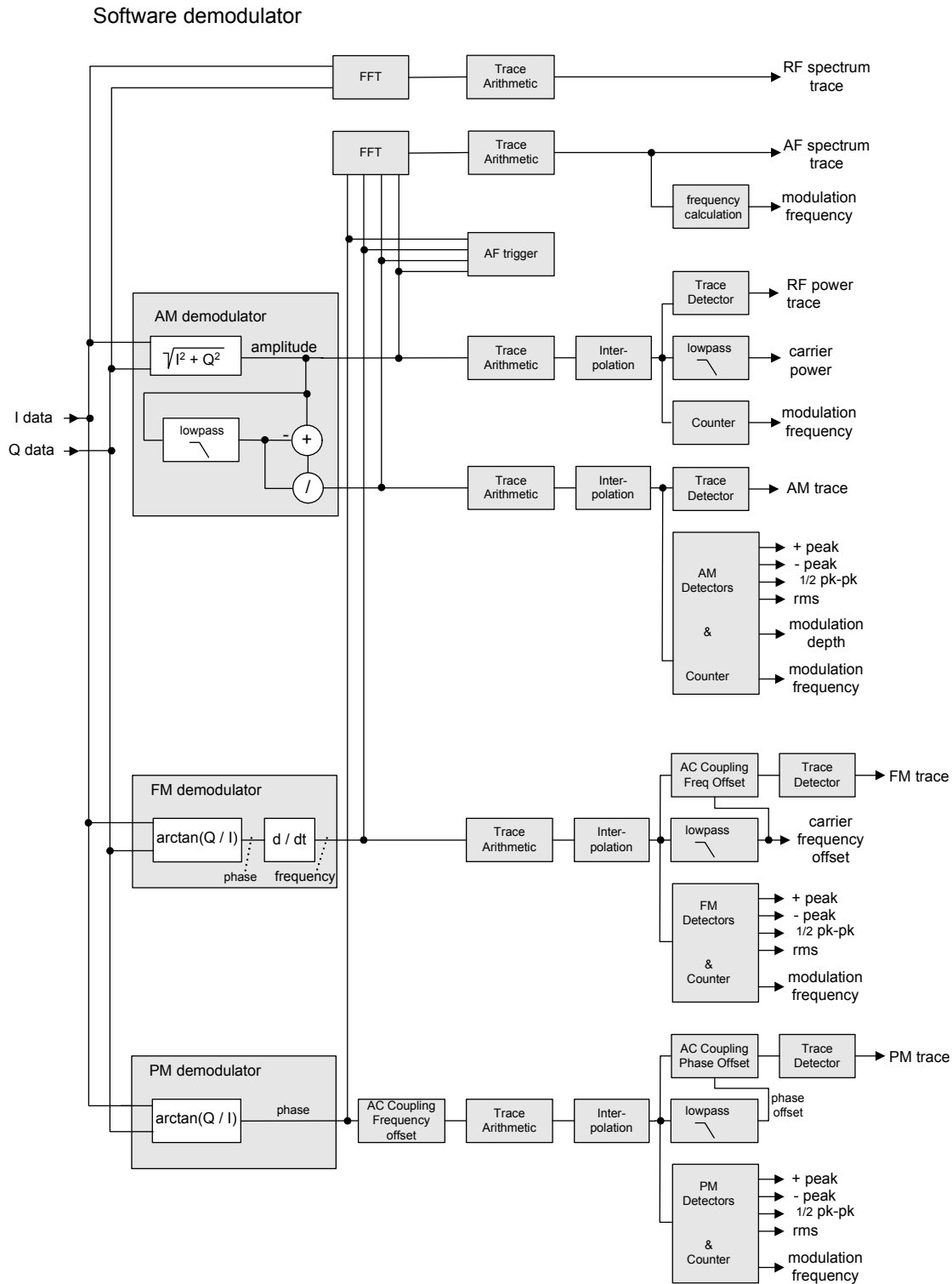


Fig. 4–10: Block diagram of software demodulator

The AM DC, FM DC and PM DC raw data of the demodulators is fed into the *Trace Arithmetic* block that combines consecutive data sets. Possible trace modes are: Clear Write, Max Hold, Min Hold and Average (for details refer to chapter "Instrument Functions", section "Trace mode overview"). The output data of the *Trace Arithmetic* block can be read via remote control.

The collected measurement points are evaluated by the selected detector (for details refer to chapter "Instrument Functions", section "Detector overview"). The result is displayed on the screen and can be read out via remote control.

In addition, important parameters are calculated:

- A counter determines the modulation frequency for AM, FM, and PM.
- A low pass filter suppresses the modulation frequency; the result is:
average power = carrier power (RF power)
average frequency = carrier frequency offset (FM)
The deviation from the selected center frequency is displayed.
- AC coupling is possible with FM and PM display. The carrier frequency offset is subtracted from the FM DC data, and the frequency deviation is determined from the trace data. +Peak, –Peak, $\frac{1}{2}$ Peak–Peak and RMS are displayed.

Demodulation bandwidth

The demodulation bandwidth is not the 3 dB bandwidth but the useful bandwidth which is distortion–free with regard to phase and amplitude.

Therefore the following formulas apply:

- AM: demodulation bandwidth $\geq 2 \times$ modulation frequency
- FM: demodulation bandwidth $\geq 2 \times$ (frequency deviation + modulation frequency)
- PM: demodulation bandwidth $\geq 2 \times$ modulation frequency $\times (1 +$ phase deviation)

Note: *If the center frequency of the analyzer is not set exactly to the signal frequency, the demodulation bandwidth must be selected larger by the carrier offset, in addition to the requirement described above. This also applies if FM or PM AC coupling has been selected.*

In general, the demodulation bandwidth should be as narrow as possible to improve the S/N ratio. The residual FM caused by noise floor and phase noise increases dramatically with the bandwidth, especially with FM.

AF trigger

The analog demodulation option allows triggering to the demodulated signal. The display is stable if a minimum of five modulation periods are within the recording time.

Triggering is always DC–coupled. Therefore triggering is possible directly to the point where a specific carrier level, phase or frequency is exceeded or not attained.

Stability of measurement results

Despite amplitude and frequency modulation, the display of carrier power and carrier frequency offset is stable.

This is achieved by a digital filter which sufficiently suppresses the modulation, provided, however, that the measurement time is $\geq 3 \times 1 /$ modulation frequency, i.e. that at least three periods of the AF signal are recorded.

The mean carrier power for calculating the AM is also calculated with a digital filter that returns stable results after a measurement time of $\geq 3 \times 1 / \text{modulation frequency}$, i.e. at least three cycles of the AF signal must be recorded before a stable AM can be shown.

Sample rate, measurement time and trigger offset

Depending on the sample rate, the maximum demodulation bandwidths listed in the table can be obtained during the measurement. The permissible value range of the measurement time and trigger offset depends on the selected demodulation bandwidth.

| Demod. bandwidth | Sample rate | Min. meas. time | Max. meas. time | Min. trigger offset | Max. trigger offset |
|------------------|----------------|-----------------|-----------------|---------------------|---------------------|
| 18 MHz | 32 MHz | 31.25 ns | 12.5 ms | -12.5 ms | 507.9 ms |
| 10 MHz | 32 MHz | 31.25 ns | 12.5 ms | -12.5 ms | 507.9 ms |
| 8 MHz | 16 MHz | 62.5 ns | 25 ms | -25 ms | 1.015 s |
| 5 MHz | 8 MHz | 125 ns | 50 ms | -50 ms | 2.031 s |
| 3 MHz | 4 MHz | 250 ns | 100 ms | -100 ms | 4.063 s |
| 1.6 MHz | 2 MHz | 500 ns | 200 ms | -200 ms | 8.126 s |
| 800 kHz | 1 MHz | 1 μ s | 400 ms | -400 ms | 16.25 s |
| 400 kHz | 500 kHz | 2 μ s | 800 ms | -800 ms | 32.50 s |
| 200 kHz | 250 kHz | 4 μ s | 1.6 s | -1.6 s | 65.00 s |
| 100 kHz | 125 kHz | 8 μ s | 3.2 s | -3.2 s | 130.0 s |
| 50 kHz | 62.5 kHz | 16 μ s | 6.4 s | -6.4 s | 260.0 s |
| 25 kHz | 31.25 kHz | 32 μ s | 12.8 s | -12.8 s | 520.0 s |
| 12.5 kHz | 15.625 kHz | 64 μ s | 25.6 s | -25.6 s | 1040 s |
| 6.4 kHz | 7,8125 kHz | 128 μ s | 51.2 s | -51.2 s | 2080 s |
| 3.2 kHz | 3,90625 kHz | 256 μ s | 102.4 s | -102.4 s | 4160 s |
| 1.6 kHz | 1,953125 kHz | 512 μ s | 204.8 s | -204.8 s | 8321 s |
| 800 Hz | 976,5625 Hz | 1.024 ms | 409.6 s | -409.6 s | 16643 s |
| 400 Hz | 488,28125 Hz | 2.048 ms | 819.2 s | -819.2 s | 33287 s |
| 200 Hz | 244,140625 Hz | 4.096 ms | 1638.4 s | -1638.4 s | 66574 s |
| 100 Hz | 122,0703125 Hz | 8.192 ms | 3276.8 s | -3276.8 s | 133148 s |

Softkeys of the analog demodulation menu

The following table shows all softkeys available in the analog demodulation menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Submenu / Command | Command |
|---------------------|----------------------------------|---------------------|
| Modulation AM/FM/PM | | |
| Result Display | AF Time Domain | |
| | AF Spectrum | |
| | RF Time Domain | |
| | RF Spectrum | |
| | Select Trace | |
| | Diagram Full Size | |
| Demod BW | | |
| Meas Time | | |
| AF Range ↓ | Dev per Division/dB per Division | |
| | Reference Position | |
| | Reference Value | |
| | Deviation Lin/Log | |
| Demod Settings ↓ | AF Coupling AC/DC | |
| | AF Filter ↓ | Low Pass AF Filter |
| | | High Pass AF Filter |
| | | Deemphasis |
| | Zero Phase Reference Point | |
| | Phase Wrap On/Off | |
| | Phase Unit Rad/Deg | |
| More ↓ | | |
| Zoom | | |

Modulation AM/FM/PM

Selects the display of demodulated AM, FM, or PM signal. In single sweep mode, the data is determined from the current I/Q data set, i.e. a change to AM/FM/PM does not trigger a new measurement.

If FM is selected, the average value of the demodulated signal is mapped depending on the **AF Coupling AC/DC** softkey setting.

→ Remote: CALC:FEED 'XTIM:FM'

Result Display

Opens a submenu to select the measurement result to be displayed. The RF or AF signal in the zero span or the RF or AF frequency spectrum determined via FFT can be selected for display.

In order to display the measurement results, the screen is divided in two halves. In the upper half, the measurement results are displayed as a trace. In the lower half the results of additional evaluation functions are shown.

All displays are determined from the I/Q data set recorded for the measurement. In single sweep mode, the single data set recorded can be evaluated in all displays simply by switching the result display.

AF Time Domain

Selects the AF display in zero span, calculated from the AM, FM, or PM signal.

→ Remote: `CALC:FEED 'XTIM:FM'`

AF Spectrum

Selects the display of the AF spectrum. The AF spectrum can be calculated from the AM, FM, or PM signal in zero span.

→ Remote: `CALC:FEED 'XTIM:FM:AFSP'`

RF Time Domain

Selects the display of the RF signal in zero span. In contrast to normal analyzer operation, the level values are determined from the recorded I/Q data set as root-mean-square values.

The softkey is not available if the RF spectrum display is selected.

→ Remote: `CALC:FEED 'XTIM:RFP'`

RF Spectrum

Selects the display of the RF signal in span > 0. In contrast to normal spectrum analyzer operation, the measured values are determined using FFT from the recorded I/Q data set.

→ Remote: `CALC:FEED 'XTIM:SPECTRUM'`

Select Trace

Opens an edit dialog box to enter the number of the trace for which the data is to be displayed in the lower half of the screen. Only activated traces can be selected.

Diagram Full Size

Switches the diagram to full screen size.

→ Remote: `DISP:SIZE LARG`

Demod BW

Opens an edit dialog box to enter the demodulation bandwidth of the analog demodulation. The demodulation bandwidth determines the sampling rate for recording the signal to be analyzed. For details on the relation between demodulation bandwidth and sampling rate refer to "[Sample rate, measurement time and trigger offset](#)" on page 4.97.

→ Remote: `SENS:BAND:DEM 10MHZ`

Meas Time

Opens an editor for entering the measurement time of the analog demodulation. For details on the measurement time values refer to "[Sample rate, measurement time and trigger offset](#)" on page 4.97.

- Remote: SENS:ADEM:MTIM 62.5US
 - Remote: SENS:SWE:TIME 62.5US
-

AF Range

Opens a submenu for determining the diagram scaling for AF displays.

The range for RF displays is set via the amplitude menu. For details refer to "[Setting the Level Display and Configuring the RF Input – AMPT Key](#)" on page 4.12.

Dev per Division

Opens an edit dialog box to set the modulation depth or the phase or frequency deviation per division:

- AM display: 0.0001% to 1000%
- FM display: 1 Hz/div to 1 MHz/div
- PM display: 0.0001 rad/div to 1000 rad/div

The softkey is not available if logarithmic display is set (**Deviation Lin/Log** softkey).

- Remote: DISP:WIND:TRAC:Y:PDIV 50kHz
-

dB per Division

Opens an edit dialog box to set the modulation depth or the FM or PM deviation to be displayed in the range 0.1 dB/div to 20 dB/div.

The softkey is not available if linear display is set (**Deviation Lin/Log** softkey).

- Remote: DISP:WIND:TRAC:Y:PDIV 5DB
-

Reference Position

Determines the position of the reference line for the modulation depth or the phase or frequency deviation on the y axis of the diagram. By default, this line is set to 0.

The position is entered as a percentage of the diagram height with 100 % corresponding to the upper diagram border. The default setting is 50 % (diagram center) for the display of the AM, FM, or PM signal, and 100% (upper diagram border) for the AF spectrum display of the AM, FM, or PM signal.

- Remote: DISP:WIND:TRAC:Y:RPOS 50PCT
-

Reference Value

Determines the modulation depth or the frequency or phase deviation at the reference line of the y axis. The reference value is set separately for each display of the AM, FM, and PM signal and the AF spectrum of the AM, FM, and PM signal.

- AM/FM/PM signal display

The trace display takes individual frequency/phase offsets into account (in contrast, the **AF Coupling AC/DC** softkey permits automatic correction by the average frequency/phase offset of the signal, and can therefore not be activated simultaneously).

Possible values: 0 and $\pm 10000\%$ (AM), 0 and ± 10 MHz (FM), 0 and ± 10000 rad (PM).

- AF spectrum display of the AM/FM/PM signal

In the default setting, the reference value defines the modulation depth or the FM/PM deviation at the upper diagram border.

Possible values: 0 and 10000% (AM), 0 and 10 MHz (FM), 0 and 10000 rad (PM).

→ Remote: `DISP:WIND:TRAC:Y:RVAL OHZ`

Deviation Lin/Log

Switches between logarithmic and linear display of the modulation depth or the frequency or phase deviation.

→ Remote: `DISP:WIND:TRAC:Y:SPAC LOG`

Demod Settings

Opens a submenu for the demodulation settings.

AF Coupling AC/DC

Controls the automatic correction of the frequency offset and phase offset of the input signal:

- FM signal display

If DC is selected, the absolute frequency is displayed, i.e. an input signal with an offset relative to the center frequency is not displayed symmetrically with respect to the zero line.

If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

- PM signal display

If DC is selected, the phase runs according to the existing frequency offset. In addition, the DC signal contains a phase offset of ± 11 .

If AC is selected, the frequency offset and phase offset are automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

The softkey is not available with the AF spectrum display of the FM or PM signal.

→ Remote: `SENS:ADEM:AF:COUP DC`

AF Filter

Opens a submenu to select the appropriate filters. The bandwidth of the demodulated signal can be reduced by high pass or low pass filters and also a de-emphasis can be switched on. The

selected filters are used for AM, FM and PM demodulation in common. Individual settings are not possible.

Low Pass AF Filter

Opens the **Low Pass AF Filter** dialog box to select the filter type. Relative and absolute low pass filter are available.

- Relative low pass filters:

The filters (3 dB) can be selected in % of the demodulation bandwidth. The filters are designed as 5th-order Butterworth filter (30 dB/octave) and active for all demodulation bandwidths.

- Absolute low pass filters:

The filter are indicated by the 3 dB cutoff frequency. The 3 kHz and 15 kHz filters are designed as 5th-order Butterworth filter (30 dB/octave). The 150 kHz filter is designed as 8th-order Butterworth filter (48 dB/octave).

The absolute low pass filters are active in the following demodulation bandwidth range:

| | |
|----------|--|
| 3 kHz: | $6.4 \text{ kHz} \leq \text{demodulation bandwidth} \leq 4 \text{ MHz}$ |
| 15 kHz: | $50 \text{ kHz} \leq \text{demodulation bandwidth} \leq 16 \text{ MHz}$ |
| 150 kHz: | $400 \text{ kHz} \leq \text{demodulation bandwidth} \leq 16 \text{ MHz}$ |

- Remote: `SENS:FILT:LPAS`
- Remote: `SENS:FILT:LPAS:FREQ`
- Remote: `SENS:FILT:LPAS:FREQ:REL`

High Pass AF Filter

Opens the **High Pass AF Filter** dialog box to switch on a high pass filter with the given limit to separate the DC component. The filters are indicated by the 3 dB cutoff frequency. The filters are designed as 2nd-order Butterworth filter (12 dB/octave).

The high pass filters are active in the following demodulation bandwidth range:

| | |
|---------|---|
| 50 Hz: | $200 \text{ Hz} \leq \text{demodulation bandwidth} \leq 4 \text{ MHz}$ |
| 300 Hz: | $800 \text{ Hz} \leq \text{demodulation bandwidth} \leq 16 \text{ MHz}$ |

- Remote: `SENS:FILT:HPAS`
- Remote: `SENS:FILT:HPAS:FREQ`

Deemphasis

Opens the **Deemphasis** dialog box to switch on a deemphasis with the given time constant.

The deemphasis is active in the following demodulation bandwidth range:

| | |
|--------------|--|
| 25 μ s: | $25 \text{ kHz} \leq \text{demodulation bandwidth} \leq 18 \text{ MHz}$ |
| 50 μ s: | $6.4 \text{ kHz} \leq \text{demodulation bandwidth} \leq 18 \text{ MHz}$ |
| 75 μ s: | $6.4 \text{ kHz} \leq \text{demodulation bandwidth} \leq 18 \text{ MHz}$ |
| 750 μ s: | $800 \text{ Hz} \leq \text{demodulation bandwidth} \leq 4 \text{ MHz}$ |

The following table shows the required demodulation bandwidth for an error less than 0.5 dB up to a maximum AF frequency.

| | | | | |
|---------------------------------|----------------|----------------|---------------|----------------|
| deemphasis | 25 μ s | 50 μ s | 75 μ s | 750 μ s |
| max. AF frequency | 25 kHz | 12 kHz | 8 kHz | 800 Hz |
| required demodulation bandwidth | \geq 200 kHz | \geq 100 kHz | \geq 50 kHz | \geq 6.4 kHz |

For higher AF frequencies the demodulation bandwidth must be increased.

- Remote: SENS:FILT:DEMP
- Remote: SENS:FILT:DEMP:TCON

Zero Phase Reference Point

Defines the position at which the phase of the PM–demodulated signal is set to 0 rad. The entry is made with respect to time. In the default setting, the first measured value is set to 0 rad.

This softkey is only available in the PM display with DC coupling.

- Remote: SENS:ADEM:PM:RPO:X 10us

Phase Wrap On/Off

Activates/deactivates the phase wrap.

On The phase will be displayed in the range $\pm 180^\circ$ ($\pm \Pi$). For example, if the phase exceeds $+180^\circ$, 360° is subtracted from the phase value, with the display thus showing $>-180^\circ$.

Off The phase will not be wrapped.

This softkey is available in the PM signal displays.

- Remote: CALC:FORM PHAS

Phase Unit Rad/Deg

Sets the phase unit to rad or deg for displaying PM signals.

- Remote: UNIT:ANGL RAD

Zoom

Activates or deactivates the zoom function. The zoom function is not available if the number of measurement points falls below 501.

activated: A 1–to–1 allocation is selected, i.e. each measurement point corresponds to a measured value. The start of the zoom window can be determined in the associated field by entering the time.

deactivated: If more measured values than measurement points are available, several measured values are combined in one measurement point according to the method of the selected trace detector. For details on detectors refer to "[Detector overview](#)" on page 4.33.

- Remote: SENS:ADEM:ZOOM ON
- Remote: SENS:ADEM:ZOOM:START 30US

Softkeys of the frequency menu (Analog Demodulation mode)

The following table shows all softkeys available in the frequency menu in **Analog Demodulation** mode (**FREQ** key). It is possible that the standard instrument does not provide all softkeys. If a softkey is only available for a special result display, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|----------------|-----------------------|
| Center | |
| CF Stepsize ↓ | 0.1*Span/0.1*Demod BW |
| | 0.5*Span/0.5*Demod BW |
| | x*Span/x*Demod BW |
| | =Center |
| | Manual |
| AF Center | |
| AF Start | |
| AF Stop | |

Center

For details refer to the **Center** softkey of the frequency menu.

CF Stepsize

For details refer to the **CF Stepsize** softkey of the frequency menu.

0.1*Span (RF Spectrum)

For details refer to the **0.1*Span** softkey of the frequency menu.

0.1*Demod BW (AF/RF Time Domain, AF Spectrum)

For details see **0.1*RBW** softkey.

0.5*Span (RF Spectrum)

For details refer to the **0.5*Span** softkey of the frequency menu.

0.5*Demod BW (AF/RF Time Domain, AF Spectrum)

For details see **0.5*RBW** softkey.

x*Span (RF Spectrum)

For details refer to the **x*Span** softkey of the frequency menu.

x*Demod BW (AF/RF Time Domain, AF Spectrum)

For details see **x*RBW** softkey.

=Center

For details refer to the **Center** softkey of the frequency menu.

Manual

For details refer to the **Manual** softkey of the frequency menu.

AF Center (AF Spectrum)

Opens an edit box to enter the center frequency within the AF spectrum.

→ Remote: SENS:ADEM:AF:CENT 1MHZ

AF Start

Opens an edit box to define the start frequency within the AF spectrum.

→ Remote: SENS:ADEM:AF:STAR 0HZ

AF Stop

Opens an edit box to define the stop frequency within the AF spectrum.

The maximum AF stop frequency corresponds to half the demodulation bandwidth.

→ Remote: SENS:ADEM:AF:STOP 2MHZ

Softkeys of the span menu (Analog Demodulation mode)

The following table shows all softkeys available in the span menu in **Analog Demodulation** mode (**SPAN** key). It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| |
|----------------------------|
| Command |
| Span Manual/AF Span Manual |
| Demod Bandwidth |
| Full Span/AF Full Span |

Span Manual (RF Spectrum)

If the RF spectrum display is active, values between the sampling rate/200 and the demodulation bandwidth/2 are allowed.

For further details refer to the **Span Manual** softkey of the span menu.

→ Remote: ADEM:SPEC:SPAN:ZOOM 5 MHz

AF Span Manual (AF Spectrum)

Opens an edit dialog box to enter the frequency range for the AF spectrum display. Values between the sampling rate/1000 and the demodulation bandwidth/2 are allowed.

→ Remote: ADEM:AF:SPAN 2.5 MHz

Demod Bandwidth

For details see **Demod BW** softkey in the analog demodulation menu.

Full Span (RF Spectrum)

If the RF spectrum display is active, the full frequency range corresponds to the demodulation bandwidth.

For further details refer to the **Full Span** softkey of the span menu.

→ Remote: ADEM:SPEC:SPAN:ZOOM MAX

AF Full Span (AF Spectrum)

Sets the span to the maximum frequency range for the AF spectrum display. The maximum frequency range corresponds to the demodulation bandwidth.

→ Remote: ADEM:AF:SPAN:FULL

Softkeys of the amplitude menu (Analog Demodulation mode)

The following table shows all softkeys available in the amplitude menu in **Analog Demodulation** mode (**AMPT** key). It is possible that the standard instrument does not provide all softkeys. If a softkey is only available for a special result display, this information is delivered in the corresponding softkey description.

| Menu / Command | Command |
|------------------------|----------------------------------|
| Ref Level | |
| Range Log/Range Linear | |
| AF Range ↓ | Dev per Division/dB per Division |

| Menu / Command | Command |
|--------------------|--------------------|
| | Reference Position |
| | Reference Value |
| | Deviation Lin/Log |
| | |
| Preamp On/Off | |
| RF Atten Manual | |
| RF Atten Auto | |
| More ↓ | |
| Ref Level Offset | |
| Ref Level Position | |
| Grid Abs / Rel | |
| Unit | |
| Input 50 Ω / 75 Ω | |

Ref Level

For details refer to the **Ref Level** softkey in the amplitude menu.

Range Log (RF result display)

This softkey is only available for the RF result display. For the RF result display, the **AF Range** softkey is used.

For details refer to the **Range Log** softkey in the amplitude menu.

Range Linear (RF result display)

This softkey is only available for the RF result display. For the RF result display, the **AF Range** softkey is used.

For details refer to the **Range Linear** softkey in the amplitude menu.

AF Range (AF result display)

For details refer to the **AF Range** softkey in the analog demodulation menu.

Dev per Division

For details refer to the **Dev per Division** softkey in the analog demodulation menu.

dB per Division

For details refer to the **dB per Division** softkey in the analog demodulation menu.

Reference Position

For details refer to the **Reference Position** softkey in the analog demodulation menu.

Reference Value

For details refer to the **Reference Value** softkey in the analog demodulation menu.

Deviation Lin/Log

For details refer to the **Deviation Lin/Log** softkey in the analog demodulation menu.

Preamp On/Off (option RF Preamplifier, B22)

For details refer to the **Preamp On/Off** softkey in the amplitude menu.

RF Atten Manual

For details refer to the **RF Atten Manual** softkey in the amplitude menu.

RF Atten Auto

For details refer to the **RF Atten Auto** softkey in the amplitude menu.

Ref Level Offset

For details refer to the **Ref Level Offset** softkey in the amplitude menu.

Ref Level Position

For details refer to the **Ref Level Position** softkey in the amplitude menu.

Grid Abs / Rel (not available with Range Linear)

For details refer to the **Grid Abs / Rel** softkey in the amplitude menu.

Unit (PM AF result display)

For details refer to the **Unit** softkey in the amplitude menu.

Input 50 Ω / 75 Ω

For details refer to the **Input 50 Ω / 75 Ω** softkey in the amplitude menu.

Softkeys of the bandwidth menu (Analog Demodulation mode)

The following table shows all softkeys available in the bandwidth menu in **Analog Demodulation** mode (**BW** key). It is possible that the standard instrument does not provide all softkeys. If a softkey is only available for a special result display, this information is delivered in the corresponding softkey description.

| Command |
|-----------|
| Res BW |
| Demod BW |
| Meas Time |

Res BW (span > 0)

Opens an edit dialog box to enter a value for the resolution bandwidth.

→ Remote: ADEM:SPEC:BAND:RES 10 kHz

Demod BW

For details refer to the **Demod BW** softkey in the in the analog demodulation menu.

Meas Time

For details refer to the **Meas Time** softkey in the in the analog demodulation menu.

Softkeys of the sweep menu (Analog Demodulation mode)

The following table shows all softkeys available in the sweep menu in **Analog Demodulation** mode (**SWEEP** key). It is possible that the standard instrument does not provide all softkeys. If a softkey is only available for a special result display, this information is delivered in the corresponding softkey description.

| Command |
|--------------------|
| Continuous Sweep |
| Single Sweep |
| Continue Sgl Sweep |
| Meas Time |
| Sweep Count |

Continuous Sweep

For details refer to the **Continuous Sweep** softkey in the in the sweep menu.

Single Sweep

For details refer to the **Single Sweep** softkey in the in the sweep menu.

Continue Sgl Sweep

For details refer to the **Continue Single Sweep** softkey in the in the sweep menu.

Meas Time

For details refer to the **Meas Time** softkey in the in the analog demodulation menu.

Sweep Count

For details refer to the **Sweep Count** softkey in the in the sweep menu.

Softkeys of the trigger menu (Analog Demodulation mode)

The following table shows all softkeys available in the trigger menu in **Analog Demodulation** mode (**TRIG** key). It is possible that the standard instrument does not provide all softkeys. If a softkey is only available for a special result display, this information is delivered in the corresponding softkey description.

| |
|--------------------------|
| Command |
| Trigger Source |
| Trigger Level |
| Trigger Polarity Pos/Neg |
| Trigger Offset |

Trigger Source

Opens the **Trigger** dialog box to select the trigger mode. Additional to the trigger modes described in section "[Trigger mode overview](#)" on page 4.26, the following trigger modes are available:

| Selected option | Specified threshold |
|--------------------|-----------------------------------|
| AM (Online) | modulation depth of the AM signal |
| FM (Online) | frequency of the FM signal |
| PM (Online) | phase of the PM signal |
| RF (Online) | level of the RF signal |

In **Analog Demodulation** mode, the next measurement is triggered if the selected input signal exceeds the threshold specified using the **Trg / Gate Level** softkey. A periodic signal modulated onto the carrier frequency can be displayed in this way. It is recommended that the measurement time covers at least five periods of the audio signal.

For further details refer to the **Trg / Gate Source** softkey in the trigger menu.

- ➔ Remote: TRIG:SOUR IMM | IFP | EXT | FM | PM | AM | RF (Free Run, IF Power, Extern, FM (Offline), PM (Offline), AM (Offline), RF (Offline))

Trigger Level

For details refer to the **Trg / Gate Level** softkey in the in the trigger menu.

Trigger Polarity Pos/Neg

For details refer to the **Trg / Gate Polarity Pos/Neg** softkey in the in the trigger menu.

Trigger Offset

For details on the relation between demodulation bandwidth (option Analog Demodulation, R&S FSL–K7) and trigger offset refer to "[Sample rate, measurement time and trigger offset](#)" on page 4.97.

For details refer to the **Trigger Offset** softkey in the in the trigger menu.

Power Meter (Option K9)

For precise power measurement a power sensor is connected to the instrument via the front panel (USB connector) or the rear panel (power sensor, option R&S FSL–B5). The Power Sensor Support firmware option provides the power measurement functions for this test setup (see Fig. 4–11: Power sensor support – standard test setup). Both manual control and remote control are supported. The functions of this firmware option are described in this section. For details on the connectors and compatible power sensors refer to the Quick Start Guide, chapter 1, "Front and Rear Panel".

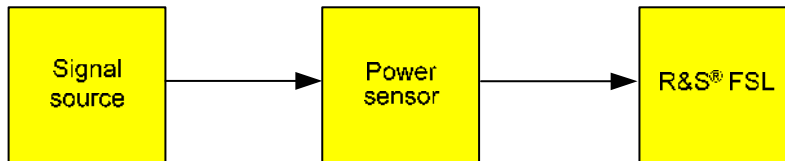


Fig. 4–11: Power sensor support – standard test setup

To open the power meter menu

1. Press the **MENU** key.
2. Press the **Power Meter** softkey.
The power meter menu is displayed.

Menu and softkey description

- ["Softkeys of the power meter menu"](#) on page 4.113

Further information

- ["Power result display"](#) on page 4.113

Tasks

- [To zero the power meter](#)
- [To use the power meter](#)

To zero the power meter

1. Press the **Zero** softkey.
A dialog box is displayed that prompts you to disconnect all signals from the input of the power sensor.
2. Disconnect all signals from the input of the power sensor and press **ENTER** to continue.
3. Wait until zeroing is complete.
A corresponding message is displayed.

To use the power meter

1. Press the **Frequency Coupling** softkey to select the coupling option.
2. If you have selected the **Manual** coupling option, press the **Frequency Manual** softkey to enter the frequency of the signal which power you want to measure.
3. Press the **Unit/Scale** softkey to set the unit for the power result display.
4. If you have selected dB or % as units (relative display), define a reference value:
 - To set the currently measured power as a reference value, press the **Meas→Ref** softkey.
 - To enter a reference value, press the **Reference Value** softkey.
5. Press the **Meas Time** softkey to select the measurement time. For recommendations refer to the **Meas Time** softkey description.
6. Press the **Result Display** softkey to switch between two views of the power measurement display. For more details see also "[Power result display](#)" on page 4.113

Power result display

The result of the power measurement can be displayed in two views. You can switch between these views using the **Result Display** softkey.

- **PWR M** labeled value in the marker field
- split screen mode with the power measurement result displayed in the lower pane in form of a bar graph

Softkeys of the power meter menu

The following table shows all softkeys available in the power meter menu. It is possible that the standard instrument does not provide all softkeys.

| Command |
|--------------------|
| Power Meter On/Off |
| Frequency Manual |
| Frequency Coupling |
| Unit/Scale |
| Zero |
| Meas Time |
| More ↓ |
| Meas→Ref |
| Reference Value |
| Result Display |

Power Meter On/Off

Switches the power measurement on or off.

→ Remote: [SENS:] PMET[:STAT] ON

Frequency Manual

Opens an edit dialog box to enter the frequency of the signal to be measured. The power sensor has a memory with frequency-dependent correction factors. This allows extreme accuracy for signals of a known frequency.

→ Remote: [SENSe:] PMET:FREQ 1GHZ

Frequency Coupling

Opens the **Frequency Coupling** dialog box to select the coupling option. The frequency can be coupled automatically to the center frequency of the instrument or to the frequency of marker 1, or manually to a set frequency (see **Frequency Manual** softkey).

→ Remote: [SENS:] PMET:FREQ:LINK CENT

Unit/Scale

Opens the **Unit/Scale** dialog box to select the unit with which the measured power is to be displayed.

If dB or % is selected, the display is relative to a reference value that is defined with either the Meas→Ref softkey or the **Reference Value** softkey.

→ Remote: UNIT:PMET:POW DBM

→ Remote: UNIT:PMET:POW:RAT DB

Zero

Starts zeroing of the power sensor. For details on the zeroing process refer to "[To zero the power meter](#)" on page 4.112.

→ Remote: CAL:PMET:ZERO:AUTO ONCE;*WAI

Meas Time

Opens the **Meas Time** dialog box to select the measurement time. In general, results are more precise with longer measurement times. The following settings are recommended for different signal types to obtain stable and precise results:

| | |
|---------------|---|
| Short | Stationary signals with high power (> -40dBm), because they require only a short measurement time and short measurement time provides the highest repetition rates. |
| Normal | Signals with lower power or of modulated signals |
| Long | Signals at the lower end of the measurement range (<-50 dBm) or signals with lower power to minimize the influence of noise. |

→ Remote: [SENS:] PMET:MTIM LONG

Meas→Ref

Sets the currently measured power as a reference value for the relative display. The reference value can also be set manually via the **Reference Value** softkey.

→ Remote: CALC:PMET:REL[:MAGN]:AUTO ONCE

Reference Value

Opens an edit dialog box to enter a reference value for relative measurements in the unit dBm.

→ Remote: CALC:PMET:REL[:MAGN] -30DBM

Result Display

Switches between two views of the power measurement. For further details refer to "[Power result display](#)" on page 4.113.

→ Remote: DISP[:WIND]:PMET:STAT OFF

WLAN TX Measurements (Option K91)

The WLAN TX Measurements option extends the functionality of the R&S FSL spectrum analyzer to enable Wireless LAN TX measurements according to IEEE standards 802.11a and IEEE 802.11 a, b, g and j.

TX measurement of wireless LAN Device Under Test (DUT) according to the standards specified for the device can be performed:

- Modulation formats:
 - IEEE 802.11a, j, g (OFDM): BPSK, QPSK, 16QAM, 64QAM
 - IEEE 802.11b, g (single carrier): DBPSK, DQPSK, CCK (5.5 & 11 Mbps), PBCC (5.5, 11 & 22 Mbps)
- Modulation measurements:
 - Constellation diagram
 - Constellation diagram per OFDM carrier
 - I/Q offset and I/Q imbalance
 - Carrier and symbol frequency errors
 - Modulation error (EVM) per OFDM carrier or symbol
 - Amplitude response and group–delay distortion (spectral flatness)
- Amplitude statistics (CCDF) and crest factor
- Transmit spectrum mask
- FFT, also over a selected part of the signal, e.g. preamble
- Payload bit information
- Capture time selectable up to 15 ms (dependent on selected standard), multiple sweeps possible for large number of bursts (10922).

This option is available from firmware version 1.20.

To open the WLAN menu

- If the **WLAN** mode is not the active measurement mode, press the **MODE** key and activate the **WLAN** option.
- If the **WLAN** mode is already active, press the **MENU** or **MEAS** key.
The WLAN menu is displayed. .
- To exit the WLAN measurement mode, select another option. For details refer also to section "[Measurement Mode Selection – MODE Key](#)" on page 4.86.

Menu and softkey description

- [Softkeys of the WLAN menu](#)
- [Softkeys of the sweep menu \(WLAN mode\)](#)
- [Softkeys of the marker menu \(WLAN mode\)](#)
- [Softkeys of the marker→ menu \(WLAN mode\)](#)
- [Softkeys of the lines menu \(WLAN mode\)](#)
- [Softkeys of the trace menu \(WLAN mode\)](#)

The file, setup, and print menus are provided as described for the base unit. For details refer to the corresponding menu descriptions. The span and bandwidth menus are not available in the **WLAN** mode.

Further information topics

- [Measurements and result displays](#)
- [Rise / fall time measurement](#)
- [Title bar information](#)
- [Status bar information](#)

Measurements and result displays

The WLAN option provides two main measurement types:

- IQ measurements (based on captured IQ data)
 - Power vs Time (see **PVT** softkey)
 - EVM vs Symbol, EVM vs Carrier (see **EVM vs Symbol/Carrier** softkey)
 - Phase vs Preamble, Frequency vs Preamble (see **Error Frequency/Phase** softkey)
 - Spectrum Flatness (see **Spectrum Flatness** softkey)
 - Spectrum FFT (see **Spectrum FFT** softkey)
 - Constellation vs Symbol, Constellation vs Carrier (see **Constell vs Symbol/Carrier** softkey)
 - Conditional Cumulative Distribution Function (see **CCDF** softkey)
 - Bit Stream (see **Bitstream** softkey)
 - Signal Field (see **Signal Field** softkey)
- frequency sweep measurements
 - Spectrum mask (see **Spectrum Mask** or **Spectrum IEEE/ETSI** softkeys)
 - Spectrum ACP/ACPR (see **Spectrum ACPR** softkey)

The measurement result display is divided into two panes:

- [Measurement settings](#)
- Result displays

The results can be displayed in form of a list or a graph (see also **Display List/Graph** softkey).

- ["Result summary list"](#) on page 4.118
- ["Result display graph"](#) on page 4.119

Measurement settings

The overall measurement settings used to obtain the current measurement results are displayed below the title bar (see Fig. 4–12). The following settings are listed:

| Setting | Description | Restrictions |
|------------------|--|---------------------------------------|
| Frequency | The frequency of the measured input signal. | |
| Preamble Type | The type of preamble of analyzed bursts. | |
| Signal Level | The expected mean signal level for the input signal. | IEEE 802.11a, g (OFDM), j only |
| Ref Level | The reference level used for the input signal. | IEEE 802.11b, g (Single Carrier) only |
| Modulation | Shows the active setting selected in the Demod Settings dialog box: Demodulator or PSDU Modulation to Analyze . | |
| External Att | The attenuation (positive values) or gain (negative values) applied to the signal external (i.e. before the RF– or IQ–connector of the spectrum analyzer), e.g.: External Att = 10dB means that before the RF–connector of the R&S FSL a 10dB attenuator is used External Att = –20dB means that before the RF–connector of the R&S FSL a amplifier with 20dB gain is used | |
| PSDU Data Length | Shows the minimum and maximum number of data bytes that a burst may have if it is to be considered in results analysis. | IEEE 802.11b, g (Single Carrier) only |

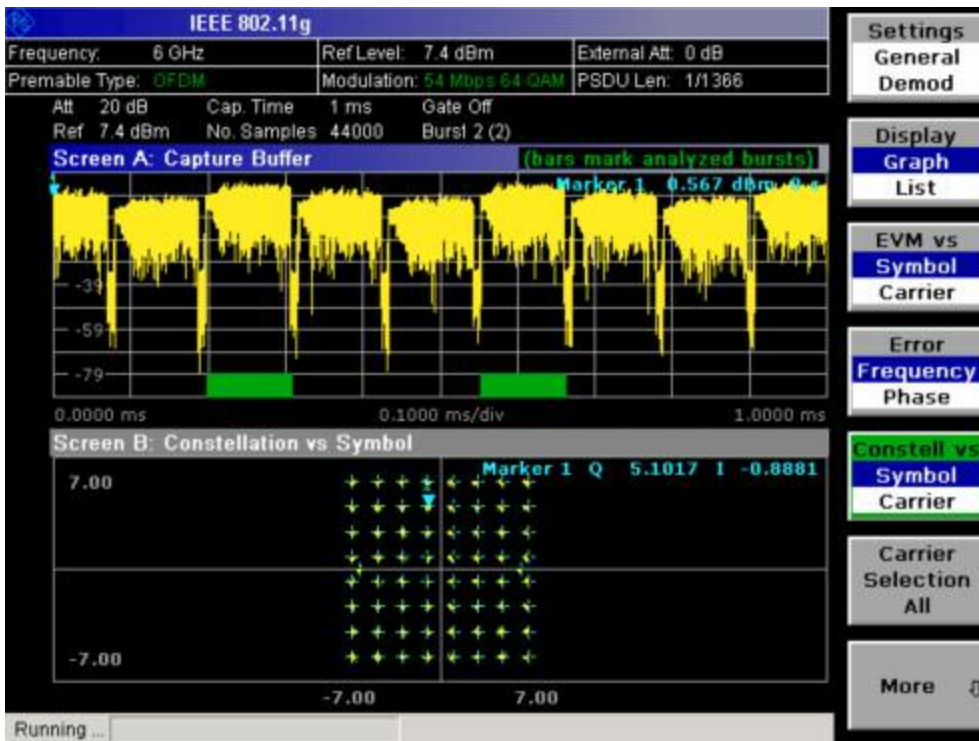


Fig. 4–12 Measurement settings (example)

Result summary list

The result summary list shows the overall measurement results and provides limit checking for result values in accordance with the selected standard. Result values which are within the limit as specified by the standard are displayed in green. Result values which are outside of the limits specified by the

standard are displayed in red with a '*' to the left. Results which have no limits specified by the standard are displayed in white. Limit values are displayed in white (not bold) and can be modified, when focused, via the keypad. To reset the limit values to the values specified in the standard, use the lines menu (**LINES** key).

The results displayed in this list are for the entire measurement. If a specific number of bursts have been requested which requires more than one sweep, the result summary list is updated at the end of each sweep. The number of bursts measured and the number of bursts requested are displayed to show the progress through the measurement. The Min / Mean / Max columns show the minimum, mean or maximum values of the burst results.

| IEEE 802.11g | | | | | | |
|------------------|-------|----------------|------------------------|---------------|------------------------|------------|
| Frequency: | 1 GHz | Ref Level: | 11.1 dBm | External Att: | 0 dB | |
| Preamble Type: | OFDM | Modulation: | 54 Mbps 64 QAM | PSDU Len: | 1/1366 | |
| * Result Summary | | | | | | |
| Bursts: | 3 | Min | Mean | Limit | Max | Limit Unit |
| EVM All Carr. | | 0.78 | 0.83 | 5.62 | 0.88 | 5.62 % |
| | | -42.14 | -41.59 | -25.00 | -41.12 | -25.00 dB |
| EVM Data Carr. | | 0.78 | 0.84 | 5.62 | 0.89 | 5.62 % |
| | | -42.11 | -41.50 | -25.00 | -41.00 | -25.00 dB |
| EVM Pilot Carr. | | 0.67 | 0.72 | 39.81 | 0.75 | 39.81 % |
| | | -43.44 | -42.88 | -8.00 | -42.45 | -8.00 dB |
| IQ Offset | | -47.53 | -46.87 | -15.00 | -46.17 | -15.00 dB |
| Gain Imbalance | | -0.16 | -0.10 | | -0.06 | % |
| | | -0.01 | -0.01 | | -0.01 | dB |
| Quadrature Err | | -0.08 | -0.06 | | -0.05 | % |
| Freq. Err | | -461.36 | -471.38 ± 25000 | | -480.19 ± 25000 | Hz |
| Symb Clock Err | | -0.60 | -0.96 ± 25 | | -1.64 ± 25 | ppm |
| Burst Power | | 1.30 | 1.30 | | 1.30 | dBm |
| Crest Factor | | 8.93 | 8.93 | | 8.94 | dB |

Fig. 4-13 Result summary list (example)

Result display graph

Additionally to the selected graphical result display, the Magnitude Capture Buffer display is provided for all IQ measurements. The different result displays are described with the corresponding softkey.

The Magnitude Capture Buffer display shows the complete range of captured data for the last sweep. All analyzed bursts are identified with a green bar at the bottom of the Magnitude Capture Buffer display. If, in the **Demod Settings** dialog box, the **Signal Field Content** option is activated only bursts that match the required criteria are marked with a green bar.

All IQ measurements process the same signal data and as such all IQ measurement results are available after a single IQ measurement execution.

IQ measurements can be run in split screen mode (allowing both the Magnitude Capture Buffer display and the selected IQ measurement results to be displayed simultaneously) or in full screen mode (with either the Magnitude Capture Buffer display or the selected IQ measurement results displayed).

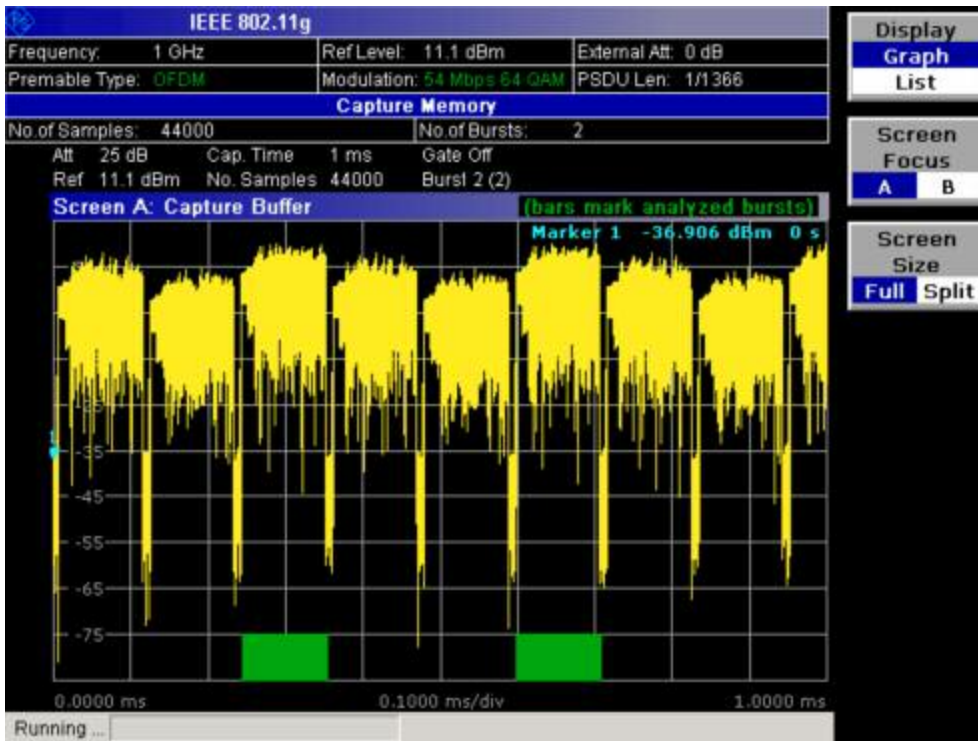


Fig. 4–14 Magnitude capture buffer results (example)

Further information

This section provides background information on measurements and displayed information. For details on signal processing refer to chapter "Advanced Measurement Examples", section "Measurement Examples of the WLAN TX Measurements Option (K91)".

Rise / fall time measurement

The rise/fall time is calculated according to the following algorithm:

- Apply a moving average filter over the burst power (adjustable average length)
- If "REF POW" = 'MAX': Search maximum power P_{\max} over the whole burst. Set $P_{\text{ref}} = P_{\max}$
- If "REF POW" = 'MEAN': Calculate mean power P_{mean} of the whole burst. Set $P_{\text{ref}} = P_{\text{mean}}$
- Rise time
 - Search the first crossing of $0.5 \cdot P_{\text{ref}}$ from the left.
 - Search backwards for the 10% crossing $0.1 \cdot P_{\text{ref}}$ and note t_{10} .
 - Search forward for the 90% crossing $0.9 \cdot P_{\text{ref}}$ and note t_{90} .
 - Return $T_{\text{rise}} = t_{90} - t_{10}$.
- Fall time
 - Search the first crossing of $0.5 \cdot P_{\text{ref}}$ from the right.
 - search forwards for the 10% crossing $0.1 \cdot P_{\text{ref}}$ and note t_{10} .

- search backwards for the 90% crossing $0.9 \cdot P_{\text{ref}}$ and note t_{90} .
- Return $T_{\text{fall}} = t_{10} - t_{90}$.

Since the single carrier modes of 802.11b, g use linear modulation formats like BPSK or QPSK, the transmit signal power varies between symbol sampling times. These power variations are determined by the transmit filter, which is not defined in the standard. The R&S FSL–K91 allows fine tuning of the PVT measurements on signals with high crest factors by an adjustable moving average filter and two different reference power settings.

The reference power equals the 100% setting for the rise / fall time calculation. Either the maximum burst power or the mean burst power can be chosen as reference power. Using the mean burst power, rarely power peaks within the burst does not influence the rise / fall time measurement.

The moving average filter smoothes the power trace and thus eliminates the modulation. While a long average length leads to more stable measurement results, it naturally increases the rise / fall times compared to no averaging.

Title bar information

The title bar displays the following information:

- wireless LAN standard applicable to the current measurement (in the middle)

Status bar information

The status bar displays the following information:

- parameter values

When a parameter in a settings dialog box is selected, the minimum and maximum values for the selected parameter are displayed.

When a Boolean parameter in a dialog box is selected, the minimum and maximum values are displayed as N/A for not applicable.

- measurement status

When a measurement is performed, the current measurement status along with detailed information about the progress is displayed.

- error messages (with red background)
- warning messages (with yellow background)

Softkeys of the WLAN menu

The following table shows all softkeys available in the WLAN menu. It is possible that the standard instrument does not provide all softkeys.

| Menu / Command | Command |
|------------------------|--------------------------------|
| Settings General/Demod | |
| Display List/Graph | |
| PVT ↓ | Settings General/Demod |
| | Display List/Graph |
| | Full Burst |
| | Rising & Falling |
| | Ramp Up/Down/Up & Down |
| | Ref Pow Max/Mean |
| | Average Length |
| | More ↓ |
| | Gating Settings On/Off |
| | Import |
| | Export |
| EVM Constell ↓ | Settings General/Demod |
| | Display List/Graph |
| | EVM vs Symbol/Carrier |
| | Error Frequency/Phase |
| | Constell vs Symbol/Carrier |
| | Carrier Selection |
| | More ↓ |
| | Gating Settings On/Off |
| | Import |
| | Export |
| | Y-Axis/Div |
| Spectrum ↓ | Settings General/Demod |
| | Display List/Graph |
| | Spectrum Flatness |
| | Spectrum Mask |
| | Spectrum IEEE/ETSI |
| | Spectrum FFT |
| | Spectrum ACPR |
| | Spectrum ACP |
| | More ↓ |
| | same contents as PVT side menu |
| Statistics ↓ | Settings General/Demod |
| | Display List/Graph |
| | CCDF |
| | Bitstream |
| | Signal Field |
| | PLCP Header |
| | More ↓ |
| | same contents as PVT side menu |

Settings General/Demod

Opens the **General Settings** or the **Demod Settings** dialog box. Screenshots of the dialog boxes are provided in chapter "Advanced Measurement Examples", section "Measurement Examples of the WLAN TX Measurements Option (K91)".

Alternatively, the **General Settings** dialog box is opened as follows:

- **FREQ** key, with focus on the **Frequency** field
- **AMPT** key, with focus on the **Signal Level (RF)** field
- **TRIG** key, with focus on the **Trigger Mode** field

In the **General Settings** dialog box, all settings related to the overall measurement can be modified. The right pane with the advanced settings is only displayed if the **Advanced Settings** option is activated. The **General Settings** dialog box contains the following elements:

| | |
|------------------------|----------------|
| Signal Characteristics | Standard |
| | Frequency |
| | Channel No |
| Level Settings | Auto Lvl |
| | Signal Level |
| | Ext Att |
| Data Capture Settings | Capture Time |
| | Burst Count |
| | Analyze Bursts |
| | Sweep Count |
| Trigger Settings | Trigger Mode |
| | Trigger Offset |
| | Auto Lvl |
| | Power Level |
| IQ Settings | Swap IQ |
| Advanced Settings | Auto Lvl |
| | Ref Level |
| | Attenuation |

In the **Demod Settings** dialog box, the settings associated with the signal modulation can be modified. The settings under **Burst to Analyze** specify the characteristics of the bursts to be considered in the measurement results. Only the bursts which meet the criteria specified in this group will be included in measurement analysis if the **Use Header Content** option is activated. The tracking settings allow various errors in measurement results to be compensated for.

The **Demod Settings** dialog box contains the following elements. If an element is only available for certain standards, the corresponding standards are listed.

| | | |
|------------------|----------------------|---|
| Burst to Analyze | Signal Field Content | IEEE 802.11a, g (OFDM), j |
| | Use Header Content | IEEE 802.11b, g (Single Carrier) |
| | Burst Type | IEEE 802.11a, g (OFDM, Single Carrier), j |
| | Preamble Type | IEEE 802.11b |
| | Auto Demodulation | IEEE 802.11a, g (OFDM), j |
| | Analyze PSDU Mod | IEEE 802.11a, g (OFDM), j |
| | Demodulator | IEEE 802.11a, g (OFDM), j |
| | Equal Burst Length | |
| | No of Data Symbols | IEEE 802.11a, j |
| | Min Data Symbols | IEEE 802.11a, j |
| | Max Data Symbols | IEEE 802.11a, j |

| | | |
|----------|--------------------|---------------------------|
| | Channel Estimation | IEEE 802.11a, g (OFDM), j |
| | Payload Length | IEEE 802.11b, g |
| | Min Payload Length | IEEE 802.11b, g |
| | Max Payload Length | IEEE 802.11b, g |
| Tracking | Phase | |
| | Timing | |
| | Level | |

Standard (General Settings dialog box)

Displays a list of all installed standards to select the wireless LAN standard. This is necessary to ensure that the measurements are performed according to the specified standard with the correct limit values and limit lines.

→ Remote: CONF:STAN 0

Frequency (General Settings dialog box)

Specifies the center frequency of the signal to be measured. When the frequency is modified, the **Channel No** field is updated accordingly.

→ Remote: FREQ:CENT 100MHz

Channel No (General Settings dialog box)

Specifies the channel to be measured. When the **Channel No** field is modified, the frequency is updated accordingly.

→ Remote: CONF:CHAN 9

Auto Lvl (General Settings dialog box)

Activates or deactivates the automatic setting of the reference level for measurements.

On The reference level is measured automatically at the start of each measurement sweep. This ensures that the reference level is always set at the optimal level for obtaining accurate results but will result in slightly increased measurement times. For details about automatic level detection refer to chapter "Advanced Measurement Examples".

Off The reference level is defined manually in the **Signal Level** field.

→ Remote: CONF:POW:AUTO 1

→ Remote: CONF:POW:AUTO:SWE:TIME 200MS

Signal Level (General Settings dialog box)

Specifies the expected mean level of the RF input signal. If an automatic level detection measurement has been executed the signal level (RF) is updated.

For all standards other than IEEE 802.11b & g (Single Carrier), the reference level is set 10 dB higher than the signal level (RF) because of the expected crest factor of the signal. For standards IEEE 802.11b & g (Single Carrier), the reference level is set to the signal level (RF).

→ Remote: CONF:POW:EXP:RF 9

→ Remote: CONF:POW:EXP:IQ 1

Ext Att (General Settings dialog box)

Specifies the external attenuation or gain applied to the RF signal. A positive value indicates attenuation, a negative value indicates gain. All displayed power level values are shifted by this value.

→ Remote: INP:ATT 30dB

Capture Time (General Settings dialog box)

Specifies the time (and therefore the amount of data) to be captured in a single measurement sweep.

→ Remote: SWE:TIME 10ms

Burst Count (General Settings dialog box)

Activates or deactivates a specified number of bursts for capture and analysis.

On The data analysis is performed over a number of consecutive sweeps until the required number of bursts has been captured and analyzed.

Off The data analysis is performed on a single measurement sweep.

→ Remote: BURS:COUN:STAT ON

Analyze Bursts (General Settings dialog box)

Specifies the number of bursts to be measured, if the **Burst Count** option is activated.

→ Remote: BURS:COUN 16

Sweep Count (General Settings dialog box)

Specifies the number of sweeps to be performed for Spectrum ACP/ACPR and Spectrum Mask measurements.

→ Remote: SWEep:COUNt 64

Trigger Mode (General Settings dialog box)

Sets the source of the trigger for the measurement sweep.

- Free Run** The measurement sweep starts immediately.
- External** Triggering via a TTL signal at the input connector EXT TRIGGER/GATE IN on the rear panel.
- Power** The measurement sweep starts when the signal power meets or exceeds the specified power trigger level. This trigger mode is not available for Spectrum Mask measurements in ETSI standard. If it is set and then the Spectrum Mask measurement in ETSI standard is selected, it automatically changes to **Free Run**.

→ Remote: TRIG:MODE IMM

Trigger Offset (General Settings dialog box)

Specifies the time offset between the trigger signal and the start of the sweep. A negative value indicates a pre-trigger. This field is not available in the **Free Run** trigger mode.

→ Remote: TRIG:HOLD 500us

Auto Lvl (General Settings dialog box)

Activates or deactivates the automatic measurement of the power trigger level.

- On** The power trigger level is measured automatically at the start of each measurement sweep. This ensures that the power trigger level is always set at the optimal level for obtaining accurate results but will result in a slightly increased measurement times.
- Off** The power trigger level is defined manually in the **Power Level** field.

→ Remote: TRIG:LEV:POW:AUTO ON

Power Level (General Settings dialog box)

Specifies the trigger level if the **Power** trigger mode is set.

→ Remote: TRIG:LEV:POW 10 DBM

Swap IQ (General Settings dialog box)

Activates or deactivates the inverted I/Q modulation.

- On** I and Q signals are interchanged.
- Off** Normal I/Q modulation.

→ Remote: SWAP ON

Ref Level (General Settings dialog box)

Specifies the reference level to use for measurements. When the reference level is modified the signal level is updated accordingly (depending on the currently selected standard and measurement type). This field is only editable if the **Auto Lvl** is deactivated.

→ Remote: DISP:TRAC:Y:RLEV?

Attenuation (General Settings dialog box)

Specifies the settings for the attenuator. This field is only editable if the **Auto Lvl** option is deactivated. If the **Auto Lvl** option is activated, the RF attenuator setting is coupled to the reference level setting.

→ Remote: INP:ATT 30dB

Signal Field Content (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

Activates or deactivates the decoding of the captured burst data.

- On Only the bursts are included in the results analysis whose modulation format specified in the signal symbol field matches the modulation format specified in the **Analyze PSDU Mod** field.
- Off The data is demodulated according to the modulation scheme specified in the **Demodulator** field. If any of the analyzed data has a modulation different to that specified the results will be of limited use.

→ Remote: DEM:FORM:SIGS ON

Use Header Content (Demod Settings dialog box, IEEE 802.11b, g – Single Carrier)

Activates or deactivates the PLCP header field decoding of the captured burst data. If activated, only the bursts are included in the results analysis whose modulation format specified in the signal symbol field matches the modulation format specified in the **Analyze PSDU Mod** field.

→ Remote: DEM:FORM:AUT ON

Burst Type (Demod Settings dialog box, IEEE 802.11a, g (OFDM, Single Carrier), j)

Specifies the type of burst to be included in measurement analysis. Only one burst type can be selected for the measurement results. The following burst types are supported:

| | |
|--------------------------|-----------------|
| Direct Link Burst | IEEE 802.11a, j |
| OFDM | IEEE 802.11g |
| Long DSSS–OFDM | IEEE 802.11g |
| Short DSSS–OFDM | IEEE 802.11g |
| Long PLCP | IEEE 802.11g |
| Short PLCP | IEEE 802.11g |

→ Remote: DEM:FORM:BAN:BTYPe 'DIRECT'

Preamble Type (Demod Settings dialog box, IEEE 802.11b)

Specifies the type of burst which should be included in measurement analysis. The following burst types are supported: Short PLCP, Long PLCP.

→ Remote: DEM:FORM:BAN:BTYPe 'SHORT'

Auto Demodulation (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

Activates or deactivates the automatic detection of the modulation. If activated, the modulation applied to the input data is determined from the modulation type of the first complete burst within the captured data. This option automatically activates the **Signal Field Content** option.

→ Remote: DEM:FORM:AUT ON

Analyze PSDU Mod (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

Specifies the modulation of the bursts to be analyzed. Only bursts using the selected modulation are considered in measurement analysis. This option is only available if the **Signal Field Content** option is activated.

→ Remote: DEM:FORM:AUT ON

Demodulator (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

Specifies the modulation to be applied to the measured data. If the captured data uses a different modulation scheme than specified by this field the results will be of limited use. This field is only available if the **Signal Field Content** option is deactivated.

→ Remote: DEM:FORM:BAN 'QAM16'

Equal Burst Length (Demod Settings dialog box)

Activates or deactivates the burst selection for measurement analysis according to the range or specific number of data symbols/bytes.

| Standard | State | Description |
|----------------------------------|-------|---|
| IEEE 802.11a, j | On | Only bursts with exactly the number of symbols specified in the No of Data Symbols field are considered for measurement analysis. |
| | Off | Only bursts within the range of data symbols specified by the Min Data Symbols and Max Data Symbols fields are considered for measurement analysis. |
| IEEE 802.11b, g (Single Carrier) | On | Only bursts with exactly the number of data bytes or duration specified in the Payload Length field are considered for measurement analysis. |
| | Off | Only bursts within the range of data bytes or duration specified by the Min Payload Length and Max Payload Length fields are considered for measurement analysis. |

| | | |
|------------------------|-----|---|
| IEEE 802.11g (OFDM) | On | Only bursts with exactly the number of data symbols or duration specified in the Payload Length field are considered for measurement analysis. |
| | Off | Only bursts within the range of data symbols or duration specified by the Min Payload Length and Max Payload Length fields are considered for measurement analysis. |

- Remote: DEM:FORM:BAN:SYM:EQU ON
- Remote: DEM:FORM:BAN:DBYTES:EQU ON
- Remote: DEM:BAN:DUR:EQU ON (PVT)

No of Data Symbols (Demod Settings dialog box, IEEE 802.11a, j)

Specifies the number of data symbols of a burst to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is activated.

- Remote: DEM:FORM:BAN:SYM:MIN 16

Min Data Symbols (Demod Settings dialog box, IEEE 802.11a, j)

Specifies the minimum number of data symbols of a burst to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is deactivated.

- Remote: DEM:FORM:BAN:SYM:MIN 16

Max Data Symbols (Demod Settings dialog box, IEEE 802.11a, j)

Specifies the maximum number of data symbols of a burst to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is deactivated.

- Remote: DEM:FORM:BAN:SYM:MAX 1300

Channel Estimation (Demod Settings dialog box, IEEE 802.11a, g (OFDM), j)

Specifies how accurately the EVM results should be calculated.

| | |
|----------|--|
| Preamble | The channel estimation is performed in the preamble as required in the standard. |
| Payload | The channel estimation is performed in the preamble. |

- Remote: DEMod:CEST ON

Payload Length (Demod Settings dialog box, IEEE 802.11b, g)

Specifies the number of symbols, bytes or duration of a burst to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is activated.

- Remote: DEM:FORM:BAN:DBYTES:MIN 16
- Remote: DEM:BAN:DUR:MIN 45

Min Payload Length (Demod Settings dialog box, IEEE 802.11b, g)

Specifies the minimum number of symbols, bytes or duration of a burst to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is deactivated.

- Remote: DEM:FORM:BAN:DBYTeS:MIN 16
 - Remote: DEM:BAN:DUR:MIN 45
-

Max Payload Length (Demod Settings dialog box, IEEE 802.11b, g)

Specifies the maximum number of symbols, bytes or duration of a burst to be considered in measurement analysis. This field is only available if the **Equal Burst Length** option is deactivated.

- Remote: DEM:FORM:BAN:DBYTeS:MAX 1300
 - Remote: DEM:BAN:DUR:MAX 1300
-

Phase (Demod Settings dialog box)

Activates or deactivates the compensation for phase error. If activated, the measurement results are compensated for phase error on a per-symbol basis.

- Remote: TRAC:PHAS 1
-

Timing (Demod Settings dialog box)

Activates or deactivates the compensation for timing error. If activated, the measurement results are compensated for timing error on a per-symbol basis.

- Remote: TRAC:TIME 1
-

Level (Demod Settings dialog box)

Activates or deactivates the compensation for level error. If activated, the measurement results are compensated for level error on a per-symbol basis.

- Remote: TRAC:LEV 1
-

Display List/Graph

Configures the result display. The measurement results are displayed either in form of a list of measurement points or as a graphical trace.

- Remote: DISP:WIND1:TABL ON
 - Remote: for result queries see chapter "Remote Control – Commands", section FETCh:BURSt Subsystem
-

PVT

Opens the PVT submenu to select the Power vs Time measurement results.

The PVT result displays show the minimum, average and maximum levels measured over the full range of the measured input data, or over complete bursts displayed within the gating lines if

gating is switched on. The results are displayed as a single burst. Using screen B in full screen provides additional power information during this measurement.

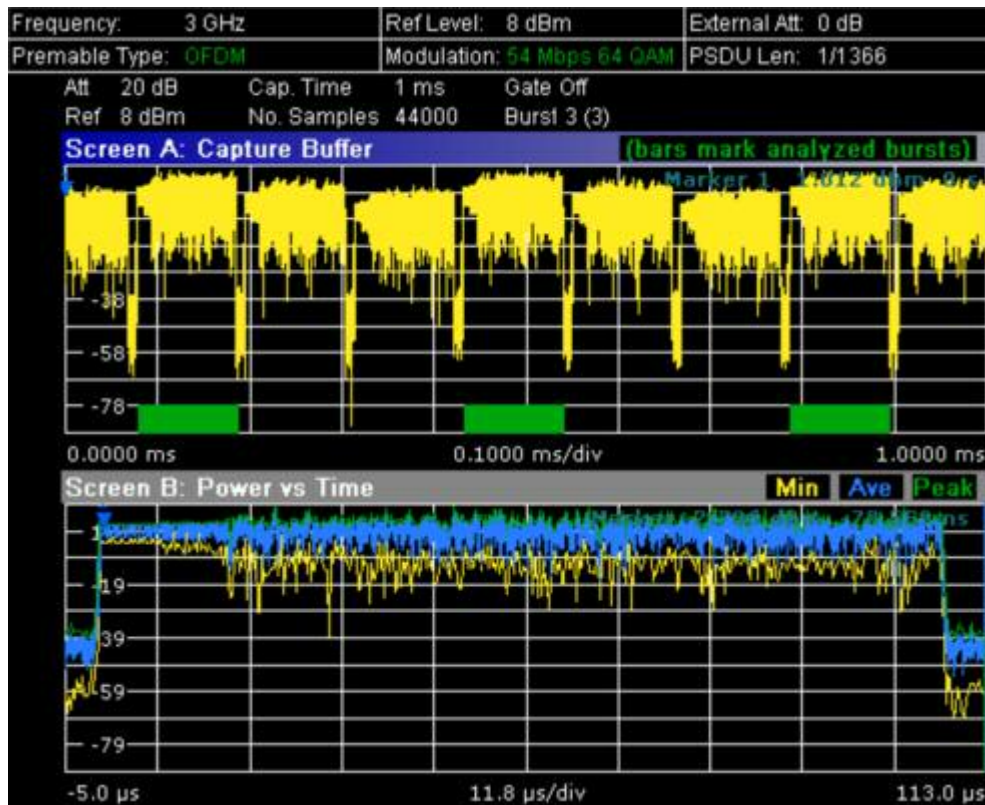
For IEEE 802.11b and g (single carrier), the PVT results are displayed as percentage values of the reference power. The reference can be set to either the max or mean power of the burst. For both rising and falling edges two time lines are displayed, which mark the points 10% and 90% of the reference power. The time between these two points is compared against the limits specified for the rising and falling edges.

For further details see also "[Rise / fall time measurement](#)" on page 4.120.

→ Remote: CONF: BURS: PVT

Full Burst (IEEE 802.11a, g, j – OFDM)

Displays the PVT results in a single graph with all burst data being displayed.

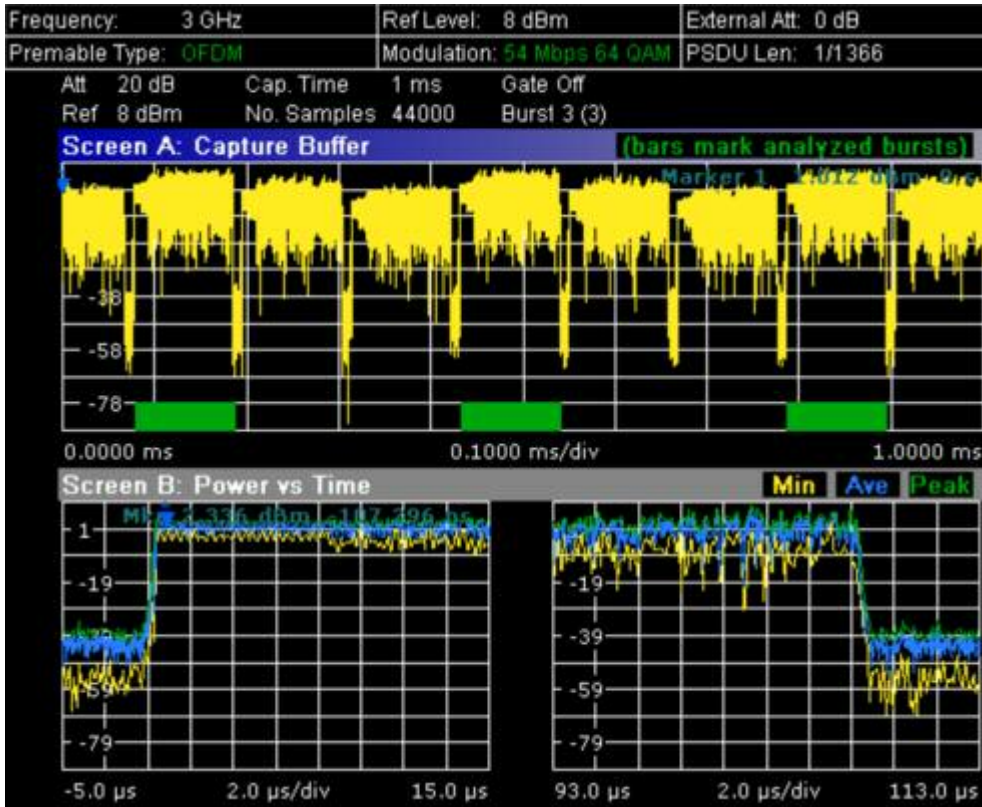


For further details refer to the **PVT** softkey.

→ Remote: CONF: BURS: PVT: SEL FULL

Rising & Falling (IEEE 802.11a, g, j – OFDM)

Displays the PVT results in two separate graphs, the left hand side showing the rising edge and the right hand side showing the falling edge.

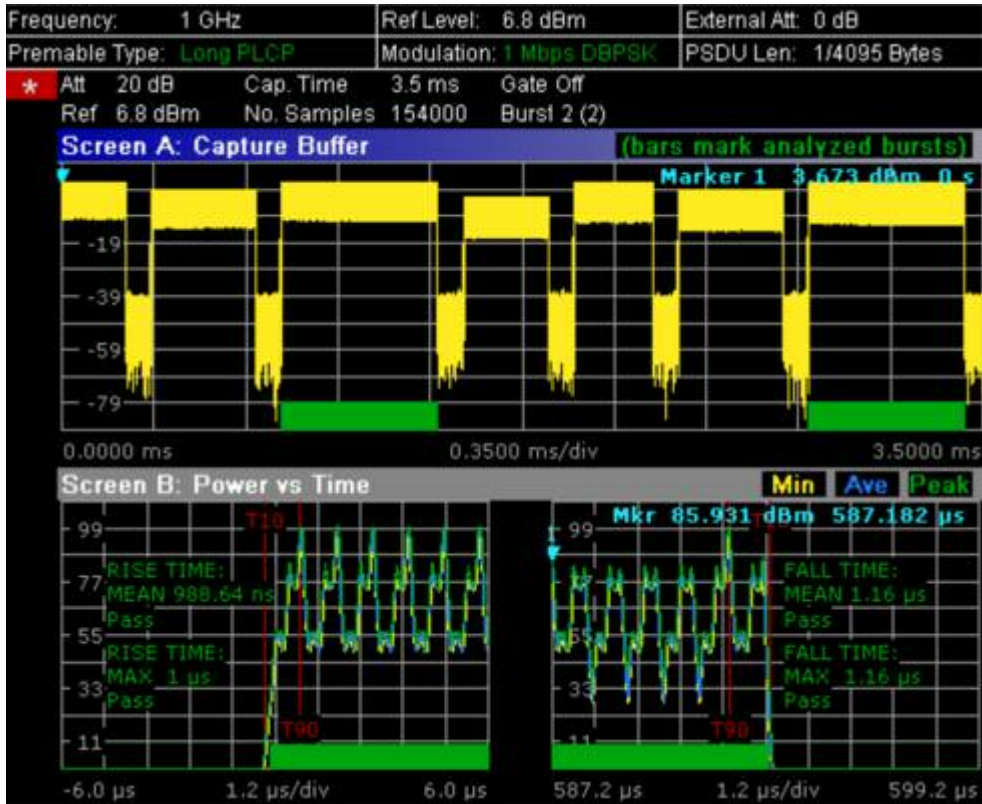


→ Remote: CONF: BURS: PVT: SEL EDGE

Ramp Up/Down/Up & Down (IEEE 802.11b, g – Single Carrier)

Sets the display of the rising/falling edge graph:

- Up** Displays the rising edge graph.
- Down** Displays the falling edge graph.
- Up & Down** Displays the rising and falling edge graph.



For further details refer to the **PVT** softkey.

→ Remote: CONF:BURS:PVT:SEL RISE

Ref Pow Max/Mean (IEEE 802.11b, g – Single Carrier)

Sets the reference for the rise and fall time calculation to the maximum or mean burst power.

For further details refer to the **PVT** softkey.

→ Remote: CONF:BURS:PVT:RPOW MEAN

Average Length (IEEE 802.11b, g – Single Carrier)

Opens an edit dialog box to enter the number of samples in order to adjust the length of the smoothing filter.

For further details refer to the **PVT** softkey.

→ Remote: CONF:BURS:PVT:AVER 31

Gating Settings On/Off

Activates or deactivates gating, or opens the **Gate Settings** dialog box to specify range of captured data used in results calculation.

- On Uses only the specified range of captured data in results calculation. In the Magnitude Capture Buffer trace, two vertical lines mark the specified range.
- Off Uses all the captured data in results calculation.

In the **Gate Settings** dialog box, the following parameters are set:

- | | |
|---------------------------|--|
| Delay | Start point of captured data to be used in results calculation, i.e. the delay from the start of the captured data in time or samples. If the delay is specified in time, the number of samples is updated accordingly, and vice versa. |
| Length | Amount of captured data to be used in results calculation. If the length is specified in time, the number of samples is updated accordingly, and vice versa. |
| Link Gate and Mark | If activated, The position of the marker and the gate lines are linked. The marker is positioned half way between gate start and end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered. |

The gate settings are defined for following measurements: PVT, Spectrum FFT, CCDF, Spectrum Mask, Spectrum ACPR.

If a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP) the result display is switched to the Magnitude Capture Buffer display in order to allow the gate to be set the correct part of the sweep.

- Remote: SWE:EGAT ON
 - Remote: SWE:EGAT:HOLD 125us, SWE:EGAT:HOLD:SAMP 2500 (Delay)
 - Remote: SWE:EGAT:LENG 20ms, SWE:EGAT:LENG:SAMP 200000 (Length)
 - Remote: SWE:EGAT:LINK ON (Link Gate and Mark)
-

Import

Opens the **Choose the file to import** dialog box.

Select the file you want to import and press **ENTER**. The extension of data files is *.iqw.

- Remote: MMEM:LOAD:IQ:STAT
-

Export

Opens the **Choose the file to export** dialog box.

Enter the path and the name of the IQ data file you want to export and press **ENTER**. The extension of data files is *.iqw. If the file cannot be created or there is no valid IQ data to export an error message is displayed.

- Remote: MMEM:STOR:IQ:STAT
-

Y–Axis/Div

Opens a dialog box to modify the y–axis settings:

| | |
|---------------------|--|
| Auto Scaling | If activated, the scaling of the y–axis is calculated automatically. |
| Per Division | Specifies the scaling to be used when Auto Scaling is deactivated. |
| Unit | Specifies the y–axis unit. With the unit is dB, Auto Scaling is always activated. |

→ Remote: DISP:WIND2:TRAC:Y:SCAL:AUTO ON

→ Remote: DISP:WIND2:TRAC:Y:SCAL:DPIV 2

EVM Constell

Opens a submenu to select the error vector magnitude (EVM) or the constellation result displays.

EVM vs Symbol/Carrier

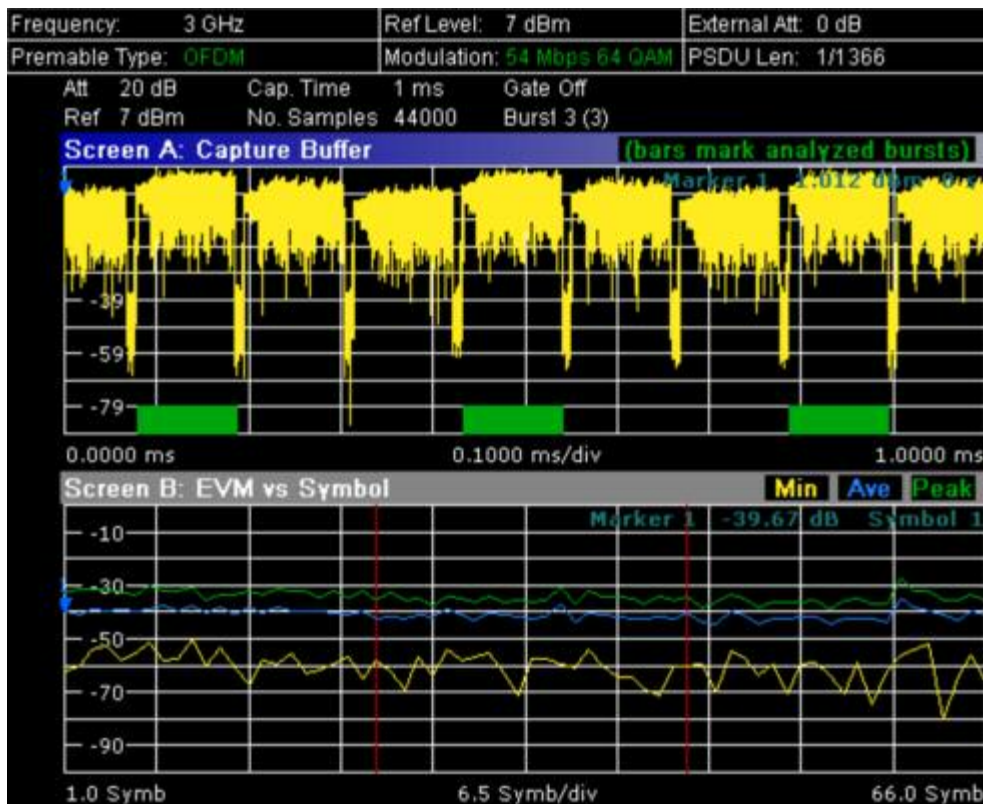
Selects the EVM vs Symbol or EVM vs Carrier result displays.

– EVM vs Symbol

This result display shows the EVM measured over the full range of the measured input data. The results are displayed on a per–symbol basis, with blue vertical lines marking the boundaries of each burst. Note that burst boundary lines are only displayed if the number of analyzed bursts is less than 250.

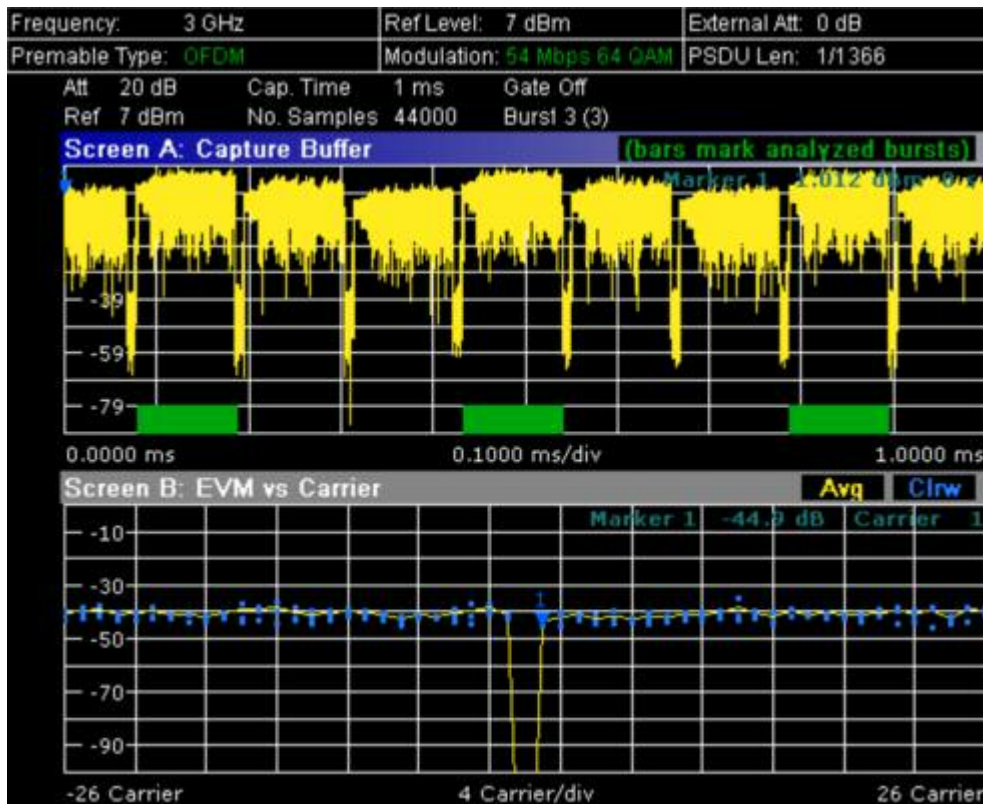
For IEEE 802.11a, j, g (OFDM) the minimum, average, and maximum traces are displayed.

For IEEE 802.11b, g (Single Carrier) two EVM traces are displayed. The trace labeled with VEC ERR IEEE shows the error vector magnitude as defined in the IEEE 802.11b, g standards. For the trace labeled with EVM a commonly used EVM definition is applied, which is the square root of the momentary error power normalized by the averaged reference power.



- EVM vs Carrier (IEEE 802.11a, g, j – OFDM)

This result display shows the all EVM values recorded on a per-carrier basis over the full set of measured data. An average trace is also displayed.

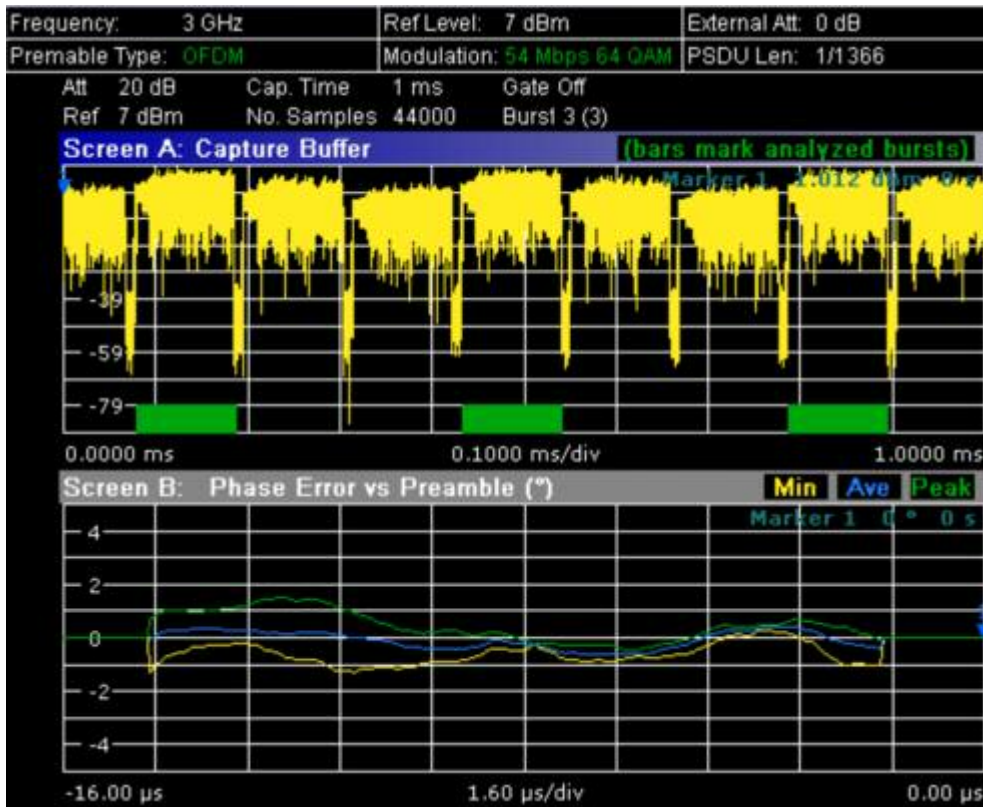


- Remote: CONF: BURS: EVM: ESYM (EVM vs Symbol)
- Remote: CONF: BURS: EVM: ECAR (EVM vs Carrier)

Error Frequency/Phase

Selects the Rel. Frequency Error vs Preamble or the Phase Error vs Preamble result displays.

These result displays show the error values recorded over the preamble part of the burst. A minimum, average and maximum trace are displayed. The results display either relative frequency error or phase error.



- Remote: CONF: BURS: PRE
- Remote: CONF: BURS: PRE: SEL_FREQ (Frequency Error vs Preamble)
- Remote: CONF: BURS: PRE: SEL_PHAS (Phase Error vs Preamble)

Constellation vs Symbol/Carrier

Selects the Constellation vs Symbol or the Constellation vs Carrier result displays.

- Constellation vs Symbol (all standards)

This result display shows the in-phase and quadrature phase results over the full range of the measured input data. The ideal points for the selected modulations scheme are displayed for reference purposes.

The amount of data displayed in the constellation results display can be reduced by selecting the carrier or carriers for which data is to be displayed (**Carrier Selection** softkey).



- Constellation vs Carrier (IEEE 802.11a, g, j – OFDM)

This result display shows the in-phase and quadrature phase results over the full range of the measured input data plotted on a per-carrier basis. The magnitude of the in-phase and quadrature part is shown on the y-axis, both are displayed as separate traces (I→ trace 1, Q→ trace 2).



- Remote: CONF: BURS: CONS: CSYM (Constellation vs Symbol)
- Remote: CONF: BURS: CONS: CCAR (Constellation vs Carrier)

Carrier Selection (IEEE 802.11a, g, j – OFDM)

Opens a dialog box to select the carrier for data display. Either a specific carrier number, pilots only or all carriers can be selected.

- Remote: CONF: BURS: CONS: CARR: SEL -26

Spectrum

Opens a submenu for frequency measurements.

Spectrum Flatness (IEEE 802.11a, g, j – OFDM)

Sets the Spectrum Flatness result display.

This result display shows the spectrum flatness and group delay values recorded on a per-carrier basis over the full set of measured data. An average trace is also displayed for each of the result types. An upper and lower limit line representing the limits specified for the selected standard are displayed and an overall pass/fail status is displayed for the obtained (average) results against these limit lines.



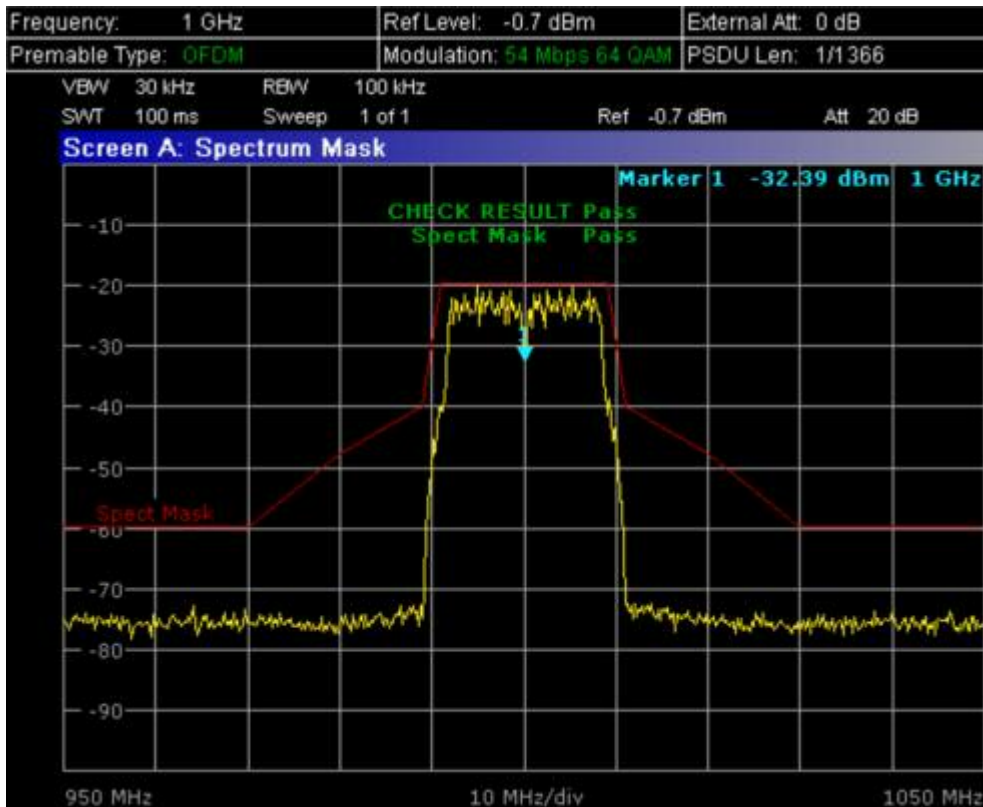
→ Remote: CONF:BURS:SPEC:FLAT

Spectrum Mask (IEEE 802.11b, g – Single Carrier)

Sets the Spectrum Mask result display.

This result display shows power against frequency. The span of the results is 100 MHz for IEEE and 500 MHz for ETSI around the specified measurement frequency. A limit line representing the spectrum mask specified for the selected standard is displayed and an overall pass/fail status is displayed for the obtained results against this limit line.

The number of sweeps is set in the **General Settings** dialog box, **Sweep Count** field. If the measurement is performed over multiple sweeps both a max hold trace and an average trace are displayed.



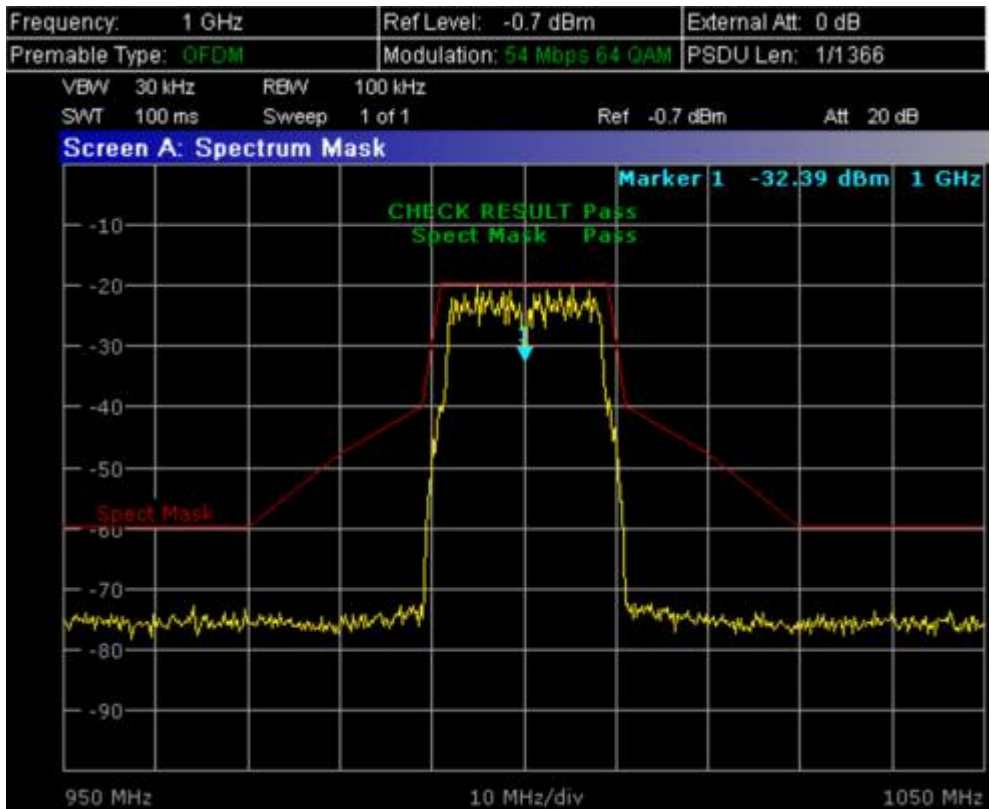
→ Remote: CONF: BURS: SPEC: MASK

Spectrum IEEE/ETSI (IEEE 802.11a, g, j – OFDM)

Selects the Spectrum Mask result display for the IEEE or ETSI standards.

These result displays show power against frequency. The span of the results is 100 MHz for IEEE and 500 MHz for ETSI around the specified measurement frequency. A limit line representing the spectrum mask specified for the selected standard is displayed and an overall pass/fail status is displayed for the obtained results against this limit line.

The number of sweeps is set in the **General Settings** dialog box, **Sweep Count** field. If the measurement is performed over multiple sweeps both a max hold trace and an average trace are displayed.

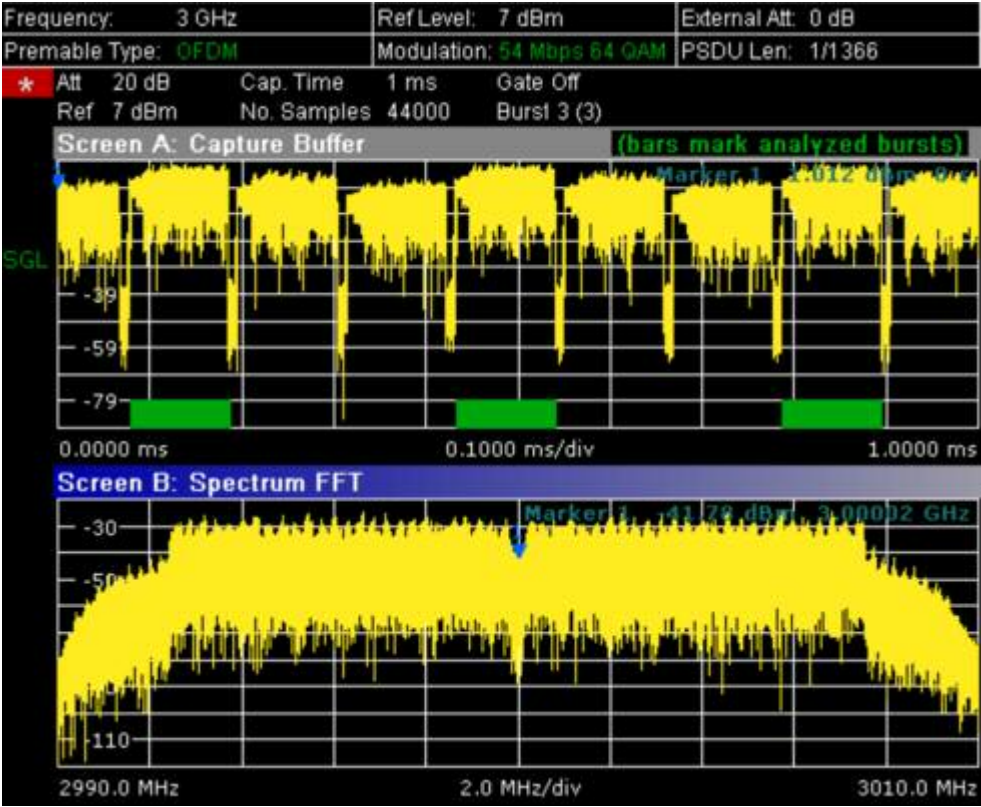


→ Remote: CONF:BURS:SPECT:MASK:SEL ETSI

Spectrum FFT

Sets the Spectrum FFT result display.

This result display shows the Power vs Frequency results obtained from a FFT performed over the range of data in the Magnitude Capture Buffer which lies within the gate lines.



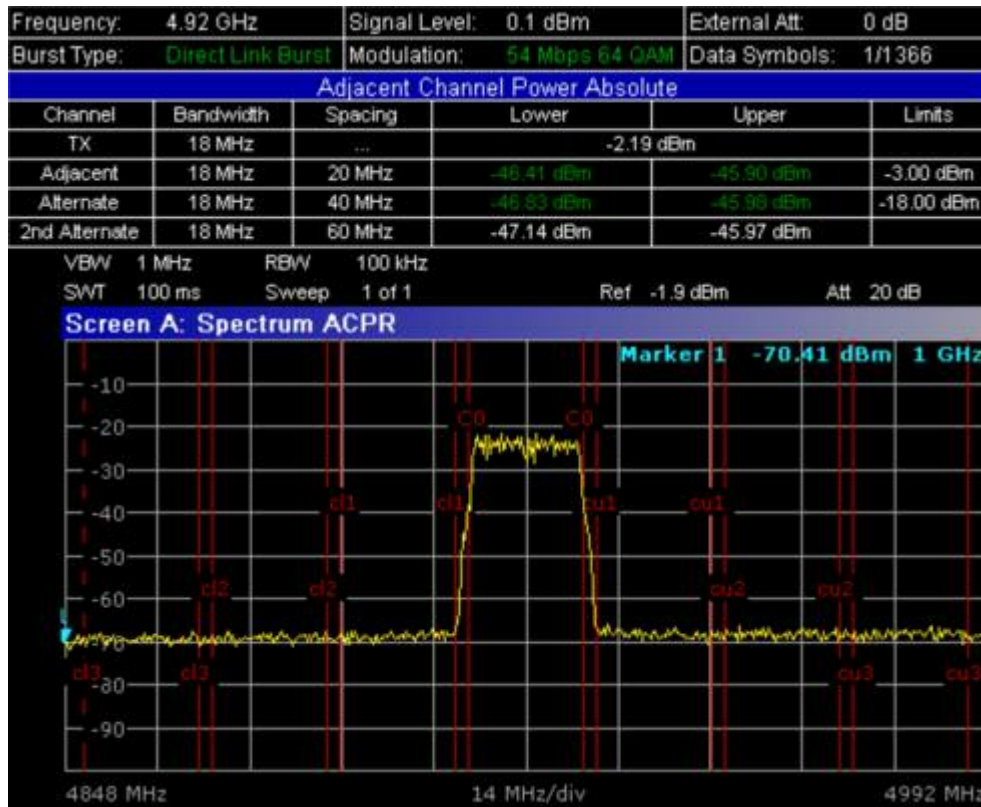
→ Remote: CONF:BURS:SPEC:FFT

**Spectrum ACPR (IEEE 802.11a, g, j – OFDM),
Spectrum ACP (IEEE 802.11b, g – Single Carrier)**

Sets the Spectrum ACPR (Adjacent Channel Power Relative) result display.

This result display is similar to the Spectrum Mask measurement, and provides information about leakage into adjacent channels. The results show the relative power measured in the three nearest channels either side of the measured channel. This measurement is the same as the adjacent channel power measurement provided by the spectrum analyzer.

The number of sweeps is set in the **General Settings** dialog box, **Sweep Count** field. If the measurement is performed over multiple sweeps both a max hold trace and an average trace are displayed.



- Remote: CONF: BURS: SPEC: ACPR
- Remote: CALC: MARK: FUNC: POW: RES? (result query)
- Remote: CALC: MARK: FUNC: POW: RES: MAXH? (result query)

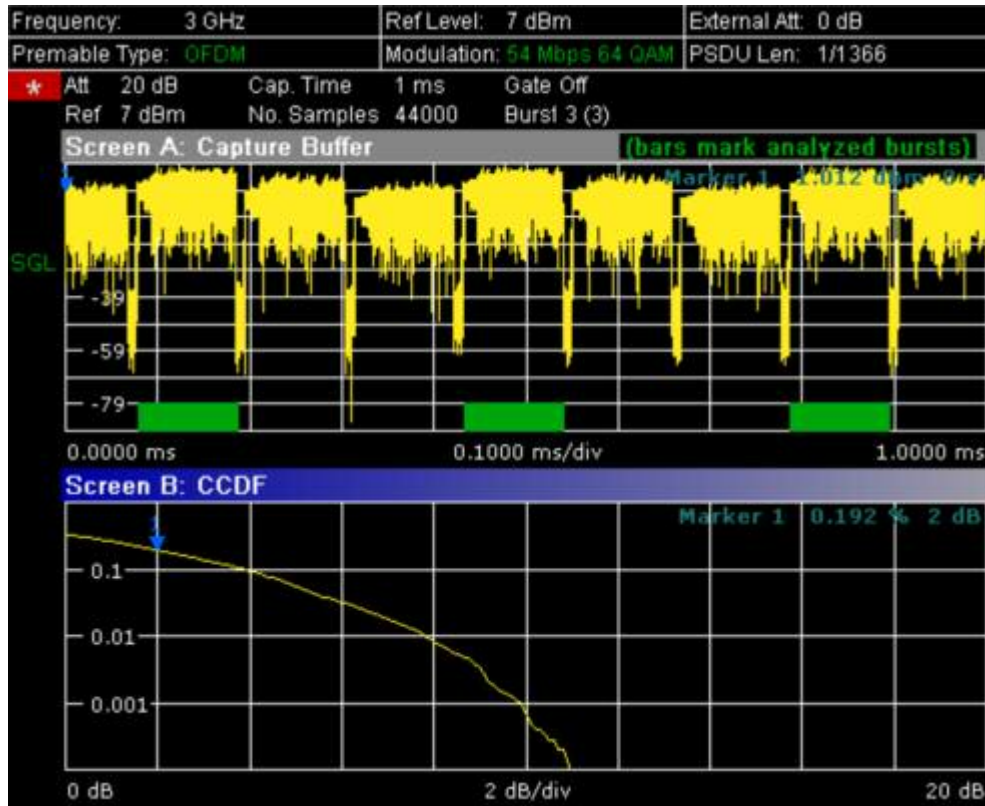
Statistics

Opens a submenu to display statistics measurement results.

CCDF

Sets the CCDF result display.

This result display shows the probability of an amplitude within the gating lines exceeding the mean power measured between the gating lines. The x-axis displays power relative to the measured mean power.



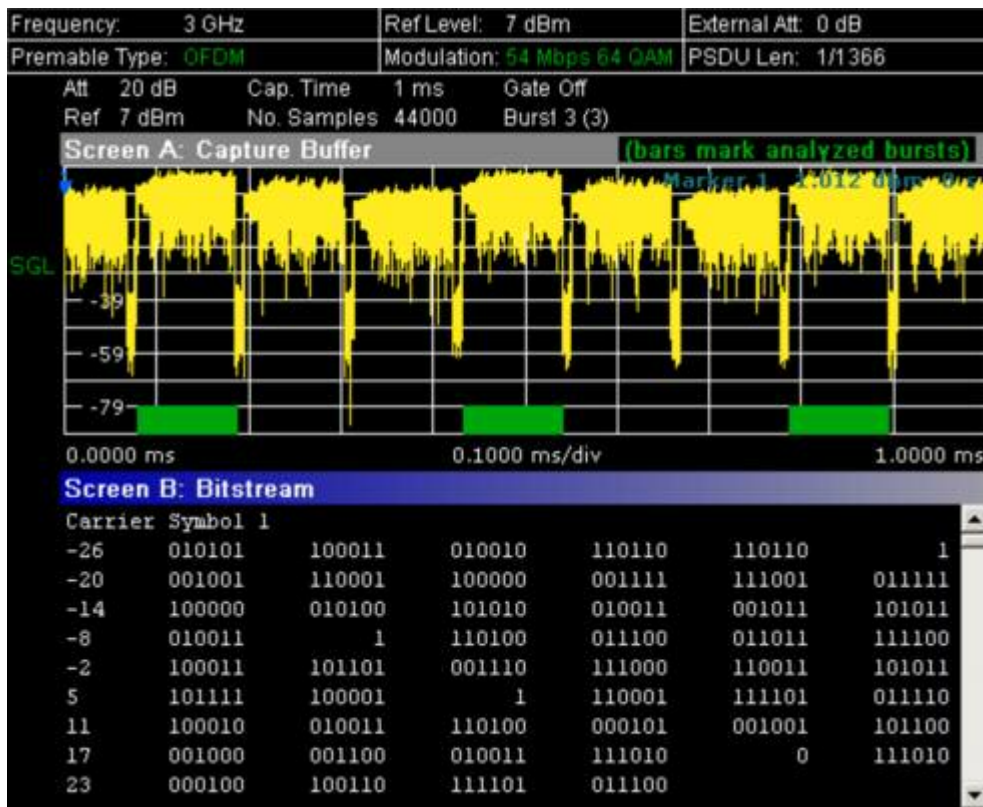
→ Remote: CONF:BURS:STAT:CCDF

Bitstream

Sets the Bitstream result display. This result display shows the demodulated data stream.

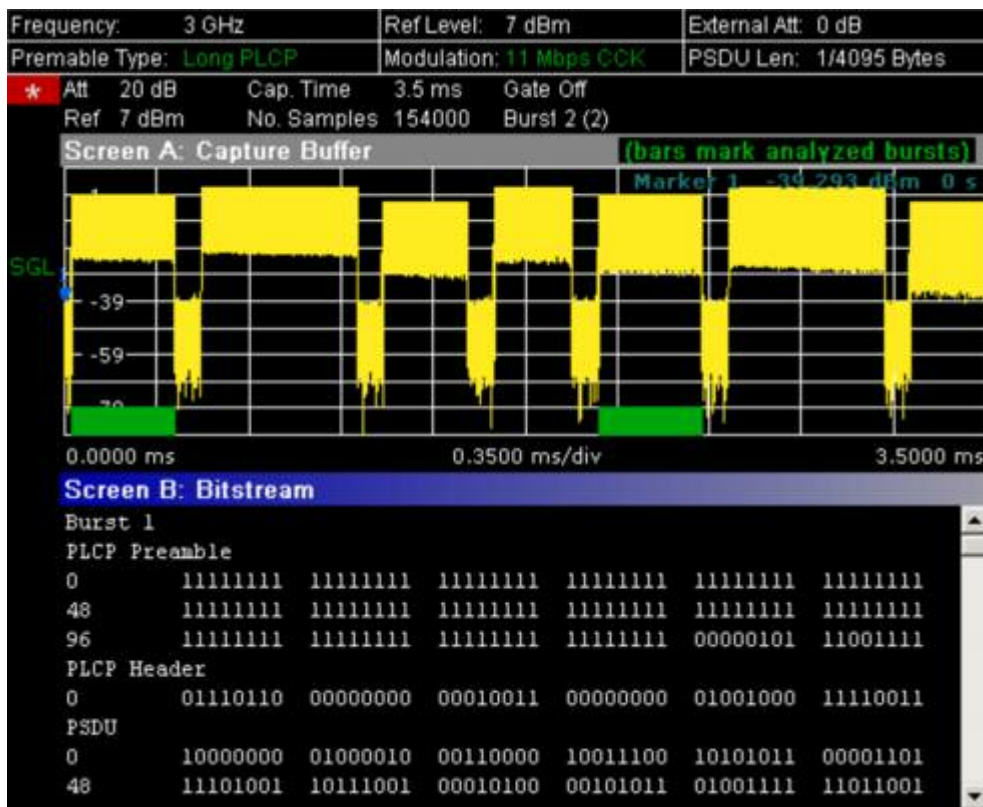
- IEEE 802.11a, j, g (OFDM):

The results are grouped by symbol and carrier.



- IEEE 802.11b or g (Single Carrier)

The results are grouped by burst.

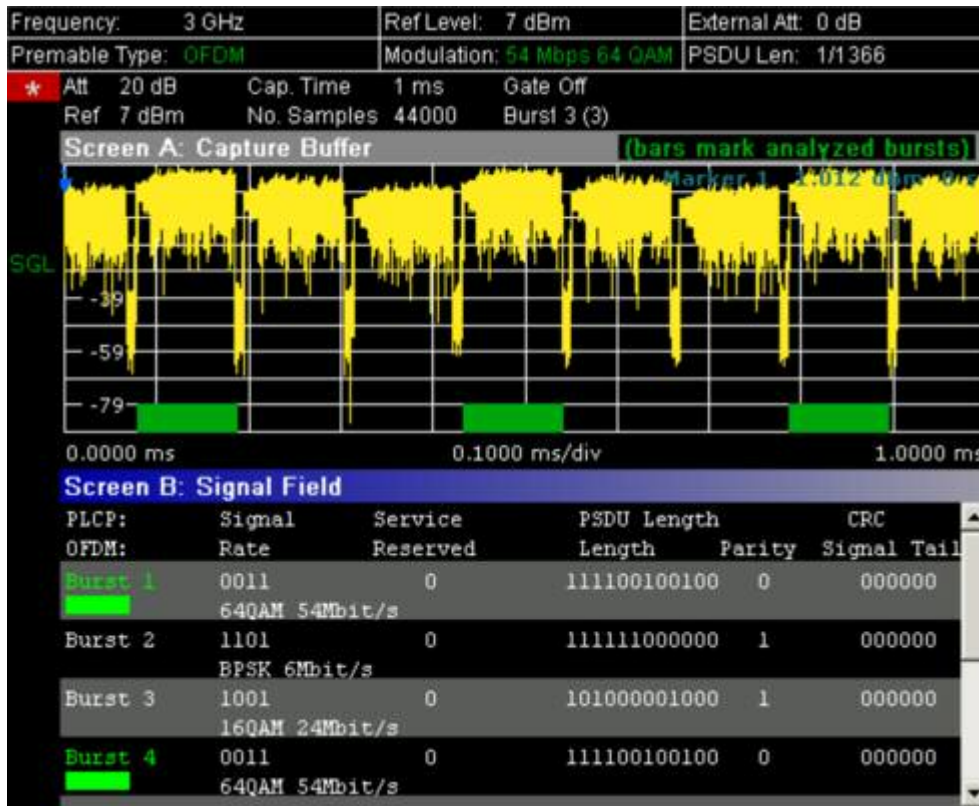


→ Remote: CONF:BURS:STAT:BSTR

Signal Field (IEEE 802.11a, g, j – OFDM)

Sets the Signal Field result display.

This result display shows the decoded data from the signal field of the burst. Therefore it is only available, if, in the **Demod Settings** dialog box, the **Signal Field Content** option is activated.



→ Remote: CONF:BURS:STAT:SField

PLCP Header (IEEE 802.11b, g – Single Carrier)

Sets the PLCP Header result display.

This result display shows the decoded data from the PLCP header of the burst. The following details are listed:

| Column header | Description | Example |
|---------------|--|----------------------------|
| Burst | number of the decoded burst A colored block indicates that the burst was successfully decoded. | Burst 1 |
| Signal | signal field The decoded data rate is shown below. | 00010100 2 Mbits/s |
| Service | service field The currently used bits are highlighted. The text below explains the decoded meaning of these bits. | 00000000 —/—/— |
| PSDU Length | length field The decoded time to transmit the PSDU is shown below. | 0000000001111000 120 µs |

CRC

CRC field
The result is displayed below (OK for passed or Failed).

1110100111001110
OK



→ Remote: CONF:BURS:STAT:SFIeld

Softkeys of the sweep menu (WLAN mode)

The following table shows all softkeys available in the sweep menu (SWEEP key). It is possible that the standard instrument does not provide all softkeys.

| Command |
|------------------|
| Meas Single/Cont |
| Auto Level |
| Refresh |

Meas Single/Cont

Selects the sweep mode.

- Single** single sweep mode
- Cont** continuous sweep mode

- Remote: INIT:CONT OFF (single sweep mode)
- Remote: INIT:CONT ON (continuous sweep mode)

Auto Level

Starts an automatic level detection measurement. If this softkey is pressed while a measurement is running, the current measurement is aborted and the automatic level detection measurement is started. If the aborted measurement was a continuous measurement it is resumed after the automatic level detection is completed.

→ Remote: CONF:POW:AUTO ONCE

Refresh

Updates the current measurement results with respect to the current gate settings. This softkey is only available if the measurement results are effected by the gate settings (Spectrum FFT, PVT and CCDF) and if the gate settings are modified after a measurement result has been obtained.

Softkeys of the marker menu (WLAN mode)

The following table shows all softkeys available in the marker menu (**MKR** key). It is possible that the standard instrument does not provide all softkeys. Close all settings dialog boxes before opening the marker menu.

| Command |
|-------------|
| Marker 1 |
| Unzoom |
| Marker Zoom |
| Marker Off |

Marker 1

Opens a dialog box to adjust the marker. The contents of the dialog box depends on the type of graph the marker is adjusted to. After every change, the marker position in the trace and the marker information are updated.

- Remote: CALC:MARK ON
 - Remote: CALC:MARK:X 2ms
 - Remote: CALC2:MARK:Y -2
 - Remote: CALC:MARK:SYMB 2
 - Remote: CALC:MARK:CARR -7
-

Unzoom

Cancels the marker zoom.

- Remote: CALC:MARK:FUNC:ZOOM 1
-

Marker Zoom

Opens an edit dialog box to select the magnification factor for the zoom. The zoom facility is provided for the following result displays: Magnitude Capture Buffer, PVT, Constellation vs Symbol, Constellation vs Carrier. The maximum magnification depends on the type of result display.

→ Remote: CALC:MARK:FUNC:ZOOM 3

Marker Off

Switches off all makers in the active result display.

→ Remote: CALC:MARK:AOFF

Softkeys of the marker→ menu (WLAN mode)

The following table shows all softkeys available in the marker→ menu (MKR→ key). It is possible that the standard instrument does not provide all softkeys.

| Command |
|-------------|
| Peak |
| Min |
| MKR → Trace |

Peak (Spectrum Flatness result display)

Sets the marker to the peak value of the assigned trace.

→ Remote: CALC:MARK:MAX

Min (Spectrum Flatness result display)

Sets the marker to the minimum value of the assigned trace.

→ Remote: CALC:MARK:MIN

MKR → Trace

Opens an edit dialog box to enter the number of the trace, on which the marker is to be placed. This softkey is available for all result displays with more than one trace.

→ Remote: CALC:MARK:TRAC 2

Softkeys of the lines menu (WLAN mode)

The following table shows all softkeys available in the lines menu (**LINES** key). It is possible that the standard instrument does not provide all softkeys.

This menu is only available if the results are displayed in form of a list (for details see [Result summary list](#) and **Display List/Graph** softkey).

| |
|---------------------------------|
| Command |
| Default Current |
| Default All |

Default Current

Resets all limits for the current modulation scheme to the values specified in the selected standard.

→ Remote: see CALCulate:LIMit:BURSt Subsystem

Default All

Resets all limits for all modulation schemes to the values specified in the selected standard.

→ Remote: see CALCulate:LIMit:BURSt Subsystem

Softkeys of the trace menu (WLAN mode)

The following table shows all softkeys available in the trace menu (**TRACE** key). It is possible that the standard instrument does not provide all softkeys.

| |
|------------------------------------|
| Command |
| Display List/Graph |
| Screen A/B |
| Screen Full/Split |

Screen A/B

Selects the active screen for IQ measurement results in split and full screen mode. Only the markers of an active screen can be controlled.

→ Remote: DISP:WIND1:SEL

Screen Full/Split

Changes the display between split and full screen for IQ measurement results. Frequency sweep measurement results are always displayed in full screen.

→ Remote: DISP:FORM SINGLE

Instrument Functions – Basic Settings

In this section, all basic settings functions of the R&S FSL and their application are explained in detail. The analyzer functions are described in section "Instrument Functions – Analyzer".

For every key a table is provided in which all submenus and corresponding commands are listed. The description of the submenus and commands follows the order of the table. The commands for the optional remote control (if any) are indicated for each softkey. The description includes the following:

- ["General Settings, Printout and Instrument Settings"](#) on page 4.153

This section provides information on how to prepare measurements and process their results: setting the instrument, managing and retrieving data, returning to manual control, and printout.

More basic information on operation is given in the Quick Start Guide. The front and the rear view of the instrument together with a table of all available keys and a short description are provided in chapter "Front and Rear Panel". Chapter "Preparing for Use" informs how to start working with the instrument for the first time. A brief introduction on handling the instrument is given in chapter "Basic Operations". This includes also the description of the keys for basic operations like switching the instrument on and off or starting a measurement.

General Settings, Printout and Instrument Settings

After putting the instrument into operation and becoming familiar with the handling of the instrument (for details see Quick Start Guide), the preparations for measurements can start. In this section the general settings of the instrument, the data management and the processing of measurement results are described. This includes the following topics and keys:

- ["Instrument Setup and Interface Configuration – SETUP Key"](#) on page 4.154
- ["Saving and Recalling Data Sets – FILE Key"](#) on page 4.169
- ["Manual Control – Local Menu"](#) on page 4.175
- ["Measurement Documentation – PRINT Key"](#) on page 4.176

Instrument Setup and Interface Configuration – SETUP Key

The **SETUP** key is used to set or display the default settings of the instrument: reference frequency, noise source, level correction values, date, time, LAN interface, firmware update and enabling of options, information about instrument configuration and service support functions. For further details refer also to the Quick Start Guide, chapter 2 "Preparing for Use", section "R&S FSL Setup".

To open the setup menu

- Press the **SETUP** key.
The setup menu is displayed.

Menu and softkey description

- "Softkeys of the setup menu" on page 4.154

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Softkeys of the setup menu

The following table shows all softkeys available in the setup menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Submenu / Command | Submenu / Command | Command |
|--------------------|---------------------------|----------------------------|---------|
| Reference Int/Ext | | | |
| Transducer ↓ | Active On/Off | | |
| | Edit ↓ | Insert Line | |
| | | Delete Line | |
| | | Edit Name | |
| | | Edit Unit | |
| | | Edit Value | |
| | | Interpolation Lin/Log | |
| | | Save Factor | |
| | New ↓ | same contents as Edit menu | |
| | Copy to ↓ | same contents as Edit menu | |
| | Delete | | |
| | Ref Level Adjust Man/Auto | | |
| | Show Directory | | |
| IF Output/IF Video | | | |
| Noise Src On/Off | | | |
| Alignment ↓ | Self Align | | |
| | Show Align Results | | |
| | Corr Data On/Off | | |

| | | | |
|-------------------|--------------------|---------------------------|-------------------------|
| General Setup ↓ | Configure Network | | |
| | Network Address ↓ | Computer Name | |
| | | IP Address | |
| | | Subnet Mask | |
| | | DHCP On/Off | |
| | GPIB ↓ | GPIB Address | |
| | | ID String Factory | |
| | | ID String User | |
| | | GPIB Language | |
| | | Display Update On/Off | |
| | | More ↓ | |
| | | GPIB Terminator LFE0I/EOI | |
| | | *IDN/*OPT Format On/Off | |
| | | I/O Logging On/Off | |
| | Time+Date | | |
| | Meas Display ↓ | Screen Title | |
| | | Time+Date On/Off | |
| | | Logo On/Off | |
| | | Annotation On/Off | |
| | | Screen Colors ↓ | Select Screen Color Set |
| | | | Color On/Off |
| | | | Select Object |
| | | | Predefined Colors |
| | | | User Defined Colors |
| | | | Set to Default |
| | | Print Colors ↓ | Select Print Color Set |
| | | | Color On/Off |
| | | | Select Object |
| | | | Predefined Colors |
| | | | User Defined Colors |
| | | | Set to Default |
| | | Display Pwr Save On/Off | |
| | Soft Frontpanel | | |
| More ↓ | | | |
| Firmware Update ↓ | Firmware Update | | |
| Option Licenses ↓ | Install Option | | |
| System Info ↓ | Hardware Info | | |
| | Versions+Options | | |
| | System Messages | | |
| | Clear All Messages | | |

| | | | |
|-----------|------------------|--|--|
| Service ↓ | Input RF/Cal/TG | | |
| | Comb Frequency | | |
| | Reset Password | | |
| | Selftest | | |
| | Selftest Results | | |
| | Password | | |
| | Service Function | | |

Reference Int/Ext

Switches between the internal and external reference signal source. The default setting is internal reference. It is important, that the external reference signal is deactivated when switching from external to internal reference to avoid interactions.

If the reference signal is missing when switching to external reference, the message **EXREF** is displayed to indicate that no synchronization is performed.

The R&S FSL can use the internal reference source or an external reference source as frequency standard from which all internal oscillators are derived. A 10 MHz crystal oscillator is used as internal reference source. In the external reference setting, all internal oscillators of the R&S FSL are synchronized to the external reference frequency (also 10 MHz). For details on connectors refer to the Quick Start Guide, chapter 1 "Front and Rear Panel".

→ Remote: ROSC:SOUR INT

Transducer

Opens the **Select Transducer** dialog box and a submenu to activate or deactivate defined transducer factors, to generate new transducer factors or to edit existing ones.

In the **Select Transducer** dialog box, a transducer factor can be edited, deleted or copied, if selected, using the corresponding softkeys. The default directory, in which the transducer factors are saved, is displayed (C:\R_S\INSTR\TRD; the extension of transducer factor files is *.TDF). Subdirectories can be added or deleted via the file manager. They are displayed or hidden using the arrow keys or the **Show Directory** softkey / **Hide Directory** button.

Two different directory views are possible: If the **Show all** option is activated, all transducer factors in the directory are displayed. If the **Show compatible** option is activated, only the compatible transducer factors in the directory are displayed.

For details on transducer factors refer to chapter "Advanced Measurement Examples".

This softkey is available from firmware version 1.10.

→ Remote: CORR:TRAN:SEL FACTOR1

Active On/Off

Activates or deactivates the selected transducer factor. A maximum of 10 transducer factors can be activated at the same time. If an additional transducer factor is activated, its unit compatibility is checked. If one factor has a different unit than dB, all the other activated factors must have the unit dB.

This softkey is available from firmware version 1.10.

- Remote: CORR:TRAN:SEL <name>
 - Remote: CORR:TRAN ON
-

Edit

Opens the **Edit Transducer** dialog box with the data of the selected factor. During editing, a transducer factor remains stored in the background until the factor is saved using the **Save Factor** softkey.

This softkey is available from firmware version 1.10.

- Remote: Comment: CORR:TRAN:COMM <string>
-

Insert Line

Inserts an empty line above the selected reference value to enter a new reference value. When entering a new reference value in the line, the ascending order of frequencies must be taken into consideration, however.

This softkey is available from firmware version 1.10.

Delete Line

Deletes the selected reference value (complete line). The reference values that follow move one line up.

This softkey is available from firmware version 1.10.

Edit Name

Sets the focus on the **Name** field to enter a file name. The extension is added automatically.

This softkey is available from firmware version 1.10.

- Remote: CORR:TRAN:SEL <name>
-

Edit Unit

Sets the focus on the **Unit** field to select the unit.

This softkey is available from firmware version 1.10.

- Remote: CORR:TRAN:UNIT <string>
-

Edit Value

Sets the focus to enter positions and values as frequency/level pairs. The entered data are also displayed graphically. Using the **Shift x** or **Shift y** button, all entered values can be shifted in x or y direction.

This softkey is available from firmware version 1.10.

→ Remote: CORR:TRAN:DATA <freq>,<level>

Interpolation Lin/Log

Sets the scaling of the x axis to linear or logarithmic.

This softkey is available from firmware version 1.10.

→ Remote: CORR:TRAN:SCAL LIN|LOG

Save Factor

Saves the changed factor to a file on the internal flash disk. If a transducer factor with the same name already exists, a confirmation query is displayed. If the new factor is active, the new values are immediately applied.

This softkey is available from firmware version 1.10.

→ Remote: In remote control, the save operation is performed automatically after the definition of the reference values.

New

Opens the **Edit Transducer** dialog box to enter data for a new factor.

This softkey is available from firmware version 1.10.

Copy to

Opens the **Edit Transducer** dialog box to copy the selected factor.

This softkey is available from firmware version 1.10.

Delete

Deletes the selected factor after confirmation.

This softkey is available from firmware version 1.10.

→ Remote: CORR:TRAN DEL

Ref Level Adjust Man/Auto

Adjusts the reference frequency to the selected transducer factor. Manual or automatic adjustment can be selected.

This softkey is available from firmware version 1.10.

→ Remote: CORR:TRAN:ADJ:RLEV ON

Show Directory

Displays the subdirectory of the selected directory.

This softkey is available from firmware version 1.10.

IF Output/IF Video (option Additional Interfaces, B5 only)

Changes the measurement mode of the IF connector.

→ Remote: `OUTP IF VID`

Noise Src On/Off (option Additional Interfaces, B5 only)

Switches the supply voltage for an external noise source on or off. For details on connectors refer to the Quick Start Guide, chapter 1 "Front and Rear Panel" .

→ Remote: `DIAG:SERV:NSO ON`

Alignment

Opens a submenu with the available functions for recording, displaying and activating the data for self alignment.

The correction data and characteristics required for the alignment are determined by comparison of the results at different settings with the known characteristics of the high-precision calibration signal source at 65.83 MHz. The correction data are stored as a file on flash disk and can be displayed using the **Show Align Results** softkey.

Self Align

Starts the recording of correction data of the instrument. If the correction data acquisition has failed or if the correction values are deactivated, a corresponding message is displayed in the status field.

As long as the self alignment data is collected the procedure can be cancelled using the **Abort** button.

→ Remote: `*CAL?`

Show Align Results

Opens a dialog box that displays the correction data of the alignment:

- date and time of last correction data record
- overall results of correction data record
- list of found correction values according to function/module

The results are classified as follows:

| | |
|---------------|---|
| PASSED | calibration successful without any restrictions |
| CHECK | deviation of correction value larger than expected, correction could however be performed |
| FAILED | deviations of correction value too large, no correction was possible. The found correction data are not applicable. |

As long as the self alignment data is collected the procedure can be cancelled using the **Abort** button.

→ Remote: CAL:RES?

→ Remote: CAL:ABOR

Corr Data On/Off

Activates and deactivates the alignment data, e.g. for service purposes the correction data can be deactivated.

→ Remote: CAL:STAT ON

General Setup

Opens a submenu for all general settings such as IP address and LAN settings, date and time, remote control (optional) and MEAS display.

Configure Network

Opens the **Network Connections** dialog box to change the LAN settings. For details refer to the Quick Start Guide, chapter 2 "Preparing for Use", section "Configuring the LAN Interface" and appendix B, "LAN Interface".

Network Address

Opens a submenu to configure the internet protocol properties and the computer name.

Computer Name

Opens an edit dialog box to enter the computer name via the keypad. The naming conventions of Windows apply. If too many characters and/or numbers are entered, in the status line, an according message is displayed. For step-by-step instructions refer to the Quick Start Guide, appendix B "LAN Interface".

IP Address

Opens an edit dialog box to enter the IP address via the keypad. The TCP/IP protocol is preinstalled with the IP address 10.0.0.10.

The IP address consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address). For step-by-step instructions refer to the Quick Start Guide, chapter 2 "Preparing for Operation".

Subnet Mask

Opens an edit dialog box to enter the subnet mask via the keypad. The TCP/IP protocol is preinstalled with the subnet mask 255.255.255.0.

The subnet mask consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a

block (as an example see the preinstalled address). For step-by-step instructions refer to the Quick Start Guide, chapter 2 "Preparing for Operation".

DHCP On/Off

Switches between DHCP server available (On) or not available (Off). If a DHCP server is available in the network, the IP address and subnet mask of the instrument are obtained automatically from the DHCP server. For further details refer to the Quick Start Guide, chapter 2 "Preparing for Operation".

GPIB (option GPIB Interface, B10 only)

Opens a submenu to set the parameters of the remote control interface.

GPIB Address (option GPIB Interface, B10 only)

Opens an edit dialog box to enter the GPIB address. Values from 0 to 30 are allowed. The default address is 20.

→ Remote: `SYST:COMM:GPIB:ADDR 20`

ID String Factory (option GPIB Interface, B10 only)

Selects the default response to the *IDN? query.

ID String User (option GPIB Interface, B10 only)

Opens an edit dialog box to enter a user-defined response to the *IDN? query. Max. 36 characters are allowed.

GPIB Language (option GPIB Interface, B10 only)

Only the remote control language SCPI is available for the R&S FSL and is set by default.

Display Update On/Off

Defines whether the instrument display is switched off when changing from manual control to remote control. In remote control mode, this softkey is displayed in the local menu (for details refer to section "[Manual Control – Local Menu](#)" on page 4.175).

→ Remote: `SYST:DISP:UPD ON`

GPIO Terminator LFEI/EOI (option GPIO Interface, B10 only)

Changes the GPIO receive terminator.

According to the standard the terminator in ASCII is <LF> and/or <EOI>. For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by changing the receive terminator to EOI.

→ Remote: SYST:COMM:GPIO:RTER EOI

***IDN/*OPT Format On/Off (option GPIO Interface, B10 only)**

Provides the response to the *IDN? and *OPT? remote command in a format that is compatible to the R&S FSP/FSU/FSQ family. This function is intended for re-use of existing control programs together with the R&S FSL. For details on the FSL specific response formats refer to chapter "Remote Control – Commands", section "Common commands" or the Online Help.

I/O Logging On/Off (option GPIO Interface, B10 only)

Activates logging all remote control commands received by the FSL in the log file ScpiLog.txt for debug purposes. Logging the commands may be extremely useful in order to find misspelled keywords in control programs. The corresponding log file will be stored in folder C:\R_S\instr\ScpiLogging.

Time+Date

Opens an edit dialog box to enter time and date for the internal real time clock. For details refer to the Quick Start Guide, chapter 2 "Preparing for Use", section "Setting the Date and Time".

→ Remote: SYST:TIME 12,30

→ Remote: SYST:DATE 2004,10,01

Meas Display

Opens a submenu to configure the display and the print colors.

This softkey is available from firmware version 1.10.

Screen Title

Activates/deactivates the display of a diagram title (if available) and opens an edit dialog box to enter a new title for the active diagram. Max. 20 characters are allowed.

This softkey is available from firmware version 1.10.

→ Remote: DISP:TEXT 'Noise Meas'

→ Remote: DISP:TEXT:STATE ON

Time+Date On/Off

Activates/deactivates the display of date and time above the diagram.

This softkey is available from firmware version 1.10.

→ Remote: `DISP:TIME OFF`

Logo On/Off

Activates/deactivates the display of the Rohde & Schwarz company logo in the upper left corner.

This softkey is available from firmware version 1.10.

→ Remote: `DISP:LOGO ON`

Annotation On/Off

Activates/deactivates the display of the frequency information. For example to protect confidential data it can be useful to hide the frequency information.

This softkey is available from firmware version 1.10.

→ Remote: `DISP:ANN:FREQ ON`

Screen Colors

Opens a submenu to configure the screen colors. For details on screen colors refer to the Quick Start Guide, chapter 2 "Preparing for Use", section "Setting the Screen Colors".

This softkey is available from firmware version 1.10.

→ Remote: `DISP:CMAP2:HSL 0.3,0.8,1.0`

Select Screen Color Set

Opens the **Select Screen Color Set** dialog box to select default or user defined color settings.

If one of the default settings is selected (**Default Colors 1/2**), the default settings for brightness, color tint and color saturation for all display screen elements are restored. The default color schemes provide optimum visibility of all picture elements at an angle of vision from above or below. Default setting is **Default Colors 1**.

If **User Defined Colors** is selected, a user-defined color set can be defined. For step-by-step instruction refer to the Quick Start Guide, chapter 2 "Preparing for Use".

This softkey is available from firmware version 1.10.

→ Remote: `DISP:CMAP:DEF2`

Color On/Off

Switches from color display to black-and-white display and back. The default setting is color display.

This softkey is available from firmware version 1.10.

Select Object

Opens the **Color Setup** dialog box to select the color settings for a selected object.

The **Selected Object** list is displayed to select the object. For setting the color the predefined colors are displayed.

This softkey is available from firmware version 1.10.

- Remote: DISP:CMAP2:HSL 0.3,0.8,1.0 (screen colors)
 - Remote: HCOP:CMAP2:HSL 0.3,0.8,1.0 (print colors)
-

Predefined Colors

In the **Color Setup** dialog box, displays the **Predefined Colors** (alternative to the **Predefined Colors** button). This softkey is only available if, in the **Select Color Set** dialog box, the **User Defined Colors** option is selected or the **Color Setup** dialog box is displayed. For further details refer to the Quick Start Guide, chapter 2 "Preparing for Use".

This softkey is available from firmware version 1.10.

- Remote: DISP:CMAP2:PDEF GRE (screen colors)
 - Remote: HCOP:CMAP2:PDEF GRE (print colors)
-

User Defined Colors

In the **Color Setup** dialog box, displays the **User Defined Colors** (alternative to the **User Defined Colors** button). This softkey is only available if, in the **Select Color Set** dialog box, the **User Defined Colors** option is selected or the **Color Setup** dialog box is displayed. For further details refer to the Quick Start Guide, chapter 2 "Preparing for Use".

This softkey is available from firmware version 1.10.

- Remote: DISP:CMAP2:HSL 0.3,0.8,1.0 (screen colors)
 - Remote: HCOP:CMAP2:HSL 0.3,0.8,1.0 (print colors)
-

Set to Default

Opens the **Set to Default** dialog box to select one of the factory default color settings.

This softkey is available from firmware version 1.10.

- Remote: DISP:CMAP:DEF2 (screen colors)
 - Remote: HCOP:CMAP:DEF2 (print colors)
-

Print Colors

Opens a submenu to select the colors for the printout. To facilitate color selection, the selected color combination is displayed when the menu is entered. The previous colors are restored when the menu is exited.

This softkey is available from firmware version 1.10.

Select Print Color Set

Opens the **Select Print Color Set** dialog box to select the color settings for printout.

| | |
|----------------------------|---|
| Screen Colors | Selects the current screen colors for the printout. The background is always printed in white and the grid in black. |
| Optimized Colors | Selects an optimized color setting for the printout to improve the visibility of the colors (default setting). Trace 1 is blue, trace 2 black, trace 3 green, and the markers are turquoise. The background is always printed in white and the grid in black. |
| User Defined Colors | Enables the softkeys to define colors for the printout. |

This softkey is available from firmware version 1.10.

→ Remote: HCOP:CMAP:DEF1|DEF2|DEF3

Color On/Off

Switches from color printout to black-and-white printout and back. All colored areas are printed in white and all colored lines in black. This improves the contrast. The default setting is color printout, provided that the selected printer can produce color printouts.

This softkey is available from firmware version 1.10.

→ Remote: HCOP:DEV:COL ON

Display Pwr Save On/Off

Switches the power-save mode for the display on/off and opens an edit dialog box to enter the time for the power-save function to respond. After the elapse of this time the display is completely switched off, i.e. including backlighting. This mode is recommended when the instrument is exclusively operated in remote control.

For details on the power-save mode for the display refer to the Quick Start Guide, chapter 2 "Preparing for Use", section "Automatically Switching Off the Internal Screen".

This softkey is available from firmware version 1.10.

→ Remote: DISP:PSAV ON

→ Remote: DISP:PSAV:HOLD 15

Soft Frontpanel

Activates or deactivates the display of the front panel keys on the screen. Alternatively, the F6 key can be used.

→ Remote: SYST:DISP:FPAN ON

Firmware Update

Opens a submenu to install firmware versions. The installation of a new firmware version can be performed via USB or LAN interface. For details on installation refer to the Quick Start Guide, chapter 3 "Firmware Update and Installation of Firmware Options", section "Firmware Update".

Firmware Update

Opens the **Firmware Update** dialog box. The update path is changed by entering the new path or via the **Browse** button. The installation is started via the **Execute** button. For details on installation refer to the Quick Start Guide, chapter 3 "Firmware Update and Installation of Firmware Options", section "Firmware Update".

→ Remote: SYST:FIRM:UPD 'D:\FW_UPDATE'

Option Licenses

Opens a submenu to install options. For details on options refer to the Quick Start Guide, chapter 3 "Firmware Update and Installation of Firmware Options", section "To activate firmware options".

Install Option

Opens an edit dialog box to enter the license key for the option that you want to install.

System Info

Opens a submenu to display detailed information on module data, device statistics and system messages.

Hardware Info

Opens a dialog box in which all modules (installed hardware components) are listed together with the corresponding hardware revisions.

→ Remote: DIAG:SERV:HWIN?

Versions+Options

Opens a dialog box that displays the model information, serial number, firmware version, and specifications version of the basic device. Additionally the operating time of the instrument, the power on cycles and the attenuator switching cycles are displayed.

For details on options refer to the Quick Start Guide, chapter 3 "Firmware Update and Installation of Firmware Options", section "To activate firmware options".

→ Remote: SYST:VERS?

System Messages

Opens the **System Messages** dialog box that displays the generated system messages in the order of their occurrence. The most recent messages are placed at the top of the list. Messages that have occurred since the last display of system messages menu are marked with an asterisk '*'. The following information is available:

| | |
|------------------|--|
| No | device-specific error code |
| Message | brief description of the message |
| Component | hardware messages: name of the affected module software messages: name of the affected software |

Date/Time date and time of the occurrence of the message

If the number of error messages exceeds the capacity of the error buffer, **Message buffer overflow** is displayed. To delete messages see **Clear All Messages** softkey.

→ Remote: SYST:ERR:LIST?

Clear All Messages

Deletes all system messages. The softkey is only available if the **System Messages** dialog box is displayed.

→ Remote: SYST:ERR:CLE:ALL?

Service

Opens a submenu that contains additional functions for maintenance and/or trouble shooting.



ATTENTION

The service functions are not necessary for normal measurement operation. However, incorrect use can affect correct operation and/or data integrity of the R&S FSL. Therefore, many of the functions can only be used after entering a password. They are described in the instrument service manual.

Input RF/Cal/TG

Selects the input for measurement.

RF Switches the input of the R&S FSL to the input connector (normal position). This is the default setting.

Cal Switches the RF input of the R&S FSL to the internal calibration source (65.83 MHz) and activates the data entry of the output level of the calibration source. Possible values are 0 dB and –30 dB.

TG Switches the RF input of the R&S FSL to the tracking generator output. Only the models 13 and 16 offer this setting.

→ Remote: DIAG:SERV:INP RF|CAL|TG

Comb Frequency

Opens a dialog box to set the comb generator frequency for the internal calibration:

Comb/1 65.8333 MHz / 1

Comb/64 65.8333 MHz / 64

Comb/65 65.8333 MHz / 65

→ Remote: Sine: DIAG:SERV:INP:PULS OFF

→ Remote: Comb: DIAG:SERV:INP:PULS ON

→ Remote: Comb: DIAG:SERV:INP:PRAT COMB64

Reset Password

Deactivates all set passwords.

→ Remote: SYST:PASS:RES

Selftest

Initiates the self test of the instrument modules to identify a defective module in case of failure . All modules are checked consecutively and the test result is displayed.

→ Remote: *TST?

Selftest Results

Opens the **Selftest Result** dialog box that contains the test results. In case of failure a short description of the failed test, the defective module, the associated value range and the corresponding test results are indicated.

→ Remote: DIAG:SERV:STE:RES?

Password

Opens an edit dialog box to enter the password. This ensures that the service functions are only used by authorized personnel.

→ Remote: SYST:PASS "Password"

Service Function

Opens the **Service Function** dialog box to start special service functions. For further information refer to the service manual.

→ Remote: DIAG:SERV:SFUNC <value>,<value>...

Saving and Recalling Data Sets – FILE Key

The **FILE** key is used to store and load instrument settings and to manage stored files.

The file menu includes functions for storing (**Save** softkey) instrument settings such as instrument configurations (measurement/display settings, etc) and measurement results on permanent storage media, or to load (**Recall** softkey) stored data back onto the instrument.

Functions for management of storage media (**File Manager** softkey) include among others functions for listing, copying, and deleting/rename files.

The R&S FSL is capable of internally storing complete instrument settings with instrument configurations and measurement data in the form of data sets. The respective data are stored on the internal flash disk or, if selected, on a memory stick or network drive. The mass media are assigned to the volume names as follows:

| Drive | Designation | Comment |
|--------|--|-------------------|
| C | operating system, firmware and stored instrument settings | for customer data |
| A | USB floppy drive | if connected |
| D | USB memory stick or USB CD-ROM | if connected |
| E ...Z | additional USB mass storage devices or mounted LAN volumes | if connected |

To open the file menu

- Press the **FILE** key.

The file menu is displayed.

Menu and softkey description

- ["Softkeys of the file menu"](#) on page 4.170

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Further information

- ["Navigation in the dialog boxes for saving and loading data sets"](#) on page 4.169
- ["Navigation in the file manager"](#) on page 4.170

Navigation in the dialog boxes for saving and loading data sets

The **Save**, **Recall** and **Startup Recall** dialog boxes are used to save and recall data sets and use the same navigation principle. Press the **Save** or **Recall** softkey to open the corresponding dialog box.

- **Path** field

To change the directory, press the **Edit Path** softkey.

To select a folder, use the rotary knob or the **UPARROW** and **DNARROW** keys. To open a subfolder, press the **RIGHTARROW** key. To close subfolders, press the **LEFTARROW** key. To confirm the selection, press the rotary knob or the **ENTER** key.

- **Files list**

If the **Startup Recall** dialog box is opened, the focus is on the **Files** list. To set the focus on the **Files** list, press the **Data Set List** softkey.

To select a folder, use the rotary knob or the **UPARROW** and **DNARROW** keys. To open a subfolder, press the **ENTER** key. To select a file, use the rotary knob or the **UPARROW** and **DNARROW** keys. To load the selected file, press the rotary knob or the **ENTER** key. To delete the selected file, press the softkey.

- **File Name field**

If the **Save** or **Recall** dialog box is opened, the focus is on the **File Name** field. Enter the name in the **File Name** field. The extension of the data name is ignored (for details on entering the name, see Quick Start Guide, chapter 4 "Basic Operations").

- **Comment field**

To enter a comment, press the **Edit Comment** softkey (for details on entering the name, see Quick Start Guide, chapter 4 "Basic Operations").

- **Data subsets**

- To select a special item, set the focus on the entry using the arrow keys or the rotary knob. To confirm the selection, press the **CHECKMARK** key. To deselect the item, press the **CHECKMARK** key again.

Navigation in the file manager

- To change from one subfolder to another, use the **ENTER** key.
- To change to the next higher directory, select the dots "..".
- To change into a subfolder, use the **RIGHTARROW** and **LEFTARROW** keys.
- To select a file or a folder, use the **UPARROW** and **DNARROW** keys.
- To confirm the selection of a file or folder, press the **ENTER** key.

Softkeys of the file menu

The following table shows all softkeys available in the file menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Submenu / Command | Command |
|----------------------|-------------------|---------|
| Save | | |
| Recall | | |
| Edit Path | | |
| Edit Comment | | |
| Data Set List | | |
| Data Set Clear | | |
| More ↓ | | |
| Startup Recall | | |
| Startup Recall Setup | | |
| File Manager ↓ | Edit Path | |
| | New Folder | |
| | Copy | |
| | Rename | |

| Menu / Command | Submenu / Command | Command |
|----------------|-----------------------|-----------|
| | Cut | |
| | Paste | |
| | More ↓ | |
| | Delete | |
| | Sort Mode ↓ | Name |
| | | Date |
| | | Extension |
| | | Size |
| | File Lists 1/2 | |
| | Current File List 1/2 | |

Save

Opens the **Save** dialog box to define and store the data set. To navigate in the dialog box and define/enter settings use the corresponding softkeys. For details see also "[Navigation in the dialog boxes for saving and loading data sets](#)" on page 4.169.

| | |
|--------------|---|
| Path | Directory in which the data set is stored. The default path for user data sets is C:\R_S\Instr\user |
| Files | List of data sets already stored. |
| File Name | Alphanumeric name of data set. |
| Comment | Comment regarding the data set. |
| Data subsets | Selection of data subsets to be saved. |

→ Remote: MMEM:STOR:STAT 1, 'TEST'

Recall

Opens the **Recall** dialog box to load a data set. For details on the dialog box see **Save** softkey. To navigate in the dialog box and define/enter settings use the corresponding softkeys. For details see also "[Navigation in the dialog boxes for saving and loading data sets](#)" on page 4.169.

→ Remote: MMEM:LOAD:STAT 1, 'C:\R_S\Instr\user\TEST01'

Edit Path

Opens the directory list to select the folder in which the device configuration is to be stored or loaded. The default path is C:\R_S\Instr\user. For details see also "[Navigation in the dialog boxes for saving and loading data sets](#)" on page 4.169.

Edit Comment

Sets the focus on the **Comment** field to enter a comment concerning the current data set. Max. 60 characters are allowed. For details see also "[Navigation in the dialog boxes for saving and loading data sets](#)" on page 4.169.

Data Set List

Sets the focus on the **Files** list. If a file is selected, the corresponding data are displayed. For details on the dialog box see also **Save** softkey and "[Navigation in the dialog boxes for saving and loading data sets](#)" on page 4.169.

Data Set Clear

Deletes the selected data set file.

Startup Recall

Activates or deactivates the startup recall function. If activated, the settings stored in the data set selected via the **Startup Recall Setup** softkey are loaded when booting or for preset. If deactivated, the default settings are loaded.

This softkey is available from firmware version 1.10.

→ Remote: MMEM:LOAD:AUTO 1, 'C:\R_S\Instr\user\TEST'

Startup Recall Setup

Opens the **Startup Recall** dialog box to select the data set for the startup recall function (see also **Startup Recall** softkey).

This softkey is available from firmware version 1.10.

→ Remote: MMEM:LOAD:AUTO 1, 'C:\R_S\Instr\user\TEST'

File Manager

Opens the **File Manager** dialog box and a submenu to manage mass storage media and files. In the upper left corner, the current drive is displayed. Below the folders and subfolders of the current directory are displayed. For details on navigation see also "[Navigation in the file manager](#)" on page 4.170.

The following tasks can be performed:

- to copy files from flash disk to other media
 - to copy files into another directory
 - to rename and delete files
-

Edit Path

For details see **Edit Path** softkey.

→ Remote: MMEM:MSIS "D:"

→ Remote: MMEM:CDIR "C:\R_S\Instr\user"

New Folder

Creates a new folder and opens an edit dialog box to enter name and path (absolute or relative to the current directory) of the new folder.

→ Remote: MMEM:MDIR "C:\R_S\Instr\user\TEST"

Copy

Copies the selected item to the clipboard. The item can be copied later using the **Paste** softkey. For details on navigation see also "[Navigation in the file manager](#)" on page 4.170.

→ Remote: MMEM:COPY "C:\R_S\Instr\user\set.cfg", "E:"

Rename

Opens an edit dialog box to enter a new file or folder name. For details on navigation see also "[Navigation in the file manager](#)" on page 4.170.

→ Remote: MMEM:MOVE "test02.cfg", "set2.cfg"

Cut

Copies the selected file to the clipboard. If the file is later copied to a different directory using the **Paste** softkey, it is deleted in the current directory. For details on navigation see also "[Navigation in the file manager](#)" on page 4.170.

Paste

Copies a file from the clipboard to the currently selected directory. For details on navigation see also "[Navigation in the file manager](#)" on page 4.170.

Delete

Deletes the selected item after confirmation. For details on navigation see also "[Navigation in the file manager](#)" on page 4.170.

→ Remote: MMEM:DEL "test01.hcp"

→ Remote: MMEM:RDIR "C:\R_S\Instr\user\TEST"

Sort Mode

Opens a submenu to select the sorting mode for the displayed files. The entry for the next higher directory level ("..") and the folders are always located at the top of the list.

Name

Sorts the displayed files in alphabetical order of the file names.

Date

Sorts the displayed files in respect to the date.

Extension

Sorts the displayed files in respect to the extension.

Size

Sorts the displayed files in respect to the size.

File Lists 1/2

Splits the screen to copy files from one directory to the other. The focus between the two panes is switched using the **FIELD RIGHT** and **FIELD LEFT** keys.

Current File List 1/2

Changes the focus to the selected file list.

Manual Control – Local Menu

When switched on, the instrument is always in the manual measurement mode and can be operated via the front panel. As soon as the instrument receives a remote command, it is switched to the remote control mode.

In remote control mode, all keys of the instrument except the **PRESET** key are disabled. The **LOCAL** softkey and the **Display Update On/Off** softkey are displayed. Depending on the setting of the **Display Update On/Off** softkey, the diagrams, traces and display fields are displayed or hidden. For further details on the **Display Update On/Off** softkey refer to section "Instrument Setup and Interface Configuration – SETUP Key".

For details on remote control refer to section "Remote Control – Basics".

The change to manual control consists of:

- Enabling the Front Panel Keys

Returning to manual mode enables all inactive keys. The main softkey menu of the current mode is displayed.

- Displaying the measurement diagrams again.

The diagrams, traces and display fields are displayed again.

- Generating the **OPERATION COMPLETE** message

If, at the time of pressing the **LOCAL** softkey, the synchronization mechanism via *OPC, *OPC? or *WAI is active, the currently running measurement procedure is aborted and synchronization is achieved by setting the corresponding bits in the registers of the status reporting system.

- Setting Bit 6 (User Request) of the Event Status Register

With a corresponding configuration of the status reporting system, this bit immediately causes the generation of a service request (SRQ) to inform the control software that the user wishes to return to front panel control. For example this can be used to interrupt the control program and to correct instrument settings manually. This bit is set each time the **LOCAL** softkey is pressed.

To return to manual control

- Press the **LOCAL** softkey.

The instrument switches from remote to manual control, but only if the local lockout function has not been activated in the remote control mode.

Measurement Documentation – PRINT Key

The **PRINT** key is used to select and configure the printer and to customize the screen printout. For detailed information on printer selection and installation refer to the Quick Start Guide.

To open the print menu

- Press the **PRINT** key.
The print menu is displayed.

Menu and softkey description

- ["Softkeys of the print menu"](#) on page 4.176

To display help to a softkey, press the **HELP** key and then softkey for which you want to display help. To close the help window, press the **ESC** key. For further information refer to section "How to use the Help System".

Softkeys of the print menu

The following table shows all softkeys available in the trigger menu. It is possible that the standard instrument does not provide all softkeys. If a softkey is only available with a special option or model, this information is delivered in the corresponding softkey description.

| Menu / Command | Submenu / Command |
|-----------------|---------------------|
| Print Screen | |
| Device Setup | |
| Device 1/2 | |
| Colors ↓ | Select Color Set |
| | Color On/Off |
| | Select Object |
| | Predefined Colors |
| | User Defined Colors |
| | Set to Default |
| Comment | |
| Install Printer | |

Print Screen

Starts to printout all test results displayed on the screen: diagrams, traces, markers, marker lists, limit lines etc. Comments, title, date, and time are included at the bottom margin of the printout. All displayed items belonging to the instrument software (softkeys, tables, dialog boxes) are not printed out.

- ➔ Remote: HCOP : ITEM : ALL
 - ➔ Remote: HCOP : IMM
-

Device Setup

Opens the **Device Setup** dialog box to select file format and the printer. The dialog box consists of two tabs which are selected via the **Device 1/2** softkey. For further information refer to the Quick Start Guide.

- Remote: HCOP:DEV:LANG GDI
 - Remote: SYST:COMM:PRIN:ENUM:FIRS?
 - Remote: SYST:COMM:PRIN:ENUM:NEXT?
 - Remote: SYST:COMM:PRIN:SEL <Printer>
 - Remote: HCOP:PAGE:ORI PORT
 - Remote: HCOP:DEST "SYST:COMM:PRIN"
-

Device 1/2

Selects the tab of the device in the **Device Setup** dialog box. The analyzer is able to manage two print settings independently of each other. For each device the print setting is displayed on the corresponding tab of the **Device Setup** dialog box (**Device Setup** softkey). For further information refer to the Quick Start Guide.

Colors

For details see **Print Colors** softkey of the setup menu.
This softkey is available from firmware version 1.10.

Select Color Set

For details see **Select Print Color Set** softkey of the setup menu.
This softkey is available from firmware version 1.10.

Color On/Off

For details see **Color On/Off** softkey of the setup menu.
This softkey is available from firmware version 1.10.

Select Object

For details see **Select Object** softkey of the setup menu.
This softkey is available from firmware version 1.10.

Predefined Colors

For details see **Predefined Colors** softkey of the setup menu.
This softkey is available from firmware version 1.10.

User Defined Colors

For details see **User Defined Colors** softkey of the setup menu.
This softkey is available from firmware version 1.10.

Set to Default

For details see **Set to Default** softkey of the setup menu.
This softkey is available from firmware version 1.10.

Comment

Opens dialog box to enter a comment. Max. 120 characters are allowed. 60 characters fit in one line. In the first line, at any point a manual line-feed can be forced by entering "@".
Date and time are inserted automatically. The comment is printed below the diagram area, but not displayed on the screen. If a comment should not be printed, it must be deleted.
For details on the alphanumeric entries refer to the Quick Start Guide, chapter 4 "Basic Operations".
This softkey is available from firmware version 1.10.

Install Printer

Opens the **Printers and Faxes** window to install a new printer. All printers that are already installed are displayed. For details refer to the Quick Start Guide, appendix, "Printer Interface".

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5 Remote Control – Basics

This chapter assumes basic knowledge of programming and operation of the controller. It provides the following:

- Instructions on how to put the R&S FSL into operation via remote control.
- A general introduction to remote control of programmable instruments. This includes the description of the command structure and syntax according to the SCPI standard, the description of command execution and of the status registers.
- Diagrams and tables describing the status registers used in the R&S FSL.
- A description of the interfaces and protocols used for remote control.

In chapter "Instrument Functions" of this manual and in the Online Help, the remote control commands available for an instrument function are listed after each function description. In the Online Help, these remote control commands are linked to their description, provided in the manual in chapter "Remote Control – Commands". Program examples for the R&S FSL can be found in chapter "Remote Control – Programming Examples".

Introduction

The instrument is equipped with the following interfaces for remote control:

- LAN interface: the network allows for a 10 MHz Ethernet IEEE 802.3 and a 100 MHz Ethernet IEEE 802.3u. The protocol is based on TCP/IP and supports the VXI-11 standard.
- Option GPIB Interface, R&S FSL-B10: IEC/IEEE bus interface according to standard IEC 625/IEEE 488

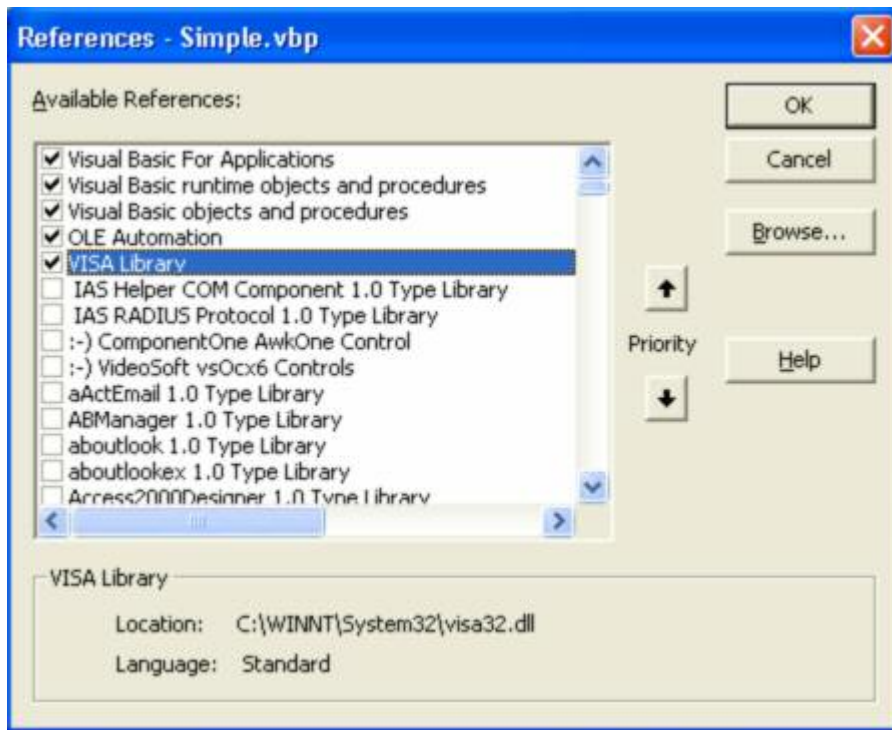
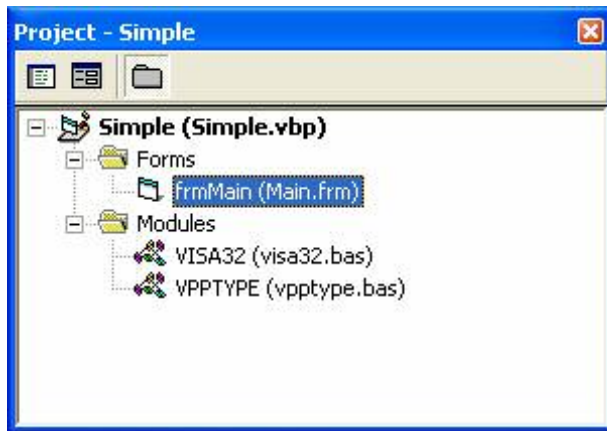
The connectors are located at the rear of the instrument and permit a connection to a controller for remote control via a local area network (LAN) or directly (option GPIB Interface, R&S FSL-B10).

SCPI (**S**tandard **C**ommands for **P**rogrammable **I**nstruments) commands – messages – are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

The requirements that the SCPI standard places on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

VISA is a standardized software interface library providing input and output functions to communicate with instruments. The I/O channel (LAN, GPIB...) is selected at initialization time by means of a channel-specific resource string. For more information about VISA refer to that user documentation.

The programming examples for remote control are all written in Microsoft® VISUAL BASIC®. Access to the VISA functions require the declaration of the functions and constants prior to their use in the project. This can be accomplished either by adding the modules VISA32.BAS and VPPTYPE.BAS or a reference to the VISA32.DLL to the project.



The modules visa32.bas and vpptype.bas can be found in the <VXI\pnpPath>\WinNT\include (typically C:\VXI\pnp\WinNT\include).

Note: Manual control is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the device status. Therefore, control programs should always define an initial device status (e.g. with the command *RST) and then implement the required settings.

To make remote control operation more comfortable and faster, you can use IVI drivers. They bundle remote control commands, reduce the I/O to the instrument by status caching, check status and parameters and offer simulation modes.

Getting Started

The short and simple operating sequence below shows how to put the instrument into operation and quickly set its basic functions. The remote control address, which is factory-set to 10.0.0.10, subnet mask 255.255.255.0 for LAN operation and 20 for operation via GPIB, is used. If you want to change the IP address, see "[Setting the Remote Control \(IP/GPIB\) Address](#)".

To prepare for remote control

1. Connect the instrument to the LAN or directly to the GPIB controller (option GPIB Interface, R&S FSL-B10).

For details refer to the Quick Start Guide, appendix, section "Remote Control with XP Remote Desktop".

2. Switch on the instruments.
3. Write and start the following program on the controller:

```

status = viOpenDefaultRM(defaultRM)           ' Open default resource manager
Cmd = "*RST;*CLS"                             ' Reset instrument and clear status
status = viWrite(vi, Cmd, Len(Cmd),          registers
retCount)

Cmd = "FREQ:CENT 100MHz"                       ' Set center frequency to 100 MHz
status = viWrite(vi, Cmd, Len(Cmd),
retCount)
Cmd = "FREQ:SPAN 10MHz"                       ' Set span to 10 MHz
status = viWrite(vi, Cmd, Len(Cmd),
retCount)
Cmd = "DISP:TRAC:Y:RLEV -10dBm"              ' Set reference level to -10 dBm
status = viWrite(vi, Cmd, Len(Cmd),
retCount)

```

The instrument now performs a sweep in the frequency range of 95 MHz to 105 MHz.

Setting the Remote Control (IP/GPIB) Address

In order to operate the instrument via remote control, it must be addressed using the set IP or GPIB address. The remote control address is factory-set (for details refer to "[Getting Started](#)"), but it can be changed, if it does not fit in the network environment.

To change the GPIB address via R&S FSL

For details see Quick Start Guide, chapter 2, section "Setting the IEC/IEEE Bus Interface".

To change the GPIB address via IEC/IEEE bus

```

status = viOpenDefaultRM(defaultRM)           ' Open default resource manager
status = viOpen(defaultRM, "GPIB:20::INSTR", 0, ' Open connection to instrument
5000, vi)                                     with old address
Cmd = "SYST:COMM:GPIB:ADDR 18"               ' Set instrument to new address
status = viWrite(vi, Cmd, Len(Cmd), retCount)
status = viClose(vi)                         ' Close old connection and reopen
status = viOpen(defaultRM, "GPIB:18::INSTR", 0, with new address
5000, vi)

```

To change the IP address via R&S FSL

For details see Quick Start Guide, chapter 2, section "Configuring the LAN Interface".

Starting Remote Control Operation

On power-on, the instrument is always in the manual operating state ("local" state) and can be operated via the front panel.

To start remote control

- Send an addressed command from a controller to the instrument.

The instrument is switched to remote control ("remote" state). Operation via the front panel is disabled. Only the **Local** softkey is displayed to return to manual operation. The instrument remains in the remote state until it is reset to the manual state via the instrument or via remote control interfaces. Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

- During program execution, send the `SYSTem:DISPlay:UPDate ON` command to activate the display of results.

The changes in the device settings and the recorded measurement curves are displayed on the instrument screen.

- To obtain optimum performance during remote control operation, send the `SYSTem:DISPlay:UPDate OFF` command to hide the display of results and diagrams again (default setting in remote control).

- To prevent unintentional return to manual control, disable the keys of the R&S FSL by the universal command LLO.

Then the transition to manual mode is only possible via remote control.

This function is only available for the GPIB interface.

- To enable the keys of the R&S FSL again, switch the instrument to local mode, i.e. deactivate the REN line of the remote control interface.

| |
|---|
| <p>Note: <i>If the instrument is exclusively operated in remote control, it is recommended to switch on the power-save mode for the display. For more details on this mode refer to the Quick Start Guide.</i></p> |
|---|

Returning to Manual Control

Before the transition, command processing must be completed. If command processing is not completed, it is not possible to return to manual operation and the instrument will switch back to remote control immediately.

To return to manual operation via R&S FSL

- Press the **Local** softkey or the **Preset** key.

To return to manual operation via IEC/IEEE bus

```

...
status = viGpibControlREN(vi,          ' Set instrument to manual
VI_GPIB_REN_ADDRESS_GTL)              operation
...

```

SCPI Command Structure and Syntax

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure.

SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see section "Responses to Queries").

Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note: *Not all commands used in the following examples are implemented in the instrument.*

Common commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

| | | |
|-----------|----------|--|
| Examples: | *RST | RESET, resets the device |
| | *ESE 253 | EVENT STATUS ENABLE, sets the bits of the event status enable register |
| | *ESR? | EVENT STATUS QUERY, queries the contents of the event status register. |

Device-specific commands

- Hierarchy

Device-specific commands are of hierarchical structure (see Fig. 5–1). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example: SENSE

This key word denotes the SENSE command system.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example: SENSE:FREQUENCY:SPAN 10MHZ

This command lies in the third level of the SENSE system. It sets the frequency span.

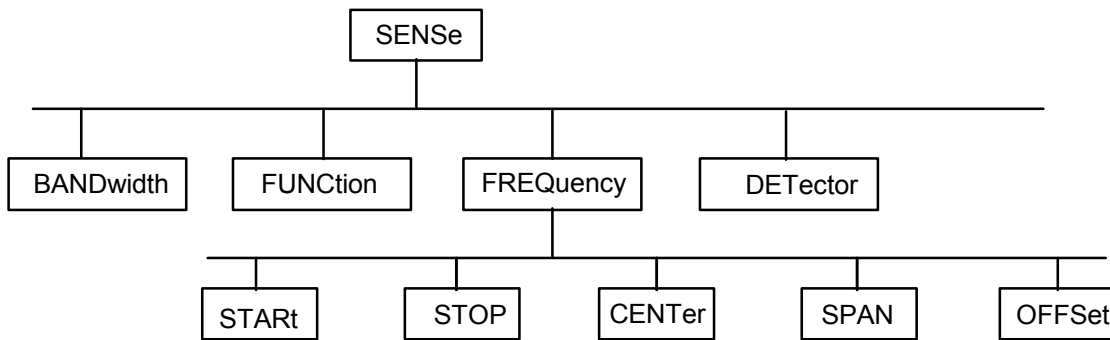


Fig. 5–1 Tree structure the SCPI command systems using the SENSE system as example

- Multiple key words

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, i.e. at which position in the header of a command they are inserted.

Example: `SOURce:FM:POLarity NORMal`

This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

Example: `SOURce:FM:EXTernal:POLarity NORMal`

This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

- Optional key words

Some command systems permit certain key words to be inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example: `[SENSe]:BANDwidth[:RESolution]:AUTO`

This command couples the resolution bandwidth of the instrument to other parameters. The following command has the same effect: `BANDwidth:AUTO`

Note: An optional key word must not be omitted if its effect is specified in detail by a numeric suffix.

- Long and short form

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permitted.

Example: `STATus:QUESTionable:ENABLE 1= STAT:QUES:ENAB 1`

Note: Upper–case and lower–case notation only serves to distinguish the two forms in the manual, the instrument itself does not distinguish upper–case and lower–case letters.

- Parameter

The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to section "Parameters".

Example: SENSE:FREQUENCY:STOP? MAXimum, Response: 3.5E9
This query requests the maximal value for the stop frequency.

- Numeric suffix

If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1. Optional keywords must be specified if they select a function with the suffix.

Example: SYSTEM:COMMUNICATE:SERIAL2:BAUD 9600
This command sets the baud rate of a second serial interface.

Note: In case of remote control, suffix counting may differ from the numbers of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified. Some standards define a fixed numbering, starting with 0. With GSM, for instance, slots are counted from 0 to 7. In the case of remote control, the slots are selected with the suffixes 1 to 8. If the numbering differs in manual operation and remote control, it is indicated with the respective command.

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by an EOI signal together with the last data byte.

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon. A colon ":" at the beginning of a command marks the root node of the command tree.

Example:

```
CALL InstrWrite(analyzer, "SENSE:FREQUENCY:CENTer 100MHz;:INPut:ATTenuation 10")
```

This command line contains two commands. The first one is part of the SENSE command system and is used to determine the center frequency of the instrument. The second one is part of the INPut command system and sets the input signal attenuation.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. For that purpose, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 5–1). The colon following the semicolon must be omitted in this case.

Example:

```
CALL InstrWrite(analyzer, "SENSe:FREQuency:STARt 1E6; SENSe:FREQuency:STOP 1E9")
```

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SENSE command system, subsystem FREQUENCY, i.e. they have two common levels.

When abbreviating the command line, the second command begins with the level below SENSE:FREQUENCY. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

```
CALL InstrWrite(analyzer, "SENSe:FREQuency:STARt 1E6;STOP 1E9")
```

However, a new command line always begins with the complete path.

Example:

```
CALL InstrWrite(analyzer, "SENSe:FREQuency:STARt 1E6")
```

```
CALL InstrWrite(analyzer, "SENSe:FREQuency:STOP 1E9")
```

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without header.
Example: INPut:COUPling?, Response: DC
- Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
Example: SENSe:FREQuency:STOP? MAX, Response: 3.5E9
- Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
Example: SENSe:FREQuency:CENTer?, Response: 1E6 (for 1 MHz)
- Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
Example: SENSe:BANDwidth:AUTO?, Response: 1 (for ON)
- Text (character data) is returned in a short form.
Example: SYSTem:COMMunicate:SERial:CONTRol:RTS?, Response STAN (for standard)

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description.

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000 . The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ

are also permissible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: SENSE:FREQUENCY:STOP 1.5GHz = SENSE:FREQUENCY:STOP 1.5E9

Special numerical

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as values special numerical values. In the case of a query, the numerical value is provided.

Example:

Setting command: SENSE:FREQUENCY:STOP MAXimum

Query: SENSE:FREQUENCY:STOP?, Response: 3.5E9

- MIN/MAX
MINimum and MAXimum denote the minimum and maximum value.
- DEF
DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command
- UP/DOWN
UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.
- INF/NINF
INFinity, Negative INFinity (NINF) Negative INFinity (NINF) represent the numerical values $-9.9E37$ or $9.9E37$, respectively. INF and NINF are only sent as device responses.
- NAN
Not A Number (NAN) represents the value $9.91E37$. NAN is only sent as device response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. The numerical values are provided as response for query.

Example:

Setting command: DISPLAY:WINDOW:STATE ON

Query: DISPLAY:WINDOW:STATE?, Response: 1

Text

Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:

Setting command: INPUT:COUPLING GROund

Query: INPUT:COUPLING?, Response: GRO

Strings

Strings must always be entered in quotation marks (' or ").

Example:

SYSTEM:LANGUAGE "SCPI" or SYSTEM:LANGUAGE 'SCPI'

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

```
HEADer:HEADer #45168xxxxxxxx
```

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

- : The colon separates the key words of a command. In a command line the separating semicolon marks the uppermost command level.
- ; The semicolon separates two commands of a command line. It does not alter the path.
- , The comma separates several parameters of a command.
- ? The question mark forms a query.
- * The asterisk marks a common command.
- " Quotation marks introduce a string and terminate it.
- # The hash symbol # introduces binary, octal, hexadecimal and block data.

Binary: #B10110

Octal: #O7612

Hexa: #HF3A7

Block: #21312

A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

Instrument Model and Command Processing

The block diagram in Fig. 5–2 shows how SCPI commands are serviced in the instrument. The individual components work independently and simultaneously. They communicate with each other by means of so-called "messages".

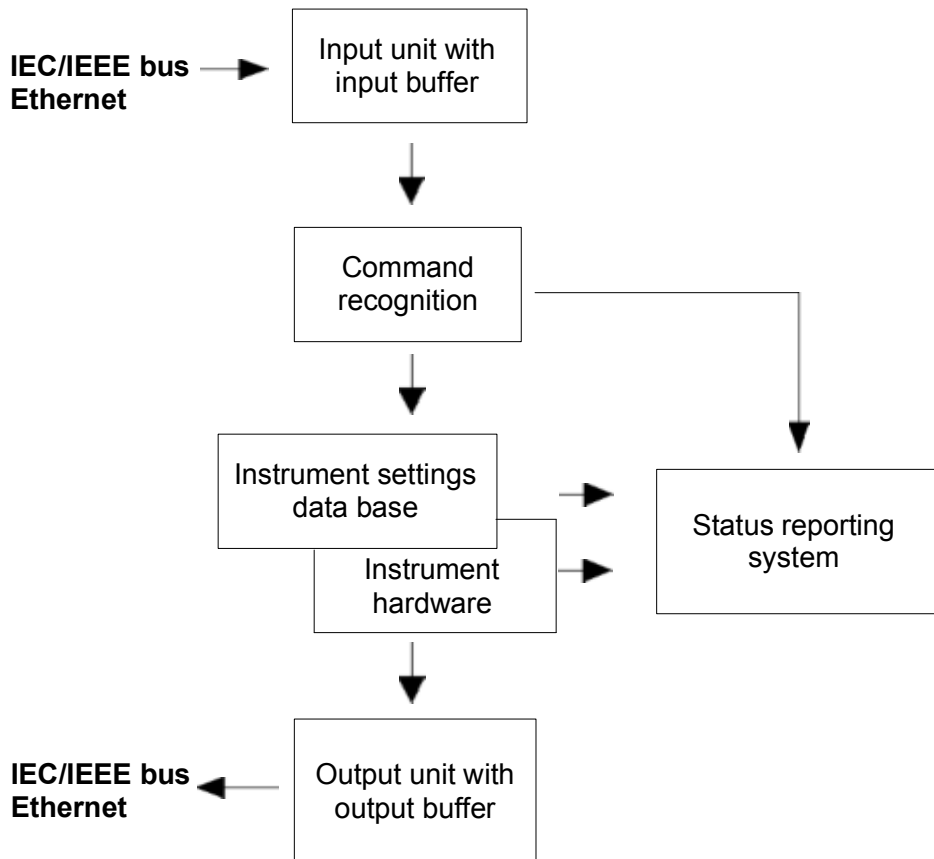


Fig. 5–2 Instrument model in the case of remote control

Input unit

The input unit receives commands character by character from the controller and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message `DCL`.

If the input buffer is full, the traffic is stopped and the data received up to then are processed. Subsequently the traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of `DCL` clears the input buffer and immediately resets the command recognition.

Command recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only `DCL` is serviced with priority, for example `GET` (Group Execute Trigger) is only executed after the commands received before. Each recognized command is immediately transferred to the internal instrument settings data base but not executed immediately.

The command recognition detects syntax errors in the commands and transfers them to the status reporting system. The rest of a command line after a syntax error is analyzed further if possible and serviced. After the syntax test, the value range of the parameter is checked, if required.

If the command recognition detects a delimiter, it passes the command to an execution unit that performs the instrument settings. In the meantime, the command recognition is ready to process new commands (overlapping execution). A `DCL` command is processed in the same way.

Data base and instrument hardware

Here the expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function – signal generation, measurement etc. The controller is not included. The term "database" denotes a database that manages all the parameters and associated settings required for setting the instrument hardware.

Setting commands leads to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. This only takes place at the end of a command line.

The data are checked for compatibility with the current instrument settings before they are transmitted to the instrument hardware. If the execution is not possible, an "execution error" is signaled to the status reporting system. The corresponding settings are discarded.

Before passing on the data to the hardware, the settling bit in the `STATus:OPERation` register is set (refer to section "[STATus:OPERation Register](#)"). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

Queries induce the data set management to send the desired data to the output unit.

Status reporting system

For detailed information refer to section "[Status Reporting System](#)".

Output unit

The output unit collects the information requested by the controller, which it receives from the data base management. It processes it according to the SCPI rules and makes it available in the output buffer.

If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data base management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC/IEEE bus or via the Ethernet, the controller waits until it has reached its time limit. This behavior is specified by SCPI.

Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping. In order to prevent an overlapping execution of commands, one of the commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set. By suitable programming, the controller can be forced to wait for the respective action to occur (refer to [Table 5–1](#)).

Table 5–1 Synchronization using *OPC, *OPC? and *WAI

| Command | Action | Programming the controller |
|---------|--|---|
| *OPC | Sets the Operation Complete bit in the ESR after all previous commands have been executed. | <ul style="list-style-type: none"> – Setting bit 0 in the ESE – Setting bit 5 in the SRE – Waiting for service request (SRQ) |
| *OPC? | Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed. | Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed. |
| *WAI | Stops further command processing until all commands sent before *WAI have been executed. | Sending *WAI directly after the command whose processing should be terminated before other commands are executed. |

An example for command synchronization can be found in chapter "Remote Control – Programming Examples".

For a couple of commands the synchronization to the end of command execution is mandatory in order to obtain the desired result. The affected commands require either more than one measurement in order to accomplish the desired instrument setting (e.g. auto range functions), or they require a longer period of time for execution. If a new command is received during execution of the corresponding function this may either lead to either to an aborted measurement or to incorrect measurement data.

The following list includes the commands, for which a synchronization via *OPC, *OPC? or *WAI is mandatory:

Table 5–2 Commands with mandatory synchronization (overlapping commands)

| Command | Purpose |
|--------------------------|--|
| INIT | start measurement |
| INIT:CONM | continue measurement |
| CALC:MARK:FUNC:ZOOM | zoom frequency range around marker 1 |
| CALC:STAT:SCAL:AUTO ONCE | optimize level settings for signal statistic measurement functions |
| [SENS:]POW:ACH:PRES:RLEV | optimize level settings for adjacent channel power measurements |

Status Reporting System

The status reporting system (refer to Fig. 5–4) stores all information on the present operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC/IEEE bus or via the Ethernet.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATUS:OPERation and STATUS:QUESTionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills the same function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB.

Structure of an SCPI Status Register

Each standard SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (refer to Fig. 5–3). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number that applies to all five parts. For example, bit 3 of the STATUS:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

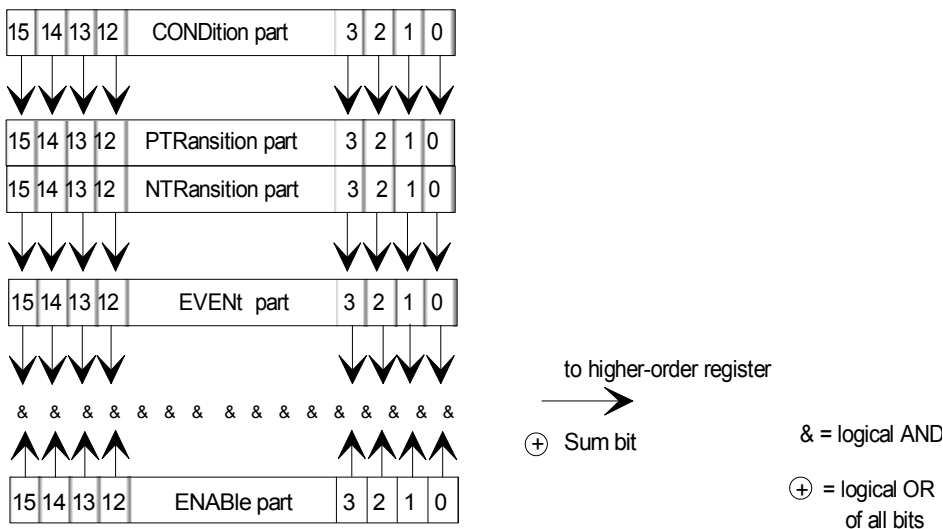


Fig. 5–3 The status–register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as an edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENT bit is set to 1.

PTR bit =1: the EVENT bit is set.

PTR bit =0: the EVENT bit is not set.

This part can be written into and read at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as an edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENT bit is set to 1.

NTR-Bit = 1: the EVENT bit is set.

NTR-Bit = 0: the EVENT bit is not set.

This part can be written into and read at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENT part.

EVENT part

The EVENT part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.

ENABLE part

The ENABLE part determines whether the associated EVENT bit contributes to the sum bit (see below). Each bit of the EVENT part is ANDed with the associated ENABLE bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').

ENABLE-Bit = 0: the associated EVENT bit does not contribute to the sum bit

ENABLE-Bit = 1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.

This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit

As indicated above, the sum bit is obtained from the EVENT and ENABLE part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note: *The service request enable register SRE defined in IEEE 488.2 can be taken as ENABLE part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABLE part of the ESR.*

Overview of the Status Registers

The following figure shows the status registers used in the R&S FSL.

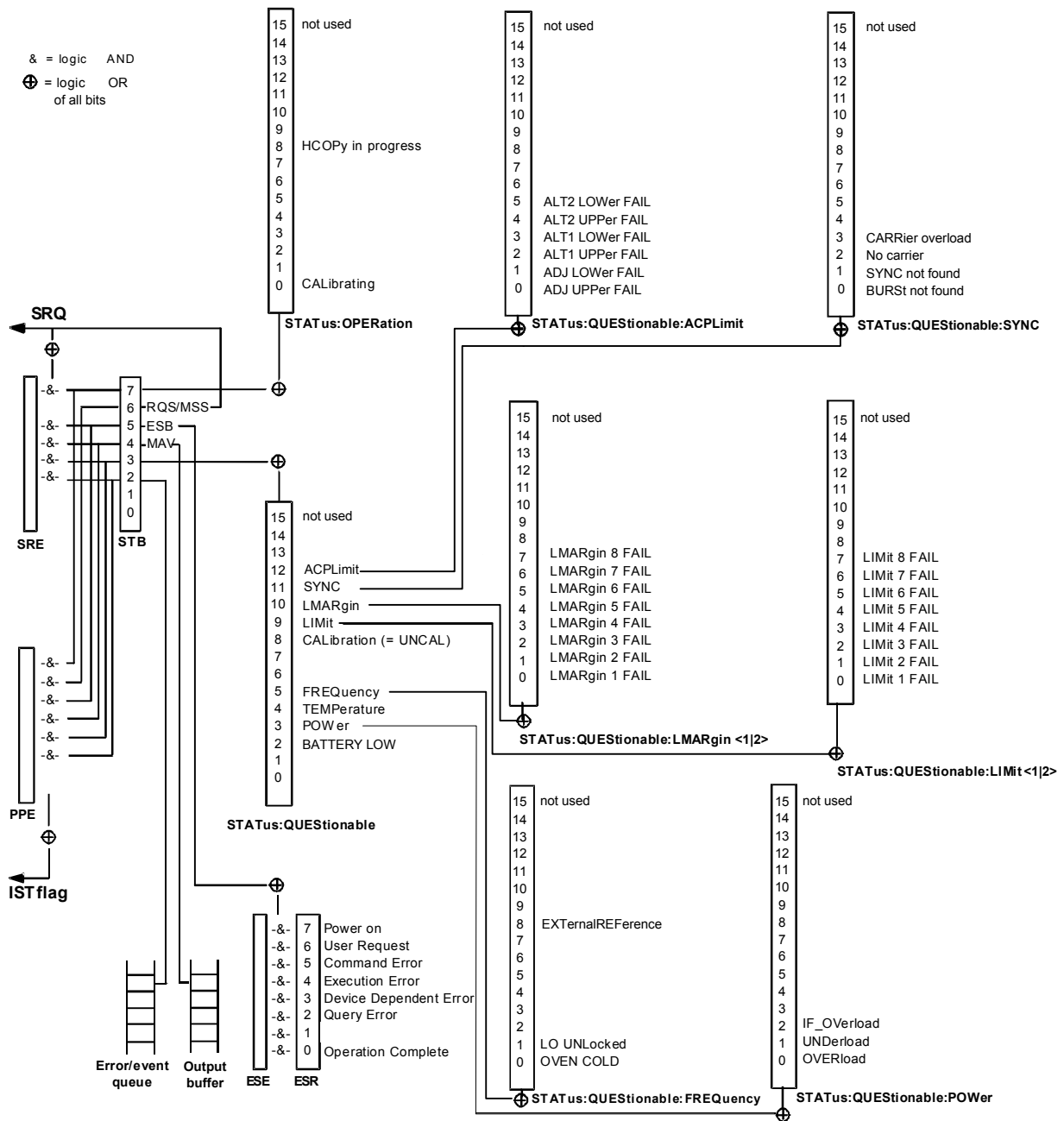


Fig. 5-4 Overview of the status registers

Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STATUS BYTE is read using the command "***STB?**" or a serial poll.

The STB is linked to the SRE. The latter corresponds to the ENABLE part of the SCPI registers in its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated on the IEC/IEEE bus or via the Ethernet, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.

The SRE can be set using the command "***SRE**" and read using the command "***SRE?**"

Table 5–3 Meaning of the bits used in the status byte

| Bit No. | Meaning |
|---------|--|
| 0...1 | Not used |
| 2 | <p>Error Queue not empty</p> <p>The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.</p> |
| 3 | <p>QUESTIONable status sum bit</p> <p>The bit is set if an EVENT bit is set in the QUESTIONable: status register and the associated ENABLE bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUESTIONable status register.</p> |
| 4 | <p>MAV bit (message available)</p> <p>The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.</p> |
| 5 | <p>ESB bit</p> <p>Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.</p> |
| 6 | <p>MSS bit (master status summary bit)</p> <p>The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.</p> |

| Bit No. | Meaning |
|---------|--|
| 7 | <p>OPERation status register sum bit</p> <p>The bit is set if an EVENT bit is set in the OPERation status register and the associated ENABLE bit is set to 1.</p> <p>A set bit indicates that the instrument is just performing an action. The type of action can be determined by polling the OPERation status register.</p> |

IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be read by means of a parallel poll (refer to section "Parallel Poll") or using the command *IST?.

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the ORing of all results. The PPE can be set using commands *PRE and read using command *PRE?.

Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the EVENT part of a SCPI register. The event status register can be read out using command *ESR?.

The ESE is the associated ENABLE part. It can be set using the command *ESE and read using the command *ESE?.

Table 5–4 Meaning of the bits in the event status register

| Bit No. | Meaning |
|---------|---|
| 0 | <p>Operation Complete</p> <p>This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.</p> |
| 1 | Not used |
| 2 | <p>Query Error</p> <p>This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.</p> |
| 3 | <p>Device–dependent Error</p> <p>This bit is set if a device–dependent error occurs. An error message with a number between –300 and –399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.</p> |

| Bit No. | Meaning |
|---------|---|
| 4 | Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between –200 and –300, which denotes the error in greater detail, is entered into the error queue. |
| 5 | Command Error This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between –100 and –200, which denotes the error in greater detail, is entered into the error queue. |
| 6 | User Request This bit is set on pressing the Local softkey. |
| 7 | Power On (supply voltage on) This bit is set on switching on the instrument. |

STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVEnt part, information on which actions the instrument has executed since the last reading. It can be read using the commands STATus:OPERation:CONDition? or STATus:OPERation[:EVEnt]?

Table 5–5 Meaning of the bits in the STATus:OPERation register

| Bit No. | Meaning |
|---------|--|
| 0 | CALibrating This bit is set as long as the instrument is performing a calibration. |
| 1 to 7 | Not used |
| 8 | HardCOPy in progress This bit is set while the instrument is printing a hardcopy. |
| 9 to 14 | Not used |
| 15 | This bit is always 0 |

STATus:QUEStionable Register

This register contains information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be read using the commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENT]?`.

Table 5–6 Meaning of bits in STATus:QUEStionable register

| Bit No. | Meaning |
|----------|---|
| 0 to 1 | These bits are not used |
| 2 | BATTERY LOW If the instrument is running without any external power supply and the charging level of the internal battery is approximately lower than 5% this bit is set to indicate that the system will be shut down automatically in approx. 5 minutes. |
| 3 | POWER This bit is set if a questionable power occurs (refer also to section " STATus:QUEStionable:POWER Register ") |
| 4 | TEMPERature This bit is set if a questionable temperature occurs. |
| 5 | FREQUency The bit is set if a frequency is questionable (refer to section " STATus:QUEStionable:FREQUency Register ") |
| 6 to 7 | Not used |
| 8 | CALibration The bit is set if a measurement is performed unaligned (label UNCAL) |
| 9 | LIMit (device-specific) This bit is set if a limit value is violated (see also section " STATus:QUEStionable:LIMit Register ") |
| 10 | LMARgin (device-specific) This bit is set if a margin is violated (see also section " STATus:QUEStionable:LMARgin Register ") |
| 11 | SYNC (device-dependent) This bit is set if, in measurements or pre-measurements in GSM MS mode, synchronization to midamble fails or no burst is found. This bit is also set if, in pre-measurements in GSM MS mode, the result differs too strongly from the expected value (see also " STATus:QUEStionable:SYNC Register "). |
| 12 | ACPLimit (device-specific) This bit is set if a limit for the adjacent channel power measurement is violated (see also section " STATus:QUEStionable:ACPLimit Register ") |
| 13 to 14 | Not used |
| 15 | This bit is always 0. |

STATus:QUEStionable:ACPLimit Register

This register contains information about the observance of limits during adjacent power measurements. It can be read using the commands 'STATus:QUEStionable:ACPLimit :CONDition?' and 'STATus:QUEStionable:ACPLimit[:EVENT]?'

Table 5–7 Meaning of bits in STATus:QUEStionable:ACPLimit register

| Bit No. | Meaning |
|---------|--|
| 0 | ADJ UPPer FAIL This bit is set if the limit is exceeded in the upper adjacent channel |
| 1 | ADJ LOWEr FAIL This bit is set if the limit is exceeded in the lower adjacent channel. |
| 2 | ALT1 UPPer FAIL This bit is set if the limit is exceeded in the upper 1st alternate channel. |
| 3 | ALT1 LOWEr FAIL This bit is set if the limit is exceeded in the lower 1st alternate channel. |
| 4 | ALT2 UPPer FAIL This bit is set if the limit is exceeded in the upper 2nd alternate channel. |
| 5 | ALT2 LOWEr FAIL This bit is set if the limit is exceeded in the lower 2nd alternate channel. |
| 6 to 14 | Not used |
| 15 | This bit is always set to 0. |

STATus:QUEStionable:FREQuency Register

This register contains information about the reference and local oscillator. It can be read using the commands STATus:QUEStionable:FREQuency:CONDition? and STATus :QUEStionable:FREQuency[:EVENT]?

Table 5–8 Meaning of bits in STATus:QUEStionable:FREQuency register

| Bit No. | Meaning |
|---------|---|
| 0 | OVEN COLD This bit is set if the reference oscillator has not yet attained its operating temperature. OCXO is displayed. |
| 1 | LO UNLoked This bit is set if the local oscillator no longer locks. LOUNL is displayed. |
| 2 to 7 | Not used |

| Bit No. | Meaning |
|---------|--|
| 8 | EXternalREference Bit 8 indicates that the external reference oscillator is selected and no useable external reference source is connected to the instrument. Therefore the synthesizer can not lock and the frequency accuracy is not guaranteed. |
| 9 to 14 | Not used |
| 15 | This bit is always 0. |

STATus:QUESTionable:LIMit Register

This register contains information about the observance of limit lines. It can be read using the commands `STATus:QUESTionable:LIMit:CONDition?` and `STATus:QUESTionable:LIMit[:EVENT]?`.

Table 5–9 Meaning of bits in STATus:QUESTionable:LIMit register

| Bit No. | Meaning |
|---------|---|
| 0 | LIMit 1 FAIL This bit is set if limit line 1 is violated. |
| 1 | LIMit 2 FAIL This bit is set if limit line 2 is violated. |
| 2 | LIMit 3 FAIL This bit is set if limit line 3 is violated. |
| 3 | LIMit 4 FAIL This bit is set if limit line 4 is violated. |
| 4 | LIMit 5 FAIL This bit is set if limit line 5 is violated. |
| 5 | LIMit 6 FAIL This bit is set if limit line 6 is violated. |
| 6 | LIMit 7 FAIL This bit is set if limit line 7 is violated. |
| 7 | LIMit 8 FAIL This bit is set if limit line 8 is violated. |
| 8 to 14 | Not used |
| 15 | This bit is always 0. |

STATus:QUEStionable:LMARgin Register

This register contains information about the observance of limit margins. It can be read using the commands `STATus:QUEStionable:LMARgin:CONDition?` and `STATus:QUEStionable:LMARgin[:EVENT]?`.

Table 5–10 Meaning of bits in STATus:QUEStionable:LMARgin register

| Bit No. | Meaning |
|---------|---|
| 0 | LMARgin 1 FAIL This bit is set if limit margin 1 is violated. |
| 1 | LMARgin 2 FAIL This bit is set if limit margin 2 is violated. |
| 2 | LMARgin 3 FAIL This bit is set if limit margin 3 is violated. |
| 3 | LMARgin 4 FAIL This bit is set if limit margin 4 is violated. |
| 4 | LMARgin 5 FAIL This bit is set if limit margin 5 is violated. |
| 5 | LMARgin 6 FAIL This bit is set if limit margin 1 is violated. |
| 6 | LMARgin 7 FAIL This bit is set if limit margin 7 is violated. |
| 7 | LMARgin 8 FAIL This bit is set if limit margin 8 is violated. |
| 8 to 14 | Not used |
| 15 | This bit is always 0. |

STATus:QUEStionable:POWER Register

This register contains all information about possible overloads of the unit. It can be read using the commands `STATus:QUEStionable:POWER:CONDition?` and `STATus:QUEStionable:POWER[:EVENT]?`.

Table 5–11 Meaning of bits in STATus:QUEStionable:POWer register

| Bit No. | Meaning |
|---------|--|
| 0 | OVERload This bit is set if the RF input is overloaded. OVLD is displayed. |
| 1 | UNDerload This bit is set if the RF input is underloaded. UNLD is displayed. |
| 2 | IF_OVERload This bit is set if the IF path is overloaded. IFOVL is displayed. |
| 3 to 14 | Not used |
| 15 | This bit is always 0. |

STATus:QUEStionable:SYNC Register

This register is used for GSM power measurements. It contains information about sync and bursts not found, and about pre-measurement results exceeding or falling short of expected values (for details on GSM power measurements refer to chapter "Advanced Measurement Examples", and the Quick Start Guide, chapter 5, "Basic Measurement Examples").

It can be read using the commands `STATus:QUEStionable:SYNC:CONDition?` and `STATus:QUEStionable:SYNC[:EVENT]?`.

Table 5–12 Meaning of bits in STATus:QUEStionable:SYNC register

| Bit No. | Meaning |
|---------|---|
| 0 | BURSt not found This bit is set if no burst is found in the measurements/pre-measurements for phase/frequency error (PFE) or carrier power versus time (PVT) in GSM power measurements. If a burst is found in these measurements/pre-measurements, the bit is reset. |
| 1 | SYNC not found This bit is set if the synchronization sequence (training sequence) of the midamble is not found in the measurements/pre-measurements for phase/frequency error (PFE) or carrier power versus time (PVT) in GSM power measurements. If the synchronization sequence (training sequence) of the midamble is found in these measurements/pre-measurements, the bit is reset. |
| 2 | No carrier This bit is set if, in GSM power measurements, the level value determined in the pre-measurements for carrier power versus time (PVT) and spectrum due to modulation is too low. The bit is reset at the beginning of the pre-measurement. |
| 3 | Carrier overload This bit is set if, in GSM power measurements, the level value determined in the pre-measurements for carrier versus time (PVT) and spectrum due to modulation is too high. The bit is reset at the beginning of the pre-measurement. |
| 4–14 | Not used. |

| Bit No. | Meaning |
|---------|-----------------------|
| 15 | This bit is always 0. |

Application of the Status Reporting Systems

In order to be able to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are represented in the following. For detailed program examples refer to chapter "Remote Control – Programming Examples".

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from Fig. 5–4, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The ENABLE parts of the status registers can be set so that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request effectively, all bits should be set to "1" in enable registers SRE and ESE.

Example: Use of the command *OPC to generate an SRQ at the end of a sweep

1. `CALL InstrWrite(analyzer, "*ESE 1")` 'Set bit 0 in the ESE (Operation Complete)
2. `CALL InstrWrite(analyzer, "*SRE 32")` 'Set bit 5 in the SRE (ESB)?

After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument in a way that a service request is initiated in the case of malfunction. The program should react appropriately to the service request. A detailed example for a service request routine is to be found in chapter "Remote Control – Programming Examples".

Serial Poll

In a serial poll, just as with command *STB, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works with instruments which do not adhere to SCPI or IEEE 488.2.

The VISUAL BASIC command for executing a serial poll is `IBRSP()`. Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Parallel Poll

In a parallel poll, the controller uses a single command to request up to eight instruments to transmit one bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logical "0" or "1". In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a parallel poll enable register (PPE). This register is ANDed with the STB bit by bit,

considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent as a response to the parallel poll of the controller. The result can also be queried without parallel poll by means of the command `*IST?`.

The instrument first has to be set for the parallel poll using the VISUAL BASIC command `IBPPC()`. This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using `IBRPP()`.

The parallel poll method is mainly used to find out quickly which one of the instruments connected to the controller has sent a service request. To this effect, SRE and PPE must be set to the same value.

Query by Means of Commands

Each part of any status register can be read by means of queries. The individual commands are listed in the description of the STATus Subsystem. The returned value is always a number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages that can be displayed via manual control using the setup menu or queried via remote control using the command `SYSTEM:ERROR?`. Each call of `SYSTEM:ERROR?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

Reset Values of the Status Reporting System

Table 5-13 contains the different commands and events causing the status reporting system to be reset. None of the commands, except `*RST` and `SYSTEM:PRESet`, influences the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 5–13 Resetting the status reporting system

| Event | Switching on supply voltage | | DCL,SDC (Device Clear, Selected Device Clear) | *RST or SYSTEM:PRE Set | STATus:PRE Set | *CLS |
|--|-----------------------------|-----|--|------------------------|----------------|------|
| | Power-On-Status-Clear | | | | | |
| | 0 | 1 | | | | |
| Effect | | | | | | |
| Clear STB,ESR | — | yes | — | — | — | yes |
| Clear SRE,ESE | — | yes | — | — | — | — |
| Clear PPE | — | yes | — | — | — | — |
| Clear EVENT parts of the registers | — | yes | — | — | — | yes |
| Clear ENABLE parts of all OPERATION and QUESTIONable registers; Fill ENABLE parts of all other registers with "1". | — | yes | — | — | yes | — |
| Fill PTRansition parts with "1"; Clear NTRansition parts | — | yes | — | — | yes | — |
| Clear error queue | yes | yes | — | — | — | yes |
| Clear output buffer | yes | yes | yes | 1) | 1) | 1) |
| Clear command processing and input buffer | yes | yes | yes | — | — | — |

1)Every command being the first in a command line, i.e., immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

Interfaces and Protocols

The standard instrument is accessed via LAN in order to perform for remote control. Optional a GPIB interface can be used for remote control, provided by option GPIB Interface, R&S FSL–B10.

LAN Interface

To be intergrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols (VXI–11 and RSIB). For details on the connector and its use refer to the Quick Start Guide, chapter "Front and Rear Panel". The network interface card supports IEEE 802.3 for a 10 MHz Ethernet and IEEE 802.3u for a 100 MHz Ethernet.

Instrument access via VXI11 or RSIB is usually achieved from high level programming platforms by using VISA as an intermediate abstraction layer. VISA encapsulates the low level VXI, RSIB or even GPIB function calls and thus makes the transport interface transparent for the user. The necessary VISA library is available as a seperate product. For details contact your local R&S sales representative.

VXI Basics

The VXI–11 standard is based on the RPC protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection–oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

Remote control of an instrument via a network is based on standardized protocols which follow the OSI reference model (see Fig. below).

| | |
|--------------|----------------|
| Application | SCPI |
| Presentation | XDR (VXI-11) |
| Session | ONC-RPC |
| Transport | TCP / UDP |
| Network | IP |
| Data Link | Ethernet/802.3 |
| Physical | 802.3/10BASE-T |

Fig. 5–5 Example for LAN remote control based on the OSI reference model

Based on TCP/UDP, messages between the controller and the instrument are exchanged via open network computing (ONC) – remote procedure calls (RPC). With XDR (VXI–11), legal RPC messages are known as VXI–11 standard. Based on this standard, messages are exchanged between the controller and the instrument. The messages are identical with SCPI commands. They can be organized in four groups:

- program messages (control command to the instrument)
- response messages (values returned by the instrument)
- service request (spontaneous queries of the instrument)
- low–level control messages (interface messages).

A VXI–11 link between a controller and an instrument uses three channels: core, abort and interrupt channel. Instrument control is mainly performed on the core channel (program, response and low–level control messages). The abort channel is used for immediate abort of the core channel; the interrupt channel transmits spontaneous service requests of the instrument. Link setup itself is very complex. For more details refer to the VXI–11 specification.

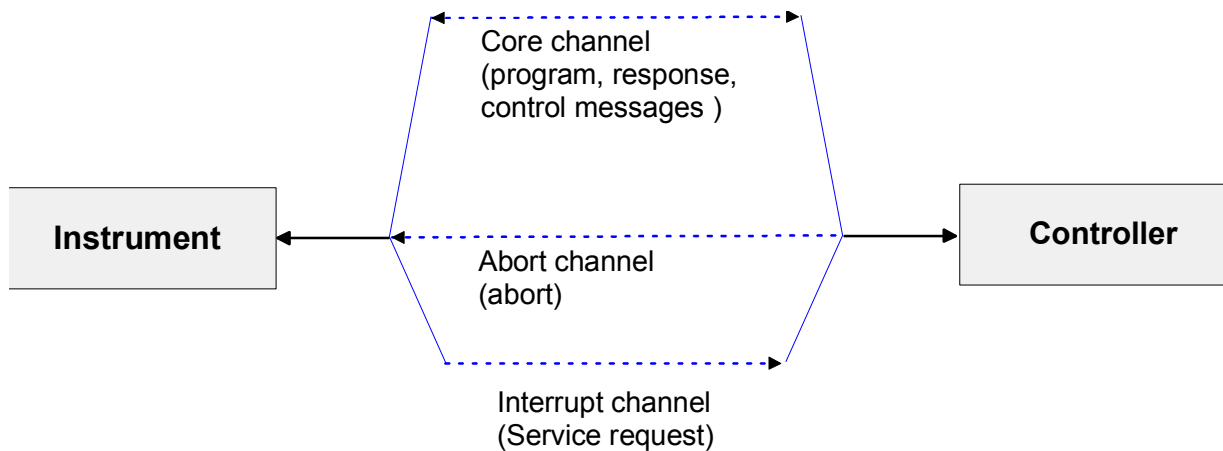


Fig. 5–6 VXI–11 channels between instrument and controller

The number of controllers that can address an instrument is practically unlimited in the network. In the instrument, the individual controllers are clearly distinguished. This distinction continues up to the application level in the controller, i.e. two applications on a computer are identified by the instrument as two different controllers.

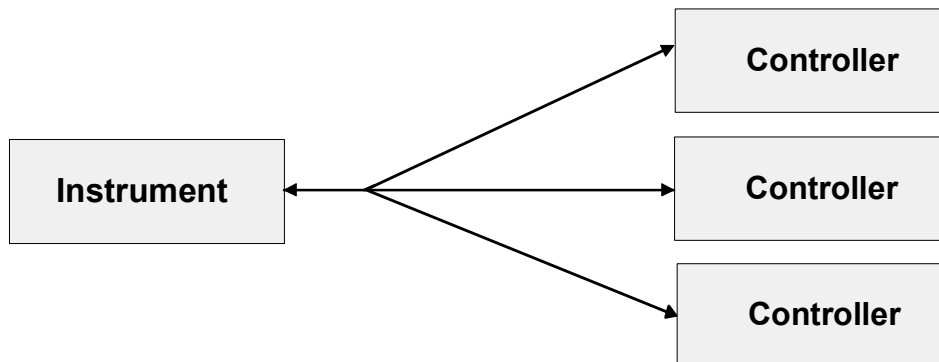


Fig. 5–7 Remote control via LAN from several controllers

The controllers can lock and unlock the instrument for exclusive access. This regulates access to the instrument of several controllers.

VXI-11 Interface Messages

On the Ethernet link, the interface messages are called low-level control messages. These messages can be used to emulate interface messages of the IEC/IEEE bus.

Table 5-14 VXI-11 Interface Messages

| Command | Effect on the instrument |
|------------------------------|--|
| &ABO (Abort) | Aborts the processing of the commands just received. |
| &DCL (Device Clear) | Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting. |
| >L (Go to Local) | Transition to the "Local" state (manual control) |
| >R (Go to Remote) | Transition to the "Remote" state (remote control) |
| &GET (Group Execute Trigger) | Triggers a previously active device function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input. |
| &LLO (Local Lockout) | Disables switchover from remote control to manual control by means of the front panel keys |
| &POL (Serial Poll) | Starts a serial poll |
| &NREN (Not Remote Enable) | Enables switchover from remote control to manual control by means of the front panel keys |

RSIB Protocol Basics

The R&S defined RSIB protocol uses the TCP/IP protocol for communication with the instrument. Remote control over RSIB is done on a message level basis using the SCPI command set of the instrument. The RSIB protocol allows you to control the instrument not only via Visual C++- and Visual Basic programs but also via the two Windows applications WinWord and Excel as well as via National Instruments LabView, LabWindows/CVI and Agilent VEE. The control applications run on an external computer in the network.

A UNIX operating system can be installed on an external computer in addition to a Windows operating system. In this case, the control applications are created either in C or C++. The supported UNIX operating systems include:

- Sun Solaris 2.6 Sparc Station
- Sun Solaris 2.6 Intel Platform
- Red Hat Linux 6.2 x86 Processors

RSIB Interface Functions

The library functions are adapted to the interface functions of National Instruments for GPIB programming. The functions supported by the libraries are listed in the following table.

| Function | Description |
|----------------|---|
| RSDLLibfind() | Provides a handle for access to a device. |
| RSDLLibwrt() | Sends a zero-terminated string to a device. |
| RSDLLilwrt() | Sends a certain number of bytes to a device. |
| RSDLLibwrtf() | Sends the contents of a file to a device. |
| RSDLLibrd() | Reads data from a device into a string. |
| RSDLLilrd() | Reads a certain number of bytes from a device. |
| RSDLLibrdf() | Reads data from a device into a file. |
| RSDLLibtmo() | Sets timeout for RSIB functions. |
| RSDLLibsre() | Switches a device to the local or remote state. |
| RSDLLibloc() | Temporarily switches a device to the local state. |
| RSDLLibeot() | Enables/disables the END message for write operations. |
| RSDLLibrsp() | Performs a serial poll and provides the status byte. |
| RSDLLibonl() | Sets the device online/offline. |
| RSDLLTestSrQ() | Checks whether a device has generated an SRQ. |
| RSDLLWaitSrQ() | Waits until a device generates an SRQ. |
| RSDLLSwapBytes | Swaps the byte sequence for binary numeric display (only required for non-Intel platforms). |

As with the National Instrument interface, the successful execution of a command can be checked by means of the variables *ibsta*, *iberr* and *ibcntl*. For this purpose, all RSIB functions are assigned references to these three variables.

Status word – *ibsta*

The status word *ibsta* provides information on the status of the RSIB interface. The following bits are defined:

| Bit designation | Bit | Hex code | Description |
|-----------------|-----|----------|---|
| ERR | 15 | 8000 | Is set when an error has occurred on calling a function. If this bit is set, <i>iberr</i> contains an error code that specifies the error in greater detail. |
| TIMO | 14 | 4000 | Is set when a timeout has occurred on calling a function. |
| CMPL | 8 | 0100 | Is set if the response of the GPIB parser has been read out completely. If a parser response is read out with the function <i>RSDLLilrd()</i> and the length of the buffer is insufficient for the answer, the bit will be cleared. |

Error variable – `iberr`

If the ERR bit (8000h) is set in the status word, `iberr` contains an error code which allows the error to be specified in greater detail. Extra error codes are defined for the RSIB protocol, independent of the National Instruments interface.

| Error | Error code | Description |
|-----------------|------------|--|
| IBERR_CONNECT | 2 | Setup of the connection to the measuring instrument has failed. |
| IBERR_NO_DEVICE | 3 | A function of the interface has been called with an illegal device handle. |
| IBERR_MEM | 4 | No empty memory available. |
| IBERR_TIMEOUT | 5 | Timeout has occurred. |
| IBERR_BUSY | 6 | The RSIB protocol is blocked by a function that is still running. |
| IBERR_FILE | 7 | Error when reading or writing to a file. |
| IBERR_SEMA | 8 | Error upon creating or assigning a semaphore (only under UNIX). |

Count variable – `ibcntl`

The variable `ibcntl` is updated with the number of transferred bytes each time a read or write function is called.

GPIB Interface (Option R&S FSL–B10)

The standard instrument is not equipped with an IEC/IEEE bus connector, but can be accessed via the LAN interface for remote control. The option R&S FSL–B10 provides a GPIB interface. For details on the connector and its use refer to the Quick Start Guide, chapter "Front and Rear Panel".

GPIB Basics

The GPIB interface is described by the following characteristics:

- 8-bit parallel data transfer
- bi-directional data transfer
- three-line handshake
- high data transfer rate of max. 700 kbyte/s
- up to 15 instruments can be connected
- maximal length of the interconnecting cables 15 m (single connection, 2m)
- wired-OR connection if several instruments are connected in parallel.

Depending on the bus type the following bus lines are used:

- Data bus with 8 lines D0 to D7.
The transmission is bit–parallel and byte–serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.
- Control bus with 5 lines

| | |
|-----------------------|--|
| IFC (Interface Clear) | active LOW resets the interfaces of the instruments connected to the default setting. |
| ATN (Attention) | active LOW signals the transmission of interface messages. inactive HIGH signals the transmission of device messages. |
| SRQ (Service Request) | active LOW enables the connected device to send a service request to the controller. |
| REN (Remote Enable) | active LOW permits switchover to remote control. |
| EOI (End or Identify) | has two functions in connection with ATN: ATN = HIGH active LOW marks the end of data transmission. ATN = LOW active LOW triggers a parallel poll. |
- Handshake bus with three lines

| | |
|---------------------------|---|
| DAV (Data Valid) | active LOW signals a valid data byte on the data bus. |
| NRFD (Not Ready For Data) | active LOW signals that one of the connected devices is not ready for data transfer. |
| NDAC (Not Data Accepted) | active LOW signals that the instrument connected is accepting the data on the data bus. |

GPIB Interface Functions

Instruments which can be remote controlled via the IEC/IEEE bus can be equipped with different interface functions. Table 5–1 lists the interface functions appropriate for the instrument.

Table 5–1 Interface functions

| Control character | Interface function |
|-------------------|---|
| SH1 | Handshake source function (source handshake), full capability |
| AH1 | Handshake sink function (acceptor handshake), full capability |
| L4 | Listener function, full capability, unaddress if MTA. |
| T6 | Talker function, full capability, ability to respond to serial poll, unaddress if MLA |
| SR1 | Service request function (Service Request), full capability |
| PP1 | Parallel poll function, full capability |
| RL1 | Remote/Local switch over function, full capability |
| DC1 | Reset function (Device Clear), full capability |
| DT1 | Trigger function (Device Trigger), full capability |
| C0 | No controller function |

GPIB Interface Messages

The messages transferred via the data lines of the IEC/IEEE bus can be divided into two groups: interface messages and device messages

Interface messages are transferred on the data lines of the IEC/IEEE bus when the "ATN" control line is active (LOW). They are used for communication between controller and instruments and can only be sent by the controller which currently has control of the IEC/IEEE bus.

Universal Commands

The universal commands are encoded 10 – 1F hex. They affect all instruments connected to the bus without addressing.

Table 5–2 Universal Commands

| Command | QuickBASIC command | Effect on the instrument |
|--------------------------|--------------------------------|---|
| DCL (Device Clear) | IBCMD (controller%, CHR\$(20)) | Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument settings. |
| IFC (Interface Clear) | IBSIC (controller%) | Resets the interfaces to the default setting. |
| LLO (Local Lockout) | IBCMD (controller%, CHR\$(17)) | The LOC/IEC ADDR key is disabled. |
| SPE (Serial Poll Enable) | IBCMD (controller%, CHR\$(24)) | Ready for serial poll. |

| Command | QuickBASIC command | Effect on the instrument |
|---------------------------------|--------------------------------|---------------------------------|
| SPD (Serial Poll Disable) | IBCMD (controller%, CHR\$(25)) | End of serial poll. |
| PPU (Parallel Poll Unconfigure) | IBCMD (controller%, CHR\$(21)) | End of the parallel-poll state. |

Addressed Commands

The addressed commands are encoded 00 – 0F hex. They are only effective for instruments addressed as listeners.

Table 5–3 Addressed Commands

| Command | QuickBASIC command | Effect on the instrument |
|-------------------------------|------------------------|--|
| SDC (Selected Device Clear) | IBCLR (device%) | Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting. |
| GET (Group Execute Trigger) | IBTRG (device%) | Triggers a previously active device function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input. |
| GTL (Go to Local) | IBLOC (device%) | Transition to the "Local" state (manual control). |
| PPC (Parallel Poll Configure) | IBPPC (device%, data%) | Configure instrument for parallel poll. Additionally, the QuickBASIC command executes PPE/PPD. |

Instrument Messages

For different interfaces, device messages are more or less alike. They are divided into two groups, depending on the direction they are sent: commands and device responses.

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the device functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:
 - *Setting commands* cause instrument settings such as a reset of the instrument or setting the frequency.
 - *Queries* cause data to be provided for remote control, e.g. for identification of the device or polling a parameter value. Queries are formed by directly appending a question mark to the header.

- According to their definition in standard:
 - *Common commands* are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and self test.
 - *Device-specific commands* refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee. Device-specific extensions following the SCPI rules are permitted by the standard.

Device responses

Device responses (response messages and service request) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (refer to section "Responses to Queries").

WLAN TX Measurements Option (K91) – Status Reporting System

Additionally to the registers provided by the base system, the following registers are used or modified in the WLAN TX Measurements option (K91):

- **STATus:OPERation Register**
Although this register is provided by the base system, the WLAN TX Measurements option (K91) makes use of bits not used within the base system.
- **STATus:QUEStionable:SYNC Register**
Although this register is provided by the base system, the WLAN TX Measurements option (K91) uses different bits and definitions.

The following registers are provided by the base system and are not available from the WLAN TX Measurements option (K91) command tree:

- [STATus:QUEStionable:ACPLimit Register](#)
- [STATus:QUEStionable:LIMit Register](#)
- [STATus:QUEStionable:LMARgin Register](#)

Detailed information on the status registers of the base system is given in section [Status Reporting System](#). In this section, only the new and altered status registers / bits for the WLAN TX Measurements option (K91) are described.

This option is available from firmware version 1.20.

STATus:OPERation Register

Additionally to the bits assigned by the base system (for details refer to [STATus:OPERation Register](#)), bit no. 4 is defined:

| Bit No | Meaning |
|--------|---|
| 4 | MEASuring This bit is set while a measurement is in progress. |

STATus:QUESTionable:SYNC Register

This register contains information about sync and bursts not found, and about pre-measurement results exceeding or falling short of expected values.

The bits can be queried with commands "STATus:QUESTionable:SYNC:CONDition?" and "STATus:QUESTionable:SYNC[:EVENT]?".

| Bit No | Meaning |
|---------|--|
| 0 | BURSt not found This bit is set if an IQ measurement is performed and no bursts are detected |
| 1 | This bit is not used |
| 2 | no bursts of REQuired type This bit is set if an IQ measurement is performed and no bursts of the specified type are detected |
| 3 | GATE length too small This bit is set if gating is used in a measurement and the gate length is not set sufficiently large enough |
| 4 | BURSt count too small This bit is set if a PVT measurement is performed with gating active and there is not at least 1 burst within the gate lines |
| 5 | auto level OVERload This bit is set if a signal overload is detected when an auto-level measurement is performed |
| 6 | auto level NoSIGnal This bit is set if no signal is detected by the auto-level measurement |
| 7 to 14 | These bits are not used |
| 15 | This bit is always 0 |

Error Reporting

Error reporting for the K91 option is carried out using the Service Request (SRQ) interrupt in the GPIB interface. When an error occurs a Service Request interrupt will be generated. The master can then query the slave instrument for the error that triggered the interrupt. Errors are queried through the "SYSTem:ERRor" command.

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6 Remote Control – Commands

This chapter describes all remote control commands for the analyzer functions, firmware options (see list below) and the basic settings functions of the R&S FSL in detail. Commands that are used both for analyzer functions and firmware options are described in the analyzer commands section. The mode information is provided for each command.

A few commands are implemented for reasons of compatibility with the FSP family only. These commands are not described in the R&S FSL documentation, because they have no effect.

Each subsystem starts with a list of commands, which provides quick access to all commands of the subsystem. Be aware, that for one subsystem more than one SCPI command lists can exist, depending on the functionality (analyzer and basic settings, options). For details on the notation refer to ["Notation"](#).

Remote commands of firmware and firmware options

- ["Remote Control – Description of Analyzer Commands"](#) on page 6.5
- ["Remote Commands of the Analog Demodulation Option \(K7\)"](#) on page 6.166
- ["Remote Commands of the Power Meter Option \(K9\)"](#) on page 6.208
- ["Remote Commands of the WLAN TX Measurements Option \(K91\)"](#) on page 6.218
- Remote Control – Description of Basic Settings Commands

Notation

In the following sections, all commands implemented in the instrument are first listed and then described in detail, arranged according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

- [Individual Description](#)
- [Upper/Lower Case Notation](#)
- [Special Characters](#)
- [Description of Parameters](#)

Individual Description

The individual description contains the complete notation of the command. An example for each command, the *RST value and the SCPI information are included as well.

The options and operating modes for which a command can be used are indicated by the following abbreviations:

| Abbreviation | Description |
|--------------|--|
| A | spectrum analysis |
| A-F | spectrum analysis – span > 0 only (frequency mode) |
| A-T | spectrum analysis – zero span only (time mode) |
| ADEMOD | analog demodulation (option R&S FSL-K7) |
| PSM | power sensor measurements (option R&S FSL-K9) |
| WLAN 802.11 | WLAN TX Measurements (option R&S FSL-K91) |

Note: *The spectrum analysis (analyzer) mode is implemented in the basic unit. For the other modes, the corresponding options are required.*

Upper/Lower Case Notation

Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see chapter "Remote Control – Basics"). The instrument itself does not distinguish between upper and lower case letters.

Special Characters

- | A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.

Example:

```
SENSe:FREQuency:CW|:FIXed
```

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz:

```
SENSe:FREQuency:CW 1E3
```

```
SENSe:FREQuency:FIXed 1E3
```

A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is used.

Example: Selection of the parameters for the command

```
[SENSe<1|2>:]AVERage:TYPE VIDEo | LINear
```

If parameter `SINGLE` is selected, full screen is displayed, in the case of `SPLIT`, split screen is displayed.

- Key words in square brackets can be omitted when composing the header. The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.

Parameters in square brackets can be incorporated optionally in the command or omitted as well.

- { Parameters in braces can be incorporated optionally in the command, either not at all, once or several times.

Description of Parameters

Due to the standardization, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also chapter "Remote Control – Basics", section "Parameters").

<Boolean>

This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword `OFF` or by the numeric value 0, the "on" state is indicated by `ON` or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value> <num>

These keywords mark parameters which may be entered as numeric values or be set using specific keywords (character data). The following keywords given below are permitted:

`MAXimum`: This keyword sets the parameter to the largest possible value.

`MINimum`: This keyword sets the parameter to the smallest possible value.

`DEFault`: This keyword is used to reset the parameter to its default value.

`UP`: This keyword increments the parameter value.

`DOWN`: This keyword decrements the parameter value.

The numeric values associated to `MAXimum`/`MINimum`/`DEFault` can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example:

```
SENSe:FREQuency:CENTer? MAXimum
```

Returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>

This keyword is provided for commands the parameters of which consist of a binary data block.

Remote Control – Description of Analyzer Commands

In this section all remote control commands for analyzer functions are described in detail. For details on basic settings commands refer to section "Remote Control – Description of Basic Settings Commands".

Subsystems of the analyzer

- [ABORt Subsystem](#)
- [CALCulate Subsystem](#)
- [DISPlay Subsystem](#)
- [FORMat Subsystem](#)
- [INITiate Subsystem](#)
- [INPut Subsystem](#)
- [OUTPut Subsystem](#)
- [SENSe Subsystem](#)
- [SOURce Subsystem \(Models 13 and 16\)](#)
- [STATus Subsystem](#)
- [SYSTem Subsystem](#)
- [TRACe Subsystem](#)
- [TRIGger Subsystem](#)
- [UNIT Subsystem](#)

ABORt Subsystem

The ABORt subsystem contains the commands for aborting triggered actions. An action can be triggered again immediately after being aborted. All commands trigger events, and therefore they have no *RST value.

Commands of the ABORt Subsystem

- [ABORt](#)

ABORt

This command aborts a current measurement and resets the trigger system.

Example

```
ABOR; INIT: IMM
```

Characteristics

RST value: –

SCPI: conforming

Mode

all

CALCulate Subsystem

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSE subsystem.

The following subsystems are included:

- "CALCulate:DELTamarker Subsystem" on page 6.6
- "CALCulate:DLINe Subsystem" on page 6.15
- "CALCulate:FLINe Subsystem" on page 6.16
- "CALCulate:LIMit Subsystem" on page 6.168
- "CALCulate:MARKer Subsystem" on page 6.17
- "CALCulate:STATistics Subsystem" on page 6.83
- "CALCulate:THReshold Subsystem" on page 6.87
- "CALCulate:TLINE Subsystem" on page 6.88
- "CALCulate:UNIT Subsystem" on page 6.89

CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem controls the delta marker functions in the instrument.

Commands of the CALCulate:DELTamarker Subsystem

- CALCulate<1|2>:DELTamarker<1...4>[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:MODE
- CALCulate<1|2>:DELTamarker<1...4>:AOFF
- CALCulate<1|2>:DELTamarker<1...4>:TRACe
- CALCulate<1|2>:DELTamarker<1...4>:X
- CALCulate<1|2>:DELTamarker<1...4>:X:RELative?
- CALCulate<1|2>:DELTamarker<1...4>:Y?
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHT
- CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHT
- CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT
- CALCulate<1|2>:DELTamarker<1...4>:FUNCTion:FIXed[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:FUNCTion:FIXed:RPOint:MAXimum[:PEAK]
- CALCulate<1|2>:DELTamarker<1...4>:FUNCTion:FIXed:RPOint:Y
- CALCulate<1|2>:DELTamarker<1...4>:FUNCTion:FIXed:RPOint:Y:OFFSet

- CALCulate<1|2>:DELTamarker<1...4>:FUNction:FIXed:RPOint:X
- CALCulate<1|2>:DELTamarker<1...4>:FUNction:PNOise[:STATe]
- CALCulate<1|2>:DELTamarker<1...4>:FUNction:PNOise:RESult?

CALCulate<1|2>:DELTamarker<1...4>[:STATe]

This command switches on and off the delta marker when delta marker 1 is selected. The corresponding marker becomes the delta marker when delta marker 2 to 4 is selected. If the corresponding marker is not activated, it will be activated and positioned on the maximum of the measurement curve.

If no numeric suffix is indicated, delta marker 1 is selected automatically.

Parameter

ON | OFF

Example

```
CALC:DELT3 ON
```

Switches marker 3 to delta marker mode.

Characteristics

RST value: OFF

SCPI: device-specific

Mode

all

CALCulate<1|2>:DELTamarker<1...4>:MODE

This command switches between relative and absolute frequency input of the delta marker (or time with span = 0).

Parameter

ABSolute | RELative

Example

```
CALC:DELT:MODE ABS
```

Switches the frequency/time indication for all delta markers to absolute values.

```
CALC:DELT:MODE REL
```

Switches the frequency/time indication for all delta markers to relative to marker 1.

Characteristics

RST value: REL

SCPI: device-specific

Mode

all

CALCulate<1|2>:DELTamarker<1...4>:AOFF

This command switches off all active delta markers.

Example

```
CALC:DELT:AOFF
```

Switches off all delta markers.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMODO

CALCulate<1|2>:DELTamarker<1...4>:TRACe

This command assigns the selected delta marker to the indicated trace. The selected trace must be active, i.e. its state must be different from "BLANK".

Parameter

1 to 4

Example

```
CALC:DELT3:TRAC 2
```

Assigns delta marker 3 to trace 2.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMODO

CALCulate<1|2>:DELTamarker<1...4>:X

This command positions the selected delta marker to the indicated frequency (span > 0), time (span = 0) or level (APD measurement = ON or CCDF measurement = ON). The input is in absolute values or relative to marker 1 depending on the command `CALCulate:DELTamarker:MODE`. If Reference Fixed measurement (`CALCulate:DELTamarker:FUNCTION:FIXed:STATE ON`) is active, relative values refer to the reference position are entered. The query always returns absolute values.

Parameter

0 to MAX (frequency | sweep time)

Example

```
CALC:DELT:MOD REL
```

Switches the input for all delta markers to relative to marker 1.

```
CALC:DELT2:X 10.7MHz
```

Positions delta marker 2 10.7 MHz to the right of marker 1.

```
CALC:DELT:X?
```

Outputs the absolute frequency/time of delta marker 1.

```
CALC:DELT:X:REL?
```

Outputs the relative frequency/time/level of delta marker 1.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMODO

CALCulate<1|2>:DELTamarker<1...4>:X:RELative?

This command queries the frequency (span > 0) or time (span = 0) of the selected delta marker relative to marker 1 or to the reference position (for CALCulate:DELTamarker:FUNCTION:FIXed:STATe ON). The command activates the corresponding delta marker, if necessary.

Example

```
CALC:DELT3:X:REL?
```

Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:Y?

This command queries the measured value of the selected delta marker. The corresponding delta marker will be activated, if necessary. The output is always a relative value referred to marker 1 or to the reference position (reference fixed active).

To obtain a correct query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the delta marker and the query of the y value. This is only possible in single sweep mode.

Depending on the unit defined with CALC:UNIT or on the activated measuring functions, the query result is output in the units below:

| Parameter or measuring functions | Output unit |
|--------------------------------------|----------------------|
| DBM DBPW DBUV DBMV DBUA | dB (lin/log) |
| WATT VOLT AMPere | dB (lin), % (log) |
| statistics function (APD or CCDF) on | dimensionless output |

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:DELT2 ON
```

Switches on delta marker 2.

```
INIT;*WAI
```

Starts a sweep and waits for its end.

```
CALC:DELT2:Y?
```

Outputs measurement value of delta marker 2.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD, BT

CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]

This command positions the delta marker to the current maximum value on the measured curve. If necessary, the corresponding delta marker will be activated first.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:DELT3:MAX
```

Sets delta marker 3 to the maximum value of the associated trace.

Characteristics

RST value:

SCPI: conforming / device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT

This command positions the delta marker to the next smaller maximum value on the measured curve. The corresponding delta marker will be activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:DELT2:MAX:NEXT
```

Sets delta marker 2 to the next smaller maximum value.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHT

This command positions the delta marker to the next smaller maximum value to the right of the current value (i.e. ascending X values). The corresponding delta marker is activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:DELT:MAX:RIGH
```

Sets delta marker 1 to the next smaller maximum value to the right of the current value.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT

This command positions the delta marker to the next smaller maximum value to the left of the current value (i.e. descending X values). The corresponding delta marker will be activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC : DELT : MAX : LEFT
```

Sets delta marker 1 to the next smaller maximum value to the left of the current value.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]

This command positions the delta marker to the current minimum value on the measured curve. The corresponding delta marker will be activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC : DELT3 : MIN
```

Sets delta marker 3 to the minimum value of the associated trace.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT

This command positions the delta marker to the next higher minimum value of the measured curve. The corresponding delta marker will be activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC : DELT2 : MIN : NEXT
```

Sets delta marker 2 to the next higher minimum value.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHT

This command positions the delta marker to the next higher minimum value to the right of the current value (i.e. ascending X values). The corresponding delta marker will be activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:DELT:MIN:RIGH
```

Sets delta marker 1 to the next higher minimum value to the right of the current value.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:MINimum:LEFT

This command positions the delta marker to the next higher minimum value to the left of the current value (i.e. descending X values). The corresponding delta marker will be activated first, if necessary.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:DELT:MIN:LEFT
```

Sets delta marker 1 to the next higher minimum to the left of the current value.

Characteristics

RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:DELTamarker<1...4>:FUNCTION:FIXed[:STATe]

This command switches the relative measurement to a fixed reference value on or off. Marker 1 will be activated previously and a peak search will be performed, if necessary. If marker 1 is activated, its position becomes the reference point for the measurement. The reference point can then be modified with commands

```
CALCulate:DELTamarker:FUNCTION:FIXed:RPoint:X and to :RPoint:Y
```

independently of the position of marker 1 and of a trace. It applies to all delta markers as long as the function is active.

Parameter

ON | OFF

Example

```
CALC:DELT:FUNC:FIX ON
```

Switches on the measurement with fixed reference value for all delta markers.

```
CALC:DELT:FUNC:FIX:RPO:X 128 MHZ
```

Sets the frequency reference to 128 MHz.

```
CALC:DELT:FUNC:FIX:RPO:Y 30 DBM
```

Sets the reference level to +30 dBm.

Characteristics

RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNction:FIXed:RPOint:Y

This command defines a new reference point level for all delta markers for a measurement with fixed reference point (CALCulate:DELTamarker:FUNction:FIXed:STATe ON).

For phase-noise measurements (CALCulate:DELTamarker:FUNction:PNOise:STATe ON), the command defines a new reference point level for delta marker 2.

Parameter

<numeric_value>

Example

CALC:DELT:FUNC:FIX:RPO:Y -10dBm

Sets the reference point level for delta markers to -10 dBm.

Characteristics

RST value: - (FUNction:FIXed[:STATe] is set to OFF)

SCPI: device-specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNction:FIXed:RPOint:Y:OFFSet

This command defines an additional level offset for the measurement with fixed reference value (CALCulate:DELTamarker:FUNction:FIXed:STATe ON). For this measurement, the offset is included in the display of all delta markers.

For phase-noise measurements (CALCulate:DELTamarker:FUNction:PNOise:STATe ON), the command defines an additional level offset which is included in the display of delta marker 2.

Parameter

<numeric_value>

Example

CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB

Sets the level offset for the measurement with fixed reference value or the phase-noise measurement to 10 dB.

Characteristics

RST value: 0 dB

SCPI: device-specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCTION:FIXed:RPOint:X

This command defines a new frequency reference (span > 0) or time (span = 0) for all delta markers for a measurement with fixed reference value

(CALCulate:DELTamarker:FUNCTION:FIXed:STATe ON).

For phase-noise measurements (CALCulate:DELTamarker:FUNCTION:PNOise:STATe ON), the command defines a new frequency reference or time for delta marker 2.

Parameter

<numeric_value>

Example

```
CALC:DELT:FUNC:FIX:RPO:X 128MHz
```

Sets the frequency reference to 128 MHz.

Characteristics

RST value: – (FUNCTION:FIXed[:STATe] is set to OFF)

SCPI: device-specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCTION:FIXed:RPOint:MAXimum[:PEAK]

This command sets the reference point level for all delta markers for a measurement with fixed reference point (CALC:DELT:FUNC:FIX:STAT ON) to the peak of the selected trace.

For phase-noise measurements (CALCulate:DELTamarker:FUNCTION:PNOise:STATe ON), the command defines a new reference point level for delta marker 2.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

```
CALC:DELT:FUNC:FIX:RPO:MAX
```

Sets the reference point level for delta markers to the peak of the selected trace.

Characteristics

RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:DELTamarker<1...4>:FUNCTION:PNOise[:STATe]

This command switches on or off the phase-noise measurement with all active delta markers. The correction values for the bandwidth and the log amplifier are taken into account in the measurement.

Marker 1 will be activated, if necessary, and a peak search will be performed. If marker 1 is activated, its position becomes the reference point for the measurement.

The reference point can then be modified with commands CALCulate:DELTamarker:FUNCTION:FIXed:RPOint:X and ...:RPOint:Y independently of the position of marker 1 and of a trace (the same commands used for the measurement with fixed reference point).

The numeric suffix <1...4> with DELTamarker is not relevant for this command.

Parameter

ON | OFF

Example

CALC:DELT:FUNC:PNO ON

Switches on the phase-noise measurement with all delta markers.

CALC:DELT:FUNC:FIX:RPO:X 128 MHZ

Sets the frequency reference to 128 MHz.

CALC:DELT:FUNC:FIX:RPO:Y 30 DBM

Sets the reference level to +30 dBm

Characteristics

RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:DELTaMarker<1...4>:FUNCTion:PNOise:RESult?

This command queries the result of the phase-noise measurement. The measurement will be switched on, if necessary.

This command is only a query and therefore has no *RST value.

Example

CALC:DELT:FUNC:PNO:RES?

Outputs the result of phase-noise measurement of the selected delta marker.

Characteristics

RST value: –

SCPI: device-specific

Mode

A

CALCulate:DLINe Subsystem

The CALCulate:DLINe subsystem defines the position of the display lines.

Commands of the CALCulate:DLINe Subsystem

- CALCulate<1|2>:DLINe<1|2>
- CALCulate<1|2>:DLINe<1|2>:STATe

CALCulate<1|2>:DLINe<1|2>

This command defines the position of display line 1 or 2. These lines enable the user to mark any levels in the diagram. The unit depends on the setting made with CALC:UNIT.

Parameter

MINimum to MAXimum (depending on current unit)

Example

CALC:DLIN -20dBm

Characteristics

*RST value: – (STATe to OFF)

SCPI: device-specific

Mode

A

CALCulate<1|2>:DLINe<1|2>:STATe

This command switches display line 1 or 2 (level lines) on or off.

Parameter

ON | OFF

Example

CALC:DLIN2:STAT OFF

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate:FLINE Subsystem

The CALCulate:FLINE subsystem defines the position of the frequency lines.

Commands of the CALCulate:FLINE Subsystem

- [CALCulate<1|2>:FLINe<1|2>](#)
- [CALCulate<1|2>:FLINe<1|2>:STATe](#)

CALCulate<1|2>:FLINe<1|2>

This command defines the position of the frequency lines that mark the frequencies.

Parameter

0 to f_{\max}

Example

CALC:FLIN2 120MHz

Characteristics

*RST value: – (STATe to OFF)

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:FLINe<1|2>:STATe

This command switches the frequency line on or off.

Parameter

ON | OFF

Example

```
CALC:FLIN2:STAT ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-F

CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem consists of the limit lines and the corresponding limit checks. Limit lines can be defined as upper or lower limit lines. The individual Y values of the limit lines correspond to the values of the X axis (CONTRol). The number of X and Y values must be identical. For details on limit lines refer to chapter "Instrument Functions", section "Using Limit Lines and Display Lines – LINES Key", or the Online Help.

The following subsystems are included:

- ["CALCulate:LIMit:ACPower Subsystem"](#) on page 6.22
- ["CALCulate:LIMit:CONTRol Subsystem"](#) on page 6.22
- ["CALCulate:LIMit:LOWer Subsystem"](#) on page 6.32
- ["CALCulate:LIMit:UPPer Subsystem"](#) on page 6.35

Commands of the CALCulate:LIMit Subsystem

- [CALCulate<1|2>:LIMit<1...8>:TRACe](#)
- [CALCulate<1|2>:LIMit<1...8>:STATe](#)
- [CALCulate<1|2>:LIMit<1...8>:UNIT](#)
- [CALCulate<1|2>:LIMit<1...8>:FAIL?](#)
- [CALCulate<1|2>:LIMit<1...8>:CLEAr\[:IMMEDIATE\]](#)
- [CALCulate<1|2>:LIMit<1...8>:COMMeNt](#)
- [CALCulate<1|2>:LIMit<1...8>:COPI](#)
- [CALCulate<1|2>:LIMit<1...8>:NAME](#)
- [CALCulate<1|2>:LIMit<1...8>:DELeTe](#)

Further information

- [Example \(analyzer mode\)](#)
- [Definition of the limit line](#)
- [Switching on and evaluating the line](#)

Example (analyzer mode)

Definition and use of a new limit line 5 for trace 2 with the following features:

- upper limit line
- absolute X axis with span > 0.
- 5 ref. values: 126 MHz/–40 dB, 127 MHz/–40 dB, 128 MHz/–20 dB, 129 MHz/–40 dB, 130 MHz/–40 dB
- relative Y axis with unit dB
- absolute threshold value at –35 dBm
- no safety margin

Definition of the limit line

1. Defining the name:

```
CALC:LIM5:NAME 'TEST1'
```

2. Entering the comment:

```
CALC:LIM5:COMM 'Upper limit line'
```

3. Associated trace:

```
CALC:LIM5:TRAC 2
```

4. Defining the X axis range:

```
CALC:LIM5:CONT:DOM FREQ
```

5. Defining the X axis scaling:

```
CALC:LIM5:CONT:MODE ABS
```

6. Defining the Y axis unit:

```
CALC:LIM5:UNIT DB
```

7. Defining the Y axis scaling:

```
CALC:LIM5:UPP:MODE REL
```

8. Defining the X axis values:

```
CALC:LIM5:CONT 126MHZ, 127MHZ, 128MHZ, 129 MHZ, 130MHZ
```

9. Defining the y values:

```
CALC:LIM5:UPP -40, -40, -30, -40, -40
```

10. Defining the y threshold value:

```
CALC:LIM5:UPP:THR -35DBM
```

The definition of the safety margin and shifting in X and/or Y direction can take place as from here (see commands below).

Switching on and evaluating the line

1. Switching on the line:

```
CALC:LIM5:UPP:STAT ON
```

2. Switching on the limit check:

```
CALC:LIM5:STAT ON
```

3. Starting a new measurement with synchronization:


```
INIT;*WAI
```

4. Querying the limit check result:

```
CALC:LIM5:FAIL?
```

CALCulate<1|2>:LIMit<1...8>:TRACe

This command assigns a limit line to a trace.

This command is available from firmware version 1.10.

Parameter

1 to 4

Example

```
CALC:LIM2:TRAC 3
```

Assigns limit line 2 to trace 3.

Characteristics

*RST value: 1

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:STATe

This command switches on or off the limit check for the selected limit line.

The result of the limit check can be queried with `CALCulate<1|2>:LIMit<1...8>:FAIL?`.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
CALC:LIM:STAT ON
```

Switches on the limit check for limit line 1.

Characteristics

*RST value: OFF

SCPI: conforming

Mode

A, FM; NF&GM

CALCulate<1|2>:LIMit<1...8>:UNIT

This command defines the unit of the selected limit line.

Upon selection of the unit DB the limit line is automatically switched to the relative mode. For units different from DB the limit line is automatically switched to absolute mode.

The units DEG, RAD, S, HZ, PCT are not available in spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DBPT | DB | DEG | RAD | S | HZ | PCT | UNITLESS

Example

```
CALC:LIM4:UNIT DBUV
```

Sets the unit of limit line 4 to dB μ V.

Characteristics

*RST value: DBM

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:FAIL?

This command queries the result of the limit check of the indicated limit line. It should be noted that a complete sweep must have been performed for obtaining a correct result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided. The result of the limit check is given with 0 for PASS, 1 for FAIL, and 2 for MARGIN.

This command is available from firmware version 1.10.

Example

```
INIT;*WAI
```

Starts a new sweep and waits for its end.

```
CALC:LIM3:FAIL?
```

Queries the result of the check for limit line 3.

Characteristics

*RST value: –

SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:CLEar[:IMMEDIATE]

This command deletes the result of the current limit check for all limit lines.

This command is an event and therefore has no *RST value.

This command is available from firmware version 1.10.

Example

```
CALC:LIM:CLE
```

Deletes the result of the limit check.

Characteristics

*RST value: –

SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:COMMENT

This command defines a comment for the limit line selected (max. 40 characters).

This command is available from firmware version 1.10.

Parameter

<string>

Example

CALC:LIM5:COMM Upper limit for spectrum
 Defines the comment for limit line 5.

Characteristics

*RST value: blank comment

SCPI: device-specific

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:COPY

This command copies one limit line onto another one

This command is an event and therefore has no *RST value and no query.

This command is available from firmware version 1.10.

Parameter

1 to 8 number of the new limit line

<name> name of the new limit line given as a string

Example

CALC:LIM1:COPY 2
 Copies limit line 1 to line 2.

CALC:LIM1:COPY FM2
 Copies limit line 1 to a new line named FM2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:NAME

This command assigns a name to a limit line numbered 1 to 8. If it does not exist already, a limit line with this name is created.

This command is available from firmware version 1.10.

Parameter

<name of limit line>

Example

CALC:LIM1:NAME FM1
 Assigns the name FM1 to limit line 1.

Characteristics

*RST value: REM1 to REM8 for lines 1 to 8

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:DELete

This command deletes the selected limit line.

This command is an event and therefore has no *RST value and no query.

This command is available from firmware version 1.10.

Example

```
CALC : LIM1 : DEL
Deletes limit line 1.
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, FM, NF&GM

CALCulate:LIMit:ACPower Subsystem

The CALCulate:LIMit:ACPower subsystem defines the limit check for adjacent channel power measurement.

Commands of the CALCulate:LIMit:ACPower Subsystem

- CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]
- CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]
- CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel[:RELative]:STATe
- CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute
- CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:ABSolute:STATe
- CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?
- CALCulate<1|2>:LIMit<1...8>:ACPower:ALternate<1|2>[:RELative]
- CALCulate<1|2>:LIMit<1...8>:ACPower:ALternate<1|2>[:RELative]:STATe
- CALCulate<1|2>:LIMit<1...8>:ACPower:ALternate<1|2>:ABSolute
- CALCulate<1|2>:LIMit<1...8>:ACPower:ALternate<1|2>:ABSolute:STATe
- CALCulate<1|2>:LIMit<1...8>:ACPower:ALternate<1|2>:RESult?

CALCulate<1|2>:LIMit<1...8>:ACPower[:STATe]

This command switches on and off the limit check for adjacent-channel power measurements.

The commands CALCulate:LIMit:ACPower:ACHannel:STATe or CALCulate:LIMit:ACPower:ALternate:STATe must be used in addition to specify whether the limit check is to be performed for the upper/lower adjacent channel or for the alternate adjacent channels.

The numeric suffixes <1...8> are irrelevant for this command.

Parameter

ON | OFF

Example

CALC:LIM:ACP ON
Switches on the ACP limit check.

Characteristics

*RST value: OFF
SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ACHannel[:RELative]

This command defines the relative limit of the upper/lower adjacent channel for adjacent-channel power measurements. The reference value for the relative limit value is the measured channel power.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit value defined with the command

CALCulate:LIMit:ACPpower:ACHannel:ABSolute. This mechanism allows automatic checking of the absolute basic values of adjacent-channel power as defined in mobile radio standards.

The numeric suffixes <1...8> are irrelevant for this command.

Parameter

first value: 0 to 100dB; limit for the upper (lower) adjacent channel

second value: 0 to 100dB; is ignored but must be indicated for reasons of compatibility with the FSP family

Example

CALC:LIM:ACP:ACH 30DB, 30DB
Sets the relative limit value for the power in the lower and upper adjacent channel to 30 dB below the channel power.

Characteristics

*RST value: 0 dB
SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ACHannel[:RELative]:STATe

This command activates the limit check for the relative limit value of the adjacent channel when adjacent-channel power measurement is performed. Before the command, the limit check must be activated using CALCulate:LIMit:ACPpower:STATe ON.

The result can be queried with CALCulate:LIMit:ACPpower:ACHannel:RESult?. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are available.

The numeric suffixes <1...8> are irrelevant for this command.

Parameter

ON | OFF

Example

```
CALC:LIM:ACP:ACH 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper adjacent channel to 30 dB below the channel power.

```
CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper adjacent channel to –35 dBm.

```
CALC:LIM:ACP ON
```

Switches on globally the limit check for the channel/adjacent channel measurement.

```
CALC:LIM:ACP:ACH:REL:STAT ON
```

Switches on the check of the relative limit values for adjacent channels.

```
CALC:LIM:ACP:ACH:ABS:STAT ON
```

Switches on the check of absolute limit values for the adjacent channels.

```
INIT;*WAI
```

Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ACH:RES?
```

Queries the limit check result in the adjacent channels.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ACHannel:ABSolute

This command defines the absolute limit value for the lower/upper adjacent channel during adjacent-channel power measurement (Adjacent Channel Power).

It should be noted that the absolute limit value has no effect on the limit check as soon as it is below the relative limit value defined with

`CALCulate:LIMit:ACPpower:ACHannel:RELative`. This mechanism allows automatic checking of the absolute basic values of adjacent-channel power as defined in mobile radio standards.

The numeric suffixes <1...8> in LIMit are irrelevant for this command.

Parameter

first value: –200DBM to 200DBM; limit for the lower and the upper adjacent channel

second value: –200 to 200DBM; is ignored but must be indicated for reasons of compatibility with the FSP family

Example

```
CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper adjacent channel to –35 dBm.

Characteristics

*RST value: –200DBM

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ACHannel:ABSolute:STATe

This command activates the limit check for the adjacent channel when adjacent-channel power measurement (Adjacent Channel Power) is performed. Before the command, the limit check for the channel/adjacent-channel measurement must be globally switched on using `CALC:LIM:ACP ON`.

The result can be queried with `CALCulate:LIMit:ACPpower:ACHannel:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are available.

The numeric suffixes <1...8> in LIMit are irrelevant for this command.

Parameter

ON | OFF

Example

```
CALC:LIM:ACP:ACH 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper adjacent channel to 30 dB below the channel power.

```
CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper adjacent channel to -35 dBm.

```
CALC:LIM:ACP ON
```

Switches on globally the limit check for the channel/adjacent-channel measurement.

```
CALC:LIM:ACP:ACH:REL:STAT ON
```

Switches on the check of the relative limit values for adjacent channels.

```
CALC:LIM:ACP:ACH:ABS:STAT ON
```

Switches on the check of absolute limit values for the adjacent channels.

```
INIT;*WAI
```

Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ACH:RES?
```

Queries the limit check result in the adjacent channels.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ACHannel:RESult?

This command queries the result of the limit check for the upper/lower adjacent channel when adjacent channel power measurement is performed.

If the power measurement of the adjacent channel is switched off, the command produces a query error.

The numeric suffixes <1...8> are irrelevant for this command.

This command is a query and therefore has no *RST value.

Parameter

The result is returned in the form <result>, <result> where <result> = PASSED | FAILED, and where the first returned value denotes the lower, the second denotes the upper adjacent channel.

Example

```
CALC:LIM:ACP:ACH 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper adjacent channel to 30 dB below the channel power.

```
CALC:LIM:ACP:ACH:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper adjacent channel to –35 dB.

```
CALC:LIM:ACP ON
```

Switches on globally the limit check for the channel/adjacent channel measurement.

```
CALC:LIM:ACP:ACH:STAT ON
```

Switches on the limit check for the adjacent channels.

```
INIT;*WAI
```

Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ACH:RES?
```

Queries the limit check result in the adjacent channels.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ALTernate<1|2>[:RELative]

This command defines the limit for the first/second alternate adjacent channel for adjacent channel power measurements. The reference value for the relative limit value is the measured channel power.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes `<1...8>` are irrelevant for this command.

It should be noted that the relative limit value has no effect on the limit check as soon as it is below the absolute limit defined with

`CALCulate:LIMit:ACPpower:ALTernate<1|2>:ABSolute`. This mechanism allows automatic checking of the absolute basic values of adjacent-channel power as defined in mobile radio standards.

Parameter

first value: 0 to 100dB; limit for the lower and the upper alternate adjacent channel

second value: 0 to 100dB; is ignored but must be indicated for reasons of compatibility with the FSP family

Example

```
CALC:LIM:ACP:ALT2 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper alternate adjacent channel to 30 dB below the channel power.

Characteristics

*RST value: 0 DB

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ALTernate<1|2>[:RELative]:STATe

This command activates the limit check for the first/second alternate adjacent channel for adjacent channel power measurements. Before the command, the limit check must be activated using `CALCulate:LIMit:ACPpower:STATe ON`.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes `<1...8>` are irrelevant for this command.

The result can be queried with `CALCulate:LIMit:ACPpower:ALTernate<1|2>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are obtained.

Parameter

ON | OFF

Example

```
CALC:LIM:ACP:ALT2 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.

```
CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper second alternate adjacent channel to -35 dBm.

```
CALC:LIM:ACP ON
```

Switches on globally the limit check for the channel/adjacent channel measurement.

```
CALC:LIM:ACP:ACH:REL:STAT ON
```

Switches on the check of the relative limit values for the alternate adjacent channels.

```
CALC:LIM:ACP:ACH:ABS:STAT ON
```

Switches on the check of absolute limit values for the alternate adjacent channels.

```
INIT;*WAI
```

Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ACH:RES?
```

Queries the limit check result in the second alternate adjacent channels.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ALTernate<1|2>:ABSolute

This command defines the absolute limit value for the lower/upper alternate adjacent-channel power measurement (Adjacent Channel Power).

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes `<1...8>` are irrelevant for this command.

It should be noted that the absolute limit value for the limit check has no effect as soon as it is below the relative limit value defined with

`CALCulate:LIMit:ACPpower:ALTernate<1|2>:RELative`. This mechanism allows automatic checking of the absolute basic values defined in mobile radio standards for the power in adjacent channels.

Parameter

first value: -200DBM to 200DBM; limit for the lower and the upper alternate adjacent channel

second value: -200 to 200DBM; is ignored but must be indicated for reasons of compatibility with the FSP family

Example

```
CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper second alternate adjacent channel to -35 dBm.

Characteristics

*RST value: -200DBM

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ALTernate<1|2>:ABSolute:STATe

This command activates the limit check for the first/second alternate adjacent channel for adjacent-channel power measurement (Adjacent Channel Power).

Before the command, the limit check must be globally switched on for the channel/adjacent-channel power with the command `CALCulate:LIMit:ACPpower:STATe ON`.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes `<1...8>` are irrelevant for this command.

The result can be queried with `CALCulate:LIMit:ACPpower:ALTernate<1|2>:RESult?`. It should be noted that a complete measurement must be performed between switching on the limit check and the result query, since otherwise no correct results are available.

Parameter

ON | OFF

Example

```
CALC:LIM:ACP:ALT2 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.

```
CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper second alternate adjacent channel to -35 dBm.

```
CALC:LIM:ACP ON
```

Switches on globally the limit check for the channel/adjacent channel measurement.

```
CALC:LIM:ACP:ACH:REL:STAT ON
```

Switches on the check of the relative limit values for the alternative adjacent channels.

```
CALC:LIM:ACP:ACH:ABS:STAT ON
```

Switches on the check of absolute limit values for the alternative adjacent channels.

```
INIT;*WAI
```

Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ACH:RES?
```

Queries the limit check result in the second alternate adjacent channels.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:ACPpower:ALTernate<1|2>:RESult?

This command queries the result of the limit check for the first/second alternate adjacent channel for adjacent channel power measurements.

The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel. The numeric suffixes `<1...8>` are irrelevant for this command.

If the power measurement of the adjacent channel is switched off, the command produces a query error.

This command is a query and therefore has no `*RST` value.

Parameter

The result is returned in the form `<result>`, `<result>` where `<result>` = PASSED | FAILED and where the first (second) returned value denotes the lower (upper) alternate adjacent channel.

Example

```
CALC:LIM:ACP:ALT2 30DB, 30DB
```

Sets the relative limit value for the power in the lower and upper second alternate adjacent channel to 30 dB below the channel power.

```
CALC:LIM:ACP:ALT2:ABS -35DBM, -35DBM
```

Sets the absolute limit value for the power in the lower and upper second alternate adjacent channel to -35 dBm.

```
CALC:LIM:ACP ON
```

Switches on globally the limit check for the channel/adjacent channel measurement.

```
CALC:LIM:ACP:ALT:STAT ON
```

Switches on the limit check for the adjacent channels.

```
INIT;*WAI
```

Starts a new measurement and waits for the sweep end.

```
CALC:LIM:ACP:ALT:RES?
```

Queries the limit check result in the second alternate adjacent channels.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate:LIMit:CONTRol Subsystem

The `CALCulate:LIMit:CONTRol` subsystem defines the X axis (`CONTRol` axis). This subsystem is available from firmware version 1.10.

Commands of the CALCulate:LIMit:CONTRol Subsystem

- `CALCulate<1|2>:LIMit<1...8>:CONTRol[:DATA]`
- `CALCulate<1|2>:LIMit<1...8>:CONTRol:DOMain`
- `CALCulate<1|2>:LIMit<1...8>:CONTRol:OFFSet`
- `CALCulate<1|2>:LIMit<1...8>:CONTRol:MODE`
- `CALCulate<1|2>:LIMit<1...8>:CONTRol:SHIFt`
- `CALCulate<1|2>:LIMit<1 ... 8>:CONTRol:SPACing`

CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA]

This command defines the X axis values (frequencies or times) of the upper or lower limit lines. The number of values for the CONTrol axis and for the corresponding UPPer and/or LOWER limit lines has to be identical. Otherwise default values are entered for missing values or not required values are deleted.

In analyzer mode, the unit of values depends on the span setting of the X axis, i.e. it is HZ with `CALC:LIM:CONT:DOM FREQ` and S with `CALC:LIM:CONT:DOM TIME`.

This command is available from firmware version 1.10.

Parameter

<numeric_value>,<numeric_value>

Example

```
CALC:LIM2:CONT 1MHz,30MHz,100MHz, 300MHz,1GHz
```

Defines 5 reference values for the X axis of limit line 2.

```
CALC:LIM2:CONT?
```

Outputs the reference values for the X axis of limit line 2 separated by a comma.

Characteristics

*RST value: – (LIMit:STATe is set to OFF)

SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain

This command defines the span setting for the X axis values.

This command is available from firmware version 1.10.

Parameter

FREQuency | TIME

Example

```
CALC:LIM2:CONT:DOM TIME
```

Defines zero span for the X axis of limit line 2.

Characteristics

*RST value: FREQuency

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFSet

This command defines an offset for the X axis value of the selected relative limit line for span > 0 or zero span.

The unit of values depends on the span setting of the X axis, i.e. it is HZ with

`CALC:LIM:CONT:DOM FREQ` and S with `CALC:LIM:CONT:DOM TIME`.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM2:CONT:OFFS 100us
```

Sets the X offset for limit line 2 (defined in zero span) to 100 μ s.

Characteristics

*RST value: 0

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE

This command selects the relative or absolute scaling for the X axis of the selected limit line.

This command is available from firmware version 1.10.

Parameter

RELative | ABSolute

Example

```
CALC:LIM2:CONT:MODE REL
```

Defines the X axis of limit line 2 as relatively scaled.

Characteristics

*RST value: ABSolute

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt

This command moves a limit line by the indicated value in x direction. In contrast to `CALC:LIM:CONT:OFFS`, the line is shifted by modifying the individual x values and not by means of an additive offset.

In the analyzer mode, the unit of values depends on the span setting of the X axis, i.e. it is HZ with `CALC:LIM:CONT:DOM FREQ` and S with `CALC:LIM:CONT:DOM TIME`.

This command is an event and therefore has no *RST value and no query.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM2:CONT:SHIF 50KHZ
```

Shifts all reference values of limit line 2 by 50 kHz.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1 ... 8>:CONTRol:SPACing

This command selects linear or logarithmic interpolation for the calculation of limit lines from frequency points.

This command is available from firmware version 1.10.

Parameter

LINear | LOGarithmic

Example

```
CALC:LIM:CONT:SPAC LIN
```

Characteristics

*RST value: LIN

SCPI: device-specific

Mode

A

CALCulate:LIMit:LOWer Subsystem

The CALCulate:LIMit:LOWer subsystem defines the lower limit line. This subsystem is available from firmware version 1.10.

Commands of the CALCulate:LIMit:LOWer Subsystem

- CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]
- CALCulate<1|2>:LIMit<1...8>:LOWer:STATe
- CALCulate<1|2>:LIMit<1...8>:LOWer:OFFSet
- CALCulate<1|2>:LIMit<1...8>:LOWer:MARGIn
- CALCulate<1|2>:LIMit<1...8>:LOWer:MODE
- CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt
- CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing
- CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold

CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA]

This command defines the values for the selected lower limit line.

The number of values for the CONTRol axis and for the corresponding LOWer limit line has to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

The unit must be identical with the unit selected by CALC:LIM:UNIT. If no unit is indicated, the unit defined with CALC:LIM:UNIT is automatically used.

If the measured values are smaller than the LOWer limit line, the limit check signals errors.

The units DEG, RAD, S, HZ, PCT are not available in the spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>,<numeric_value>

Example

```
CALC:LIM2:LOW -30,-40,-10,-40,-30
```

Defines 5 lower limit values for limit line 2 in the preset unit.

`CALC:LIM2:LOW?`

Outputs the lower limit values of limit line 2 separated by a comma.

Characteristics

*RST value: – (LIMit:STATe is set to OFF)

SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:LOWer:STATe

This command switches on or off the indicated limit line. The limit check is activated separately with `CALC:LIM:STAT ON`.

In spectrum analyzer mode, the result of the limit check can be queried with

`CALCulate:LIMit<1...8>:FAIL?`.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

`CALC:LIM4:LOW:STAT ON`

Switches on limit line 4 (lower limit).

Characteristics

*RST value: OFF

SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:LOWer:OFFSet

This command defines an offset for the Y axis of the selected relative lower limit line. In contrast to `CALC:LIM:LOW:SHIFT`, the line is not shifted by modifying the individual Y values but by means of an additive offset.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

`CALC:LIM2:LOW:OFFS 3dB`

Shifts limit line 2 by 3 dB upwards.

Characteristics

*RST value: 0

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin

This command defines a margin to a lower limit line, at which out-of-limit values are signaled (if the limit check is active), but not handled as a violation of the limit value.

Only the unit dB is available in spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM:LOW:MARG 10dB
```

Characteristics

*RST value: 0

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:LOWer:MODE

This command selects the relative or absolute scaling for the Y axis of the selected lower limit line.

Selecting RELative causes the unit to be switched to DB.

This command is available from firmware version 1.10.

Parameter

RELative | ABSolute

Example

```
CALC:LIM:LOW:MODE REL
```

Defines the Y axis of limit line 2 as relative scaled.

Characteristics

*RST value: ABSolute

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt

This command shifts a limit line by the indicated value in Y direction. In contrast to `CALC:LIM:LOW:OFFS`, the line is shifted by modifying the individual Y values but not by means of an additive offset.

This command is an event and therefore has no *RST value and no query.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM3:LOW:SHIF 20DB
```

Shifts all Y values of limit line 3 by 20 dB.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:LOWer:SPACing

This command selects linear or logarithmic interpolation for the lower limit line.

This command is available from firmware version 1.10.

Parameter

LINear | LOGarithmic

Example

```
CALC:LIM:LOW:SPAC LIN
```

Characteristics

*RST value: LIN

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:LOWer:THReshold

This command defines an absolute threshold value for limit lines with relative Y axis scaling. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALC:LIM:UNIT` (except dB which is not allowed). If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used (exception: dBm instead of dB).

The units DEG, RAD, S, HZ, PCT are not available in the spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM2:LOW:THR -35DBM
```

Defines an absolute threshold value for limit line 2.

Characteristics

*RST value: –200 dBm

SCPI: device-specific

Mode

A, FM

CALCulate:LIMit:UPPer Subsystem

The CALCulate:LIMit:UPPer subsystem defines the upper limit line. This subsystem is available from firmware version 1.10.

Commands of the CALCulate:LIMit:UPPer Subsystem

- CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]
- CALCulate<1|2>:LIMit<1...8>:UPPer:STATe
- CALCulate<1|2>:LIMit<1...8>:UPPer:OFFSet
- CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin
- CALCulate<1|2>:LIMit<1...8>:UPPer:MODE
- CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt
- CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing
- CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold

CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA]

This command defines the values for the upper limit lines

The number of values for the CONTROL axis and for the corresponding UPPER and/or LOWER limit line has to be identical. Otherwise default values are entered for missing values or not necessary values are deleted.

The unit must be identical with the unit selected by CALC:LIM:UNIT. If no unit is indicated, the unit defined with CALC:LIM:UNIT is automatically used.

In spectrum analyzer mode, the limit check indicates errors if the measured values exceed the UPPER limit line. The units DEG, RAD, S, HZ, PCT are not available in spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>,<numeric_value>

Example

```
CALC:LIM2:UPP -10,0,0,-10,-5
```

Defines 5 upper limit values for limit line 2 in the preset unit.

```
CALC:LIM2:UPP?
```

Outputs the upper limit values for limit line 2 separated by a comma.

Characteristics

*RST value: – (LIMit:STATe is set to OFF)

SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:UPPer:STATe

This command switches on or off the indicated limit line. The limit check is activated separately with CALC:LIM:STAT ON.

In spectrum analyzer mode, the result of the limit check can be queried with

```
CALCulate:LIMit<1...8>:FAIL?.
```

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

CALC:LIM4:UPP:STAT ON
Switches on limit line 4 (upper limit).

Characteristics

*RST value: OFF
SCPI: conforming

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:UPPer:OFFSet

This command defines an offset for the Y axis of the selected relative upper limit line. In contrast to CALC:LIM:UPP:SHIFT, the line is not shifted by modifying the individual Y values but by means of an additive offset.

Only the unit dB is available in the spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

CALC:LIM2:UPP:OFFS 3dB
Shifts limit line 2 by 3 dB upwards.

Characteristics

*RST value: 0
SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin

This command defines a margin to an upper limit line, at which out-of-limit values are signaled (if the limit check is active), but not handled as a violation of the limit value.

Only the unit dB is available in spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

CALC:LIM2:UPP:MARG 10dB
Defines the margin of limit line 2 to 10 dB below the limit value.

Characteristics

*RST value: 0
SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:UPPer:MODE

This command selects the relative or absolute scaling for the Y axis of the selected upper limit line.

Selecting RELative causes the unit to be switched to DB.

This command is available from firmware version 1.10.

Parameter

RELative | ABSolute

Example

```
CALC:LIM2:UPP:MODE REL
```

Defines the Y axis of limit line 2 as relative scaled.

Characteristics

*RST value: ABSolute

SCPI: device-specific

Mode

A, FM

CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt

This command moves a limit line by the indicated value in Y direction. In contrast to `CALC:LIM:UPP:OFFS`, the line is shifted by modifying the individual Y values and not by means of an additive offset.

This command is an event and therefore has no *RST value and no query.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM3:UPP:SHIF 20
```

Shifts all Y values of limit line 3 by 20 limit line units, e.g. dB.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, FM, NF&GM

CALCulate<1|2>:LIMit<1...8>:UPPer:SPACing

This command selects linear or logarithmic interpolation for the upper limit line.

This command is available from firmware version 1.10.

Parameter

LINear | LOGarithmic

Example

```
CALC:LIM:UPP:SPAC LIN
```

Characteristics

*RST value: LIN

SCPI: device-specific

Mode

A

CALCulate<1|2>:LIMit<1...8>:UPPer:THReshold

This command defines an absolute threshold value for limit lines with relative Y axis scaling. The absolute threshold value is used in the limit check as soon as it exceeds the relative limit value.

The unit must correspond to the unit selected with `CALC:LIM:UNIT` (except dB which is not possible). If no unit is indicated, the unit defined with `CALC:LIM:UNIT` is automatically used (exception: dBm instead of dB).

The units DEG, RAD, S, HZ, PCT are not available in the spectrum analyzer mode.

This command is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
CALC:LIM2:UPP:THR -35DBM
```

Defines an absolute threshold value for limit line 2.

Characteristics

*RST value: -200 dBm

SCPI: device-specific

Mode

A, FM

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the instrument.

The following subsystem is included:

- "[CALCulate:MARKer:FUNCTION Subsystem](#)" on page 6.49

Commands of the CALCulate:MARKer Subsystem

- `CALCulate<1|2>:MARKer<1...4>[:STATe]`
- `CALCulate<1|2>:MARKer<1...4>:AOFF`
- `CALCulate<1|2>:MARKer<1...4>:TRACe`
- `CALCulate<1|2>:MARKer<1...4>:X`
- `CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATe]`
- `CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT`
- `CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHT`
- `CALCulate<1|2>:MARKer<1...4>:COUNT`
- `CALCulate<1|2>:MARKer<1...4>:COUNT:RESolution`
- `CALCulate<1|2>:MARKer<1...4>:COUNT:FREQuency?`
- `CALCulate<1|2>:MARKer<1...4>:LOEXclude`
- `CALCulate<1|2>:MARKer<1...4>:Y?`

- CALCulate<1|2>:MARKer<1...4>:Y:PERCent
- CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]
- CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT
- CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHT
- CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT
- CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]
- CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT
- CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHT
- CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT
- CALCulate<1|2>:MARKer<1...4>:PEXCursion

CALCulate<1|2>:MARKer<1...4>[:STATe]

This command switches on or off the currently selected marker. If no indication is made, marker 1 is selected automatically. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

Parameter

ON | OFF

Example

CALC:MARK3 ON

Switches on marker 3 or switches to marker mode.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:AOFF

This command switches off all active markers and all delta markers and active marker/delta marker measurement functions.

This command is an event and therefore has no *RST value and no query.

Example

CALC:MARK:AOFF

Switches off all markers.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:TRACe

This command assigns the selected marker (1 to 4) to the indicated measurement curve. The corresponding trace must be active, i.e. its status must be different from "BLANK".

If necessary the corresponding marker is switched on prior to the assignment.

Parameter

1 to 4

Example

CALC:MARK3:TRAC 2
Assigns marker 3 to trace 2.

Characteristics

*RST value: –
SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:X

This command positions the selected marker to the indicated frequency (span > 0), time (span = 0) or level (APD measurement or CCDF measurement ON).

If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

Parameter

0 to MAX (frequency | sweep time)

Example

CALC:MARK2:X 10.7MHz
Positions marker 2 to frequency 10.7 MHz.

Characteristics

*RST value: –
SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:X:SLIMits[:STATE]

This command switches between a limited (ON) and unlimited (OFF) search range. The function is independent of the selection of a marker, i.e. the numeric suffix MARKer<1...4> is irrelevant.

If the power measurement in zero span is active, this command limits the evaluation range on the trace.

Parameter

ON | OFF

Example

CALC:MARK:X:SLIM ON
Switches on search limitation.

Characteristics

*RST value: OFF
SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:X:SLIMits:LEFT

This command sets the left limit of the search range for markers and delta markers. Depending on the span setting of the X axis the indicated value defines a frequency (span > 0) or time (span = 0). The function is independent of the selection of a marker, i.e. the numeric suffix in MARKer<1...4> is irrelevant.

If the power measurement in zero span is active, this command limits the evaluation range to the trace.

Note: *The function is only available if the search limit for marker and delta marker is switched on (CALC:MARK:X:SLIM ON).*

Parameter

0 to MAX (frequency | sweep time)

Example

```
CALC:MARK:X:SLIM ON
```

Switches the search limit function on.

```
CALC:MARK:X:SLIM:LEFT 10MHz
```

Sets the left limit of the search range to 10 MHz.

Characteristics

*RST value: – (is set to the left diagram border on switching on search limits)

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:X:SLIMits:RIGHT

This command sets the right limit of the search range for markers and delta markers. Depending on the span setting of the X axis the indicated value defines a frequency (span > 0) or time (span = 0). The function is independent of the selection of a marker, i.e. the numeric suffix in MARKer<1...4> is irrelevant.

If the power measurement in zero span is active, this command limits the evaluation range to the trace.

Note: *The function is only available if the search limit for marker and delta marker is switched on (CALC:MARK:X:SLIM ON).*

Parameter

0 to MAX (frequency | sweep time)

Example

```
CALC:MARK:X:SLIM ON
```

Switches the search limit function on.

```
CALC:MARK:X:SLIM:RIGH 20MHz
```

Sets the right limit of the search range to 20 MHz.

Characteristics

*RST value: – (is set to the right diagram border on switching on search limits)

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:COUNT

This command switches on or off the frequency counter at the marker position.

The count result is queried with `CALCulate:MARKer:COUNT:FREQuency?`.

Frequency counting is possible only for one marker at a time. If it is activated for another marker, it is automatically deactivated for the previous marker.

It should be noted that a complete sweep must be performed after switching on the frequency counter to ensure that the frequency to be measured is actually reached. The synchronization to the sweep end required for this is only possible in single sweep mode.

Parameter

ON | OFF

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK ON
```

Switches on marker 1.

```
CALC:MARK:COUN ON
```

Switches on the frequency counter for marker 1.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:COUN:FREQ?
```

Outputs the measured value.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:COUNT:RESolution

This command specifies the resolution of the frequency counter. The setting is independent of the selected marker, i.e. the numeric suffix in `MARKer<1...4>` is irrelevant.

Parameter

0.1 | 1 | 10 | 100 | 1000 | 10000 Hz

Example

```
CALC:MARK:COUN:RES 1kHz
```

Sets the resolution of the frequency counter to 1 kHz.

Characteristics

*RST value: 1kHz

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:COUNT:FREQuency?

This command queries the result of the frequency counter for the indicated marker. Before the command, the frequency counter should be switched on and a complete measurement

performed to obtain a correct count result. Therefore, a single sweep with synchronization must be performed between switching on the frequency counter and querying the count result.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK2 ON
```

Switches marker 2.

```
CALC:MARK2:COUN ON
```

Switches the frequency counter for marker 2.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK2:COUN:FREQ?
```

Outputs the measured value of marker 2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:LOEXclude

This command switches the local oscillator suppression for peak search on or off. This setting applies to all markers and delta markers.

The numeric suffixes 1|2 and 1 to 4 are irrelevant.

Parameter

ON | OFF

Example

```
CALC:MARK:LOEX ON
```

Characteristics

*RST value: ON

SCPI: device-specific

Mode

A–F, ADEMOD

CALCulate<1|2>:MARKer<1...4>:Y?

This command queries the measured value of the selected marker. The corresponding marker is activated before or switched to marker mode, if necessary.

To obtain a correct query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the marker and the query of the Y value. This is only possible in single sweep mode.

The query result is output in the unit determined with CALCulate:UNIT.

In the default setting, the output is made depending on the unit determined with CALC:UNIT; only with linear level scaling is the output in %.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK2 ON
```

Switches marker 2.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK2:Y?
```

Outputs the measured value of marker 2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD, BT

CALCulate<1|2>:MARKer<1...4>:Y:PERCent

This command positions the selected marker to the given probability. If marker 2, 3 or 4 is selected and used as a delta marker, it is switched to marker mode.

Note: *The command is only available with the CCDF measurement switched on. The associated level value can be determined with the CALC:MARK:X? command.*

Parameter

0 to 100%

Example

```
CALC1:MARK:Y:PERC 95PCT
```

Positions marker 1 to a probability of 95%.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK]

This command positions the marker to the current maximum value of the corresponding trace. The corresponding marker is activated first or switched to the marker mode.

This command is an event and therefore has no *RST value and no query.

Note: *If no maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

```
CALC:MARK2:MAX
```

Positions marker 2 to the maximum value of the trace.

Characteristics

*RST value: –

SCPI: device-specific

ModeA, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT

This command positions the marker to the next smaller maximum value of the corresponding trace.

This command is an event and therefore has no *RST value and no query.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example

CALC:MARK2:MAX:NEXT

Positions marker 2 to the next lower maximum value.

Characteristics

*RST value: -

SCPI: device-specific

ModeA, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHT

This command positions the marker to the next smaller maximum value to the right of the current value (i.e. in ascending X values) on the corresponding trace.

This command is an event and therefore has no *RST value and no query.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example

CALC:MARK2:MAX:RIGH

Positions marker 2 to the next lower maximum value to the right of the current value.

Characteristics

*RST value: -

SCPI: device-specific

ModeA, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT

This command positions the marker to the next smaller maximum value to the left of the current value (i.e. in descending X values) on the trace.

This command is an event and therefore has no *RST value and no query.

Note: *If no next smaller maximum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: -200) is produced.*

Example

CALC:MARK2:MAX:LEFT

Positions marker 2 to the next lower maximum value to the left of the current value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK]

This command positions the marker to the current minimum value of the corresponding trace. The corresponding marker is activated first or switched to marker mode, if necessary.

This command is an event and therefore has no *RST value and no query.

Note: *If no minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MIN

Positions marker 2 to the minimum value of the trace.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT

This command positions the marker to the next higher minimum value of the corresponding trace.

This command is an event and therefore has no *RST value and no query.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

CALC:MARK2:MIN:NEXT

Positions marker 2 to the next higher maximum value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHT

This command positions the marker to the next higher minimum value to the right of the current value (i.e. in ascending X direction) on the corresponding trace.

This command is an event and therefore has no *RST value and no query.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

```
CALC:MARK2:MIN:RIGH
```

Positions marker 2 to the next higher minimum value to the right of the current value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:MINimum:LEFT

This command positions the marker to the next higher minimum value to the left of the current value (i.e. in descending X direction) on the corresponding trace.

This command is an event and therefore has no *RST value and no query.

Note: *If no next higher minimum value is found on the trace (level spacing to adjacent values < peak excursion), an execution error (error code: –200) is produced.*

Example

```
CALC:MARK2:MIN:LEFT
```

Positions marker 2 to the next higher minimum value to the left of the current value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:MARKer<1...4>:PEXCursion

This command defines the peak excursion, i.e. the spacing below a trace maximum which must be attained before a new maximum is recognized, or the spacing above a trace minimum which must be attained before a new minimum is recognized. The set value applies to all markers and delta markers. The unit depends on the selected operating mode.

The numeric suffix in MARKer<1...4> is irrelevant.

Parameter

<numeric_value>

Example

```
CALC:MARK:PEXC 10dB
```

Defines peak excursion 10 dB in spectrum **Spectrum Analyzer** mode.

Characteristics

*RST value: 6dB in **Spectrum Analyzer** mode

SCPI: device-specific

Mode

A, ADEMOD, BT

CALCulate:MARKer:FUNCTion Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the instrument.

The following subsystems are included:

- "CALCulate:MARKer:FUNCTion:HARMonics Subsystem" on page 6.61
- "CALCulate:MARKer:FUNCTion:POWer Subsystem" on page 6.61
- "CALCulate:MARKer:FUNCTion:STRack Subsystem" on page 6.69
- "CALCulate:MARKer:FUNCTion:SUMMary Subsystem" on page 6.71

Commands of the CALCulate:MARKer:FUNCTion Subsystem

- CALCulate<1|2>:MARKer<1 to 4>:FUNCTion:DEModulation:SELEct
- CALCulate<1|2>:MARKer<1 to 4>:FUNCTion:DEModulation[:STATe]
- CALCulate<1|2>:MARKer<1 to 4>:FUNCTion:DEModulation:HOLDoff
- CALCulate<1|2>:MARKer<1 to 4>:FUNCTion:DEModulation:CONTInuous
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks[:IMMEDIATE]
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks:COUNT?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks:X?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks:Y?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks:SORT
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NDBDown
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NDBDown:STATe
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NDBDown:RESult?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NDBDown:FREQUency?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NDBDown:TIME?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:ZOOM
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NOISe[:STATe]
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:NOISe:RESult?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:MDEPth[:STATe]
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:MDEPth:RESult?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:MDEPth:SEARChsignal
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:TOI[:STATe]
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:TOI:RESult?
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:TOI:SEARChsignal
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:CENTEr
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:CSTep
- CALCulate<1|2>:MARKer<1...4>:FUNCTion:REFerence

CALCulate<1|2>:MARKer<1 to 4>:FUNction:DEModulation:SElect

This command selects the demodulation type for the audio demodulator. The command is independent of the selected marker, the suffixes 1|2 and 1 to 4 are irrelevant.

Parameter

AM | FM

Example

```
CALC:MARK:FUNC:DEM:SEL FM
```

Characteristics

*RST value: AM

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1 to 4>:FUNction:DEModulation[:STATe]

This command switches on or off the audio demodulator when the indicated marker is reached. With span > 0 the hold time can be defined at the corresponding marker position with `CALCulate:MARKer:FUNction:DEModulation:HOLD`. In zero span the demodulation is permanently active.

Parameter

ON | OFF

Example

```
CALC:MARK3:FUNC:DEM ON
```

Switches on the demodulation for marker 3.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1 to 4>:FUNction:DEModulation:HOLDoff

This command defines the hold time at the marker position for the demodulation with span > 0. The setting is independent of the selected marker, the suffixes <1|2> and <1 to 4> are irrelevant.

Parameter

10ms to 1000s

Example:

```
CALC:MARK:FUNC:DEM:HOLD 3s
```

Characteristics:

*RST value: – (DEModulation is set to OFF)

SCPI: device-specific

Mode:

A

CALCulate<1|2>:MARKer<1 to 4>:FUNCTION:DEModulation:CONTInuous

This command switches on or off the continuous demodulation for span >0. Thus acoustic monitoring of the signals can be performed. The function does not depend on the selected marker, i.e. the numeric suffix <1 to 4> is irrelevant.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
CALC2:MARK3:FUNC:DEM:CONT ON
Switches on the continuous ' demodulation.
```

Characteristics

RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:FPEaks[:IMMEDIATE]

This command searches the selected trace for the indicated number of maxima. The results are entered in a list and can be queried with commands `CALC:MARK:FUNC:FPEaks:X?` and `CALC:MARK:FUNC:FPEaks:Y?`. The number of maxima found can be queried with `CALC:MARK:FUNC:FPEaks:COUNt?`. The trace to be examined is selected with `CALC:MARK:TRACe`. The order of the results in the list can be defined with `CALC:MARK:FUNC:FPEaks:SORT`.

Note: *The number of maxima found depends on the waveform and value set for the Peak Excursion parameter (CALC:MARK:PEXC), however, a maximum number of 50 maxima are determined. Only the signals which exceed their surrounding values at least by the value indicated by the peak excursion parameter will be recognized as maxima. Therefore, the number of maxima found is not automatically the same as the number of maxima desired.*

Parameter

<numeric_value>

Example

```
INIT:CONT OFF
Switches to single sweep mode
INIT;*WAI
Starts measurement and synchronizes to end
CALC:MARK:TRAC 1
Sets marker 1 to trace 1
CALC:MARK:FUNC:FPE:SORT X
Sets the sort mode to increasing X values
CALC:MARK:FUNC:FPE 3
Searches the 3 highest maxima for trace 1
CALC:MARK:FUNC:COUN?
Queries the number of maxima found
CALC:MARK:FUNC:Y?
Queries the level of maxima found
```

CALC:MARK:FUNC:X?

Queries the frequencies (span <> 0) or time (span = 0) of maxima found.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:FPEaks:COUNT?

This query reads out the number of maxima found during the search. If no search for maxima has been performed, 0 is returned.

Example

CALC:MARK:FUNC:FPE 3

Searches the 3 highest maxima for trace 1

CALC:MARK:FUNC:FPE:COUNT?

Queries the number of maxima found

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:FPEaks:X?

This query reads out the list of X values of the maxima found. The number of available values can be queried with CALC:MARK:FUNC:FPEaks:COUNT?.

With sort mode X, the X values are in increasing order; with sort mode Y the order corresponds to the decreasing order of the Y values.

Example

CALC:MARK:FUNC:FPE:SORT Y

Sets the sort mode to decreasing y values

CALC:MARK:FUNC:FPE 3

Searches the 3 highest maxima for trace 1

CALC:MARK:FUNC:FPE:COUNT?

Queries the number of maxima found

CALC:MARK:FPE:FUNC:X?

Queries the frequencies (span <> 0) or. time (span = 0) of the maxima found

Return values

107.5E6, 153.8E6, 187.9E6

frequencies in increasing order

2.05E-3, 2.37E-3, 3.71e-3

times in increasing order

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks:Y?

This query reads out the list of X values of the maxima found. The number of available values can be queried with `CALC:MARK:FUNC:FPEaks:COUNT?`.

With sort mode X, the X values are in increasing order; with sort mode Y the order corresponds to the decreasing order of the Y values.

Example

```
CALC:MARK:FUNC:FPE:SORT Y
```

Sets the sort mode to decreasing y values

```
CALC:MARK:FUNC:FPE 3
```

Searches the 3 highest maxima for trace 1

```
CALC:MARK:FUNC:FPE:COUNT?
```

Queries the number of maxima found

```
CALC:MARK:FUNC:FPE:Y?
```

Queries the levels of the maxima found

Return value

```
-37.5, -58.3, -59.6
```

level in decreasing order

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTion:FPEaks:SORT

This command sets the sort mode for the search for maxima:

X: the maxima are sorted in the list of responses according to increasing X values

Y: the maxima are sorted in the list of responses according to decreasing Y values

Parameter

X | Y

Example

```
CALC:MARK:FUNC:FPE:SORT Y
```

Sets the sort mode to decreasing y values

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:NDBDown

This command defines the level spacing of the two delta markers to the right and left of marker 1. Marker 1 is always used as the reference marker. The numeric suffix <1...4> is irrelevant for this command.

The temporary markers T1 and T2 are positioned by n dB below the active reference marker. The frequency spacing of these markers can be queried with

CALCulate:MARKer:FUNCTION: NDBDown:RESult?.

Parameter

<numeric_value>

Example

CALC:MARK:FUNC:NDBD 3dB

Sets the level spacing to 3 dB.

Characteristics

*RST value: 6dB

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:NDBDown:STATe

This command switches the "N dB Down" function on or off. Marker 1 is activated first, if necessary. The numeric suffix <1...4> is irrelevant for this command.

Parameter

ON | OFF

Example

CALC:MARK:FUNC:NDBD:STAT ON

Switches on the "N dB Down" function.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:NDBDown:RESult?

This command queries the frequency spacing (bandwidth) of the n dB down markers. The numeric suffix <1...4> is irrelevant for this command.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value in order to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF

Switches to single sweep mode.

CALC:MARK:FUNC:NDBD ON

Switches on the n dB down function.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:NDBD:RES?
```

Outputs the measured value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:FREQuency?

This command queries the two frequencies of the n dB down marker. The numeric suffix <1...4> is irrelevant for this command. The two frequency values are separated by comma and output in ascending order.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:NDBD ON
```

Switches on the n dB down function.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:NDBD:FREQ?
```

Outputs the frequencies of the temporary markers.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:TIME?

This command queries the two frequencies of the n dB down marker. The numeric suffix <1...4> is irrelevant for this command. The two frequency values are separated by comma and output in ascending order.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode

```
CALC:MARK:FUNC:NDBD ON
```

Switches on the n dB down function.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:NDBD:TIME?
```

Outputs the time values of the temporary markers.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer<1...4>:FUNCTION:ZOOM

This command defines the range to be zoomed around marker 1. Marker 1 is activated first, if necessary.

The subsequent frequency sweep is stopped at the marker position and the frequency of the signal is counted. This frequency becomes the new center frequency, and the zoomed span is set. In order to recognize the end of the operation the synchronization to the sweep end should be activated. This is only possible in single sweep mode.

This command is an event and therefore has no *RST value and no query.

Parameter

<numeric_value>

Example

```
INIT:CONT OFF
```

Switches to single sweep mode

```
CALC:MARK:FUNC:ZOOM 1kHz;*WAI
```

Activates zooming and waits for its end.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer<1...4>:FUNCTION:NOISe[:STATe]

This command switches the noise measurement on or off for all markers. The noise power density is measured at the position of the markers. The result can be queried with

```
CALCulate:MARKer:FUNCTION:NOISe:RESult?.
```

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:NOIS ON
```

Switches on the noise measurement.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:NOISe:RESult?

This command queries the result of the noise measurement.

A complete sweep with synchronization to the sweep end must be performed between switching on the function and querying the measured value in order to obtain a correct query result. This is only possible in single sweep mode.

This command is an event and therefore has no *RST value and no query.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK2 ON
```

Switches on marker 2.

```
CALC:MARK:FUNC:NOIS ON
```

Switches on noise measurement.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK2:NOIS:RES?
```

Outputs the noise result of marker 2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCTION:MDEPth:[:STATe]

This command switches on the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for correct operation. If necessary, marker 1 is previously activated and set to the largest signal available.

The level value of marker 1 is regarded as the carrier level. On activating the function, marker 2 and marker 3 are automatically set as delta markers symmetrically to the carrier to the adjacent maxima of the trace.

If the position of delta marker 2 is changed, delta marker 3 is moved symmetrically with respect to the reference marker (marker 1). If the position of delta marker 3 is changed, fine adjustment can be performed independently of delta marker 2.

The power at the marker positions is calculated from the measured levels.

The AM modulation depth is calculated from the ratio of power values at the reference marker and the delta markers. If the two AM sidebands differ in power, the average value of the two power values is used for calculating the AM modulation depth.

The numeric suffix <1...4> of MARKer is irrelevant with this command.

Example

```
CALC:MARK:X 10MHZ
```

Sets the reference marker (marker 1) to the carrier signal at 10 MHz.

```
CALC:MARK:FUNC:MDEP ON
```

Switches on the modulation depth measurement.

CALC:DELT2:X 10KHZ

Sets delta markers 2 and 3 to the signals at 10 kHz from the carrier signal.

CALC:DELT3:X 9.999KHZ

Corrects the position of delta marker 3 relative to delta marker 2.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:RESult?

This command queries the AM modulation depth.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffix <1...4> of MARKer is irrelevant for this command.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF

Switches to single sweep mode.

CALC:MARK:X 10MHZ

Sets the reference marker (marker 1) to the carrier signal at 10 MHz.

CALC:MARK:FUNC:MDEP ON

Switches on the modulation depth measurement.

INIT;*WAI

Starts a sweep and waits for the end.

CALC:MARK:FUNC:MDEP:RES?

Outputs the measured value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:MDEPth:SEARChsignal

This command starts the search of the signals required for the modulation depth measurement.

Note: *No new measurement is done. Only the currently available trace selected for the modulation depth measurement is used*

Parameter

ONCE

Example

CALC:MARK:FUNC:MDEP:SEAR ONCE

Executes the search of an AM modulated signal at the currently available trace.

Characteristics

*RST value: –

SCPI: conforming

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI[:STATe]

This command initiates the measurement of the third-order intercept point.

A two-tone signal with equal carrier levels is expected at the RF input of the instrument. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Delta marker 3 and delta marker 4 are positioned to the intermodulation products. The delta markers can be modified separately afterwards with the commands `CALCulate:DELTamarker3:X` and `CALCulate:DELTamarker4:X`.

The third-order intercept is calculated from the level spacing between the normal markers and the delta markers.

The numeric suffix <1...4> of MARKer is irrelevant for this command.

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:TOI ON
```

Switches on the measurement of the third-order intercept.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:RESult?

This command queries the third-order intercept point measurement.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

The numeric suffix <1...4> of MARKer is irrelevant of this command.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:TOI ON
```

Switches the intercept measurement.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:TOI:RES?
```

Outputs the measured value.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:TOI:SEARChsignal

This command starts the search of the signals required for the third order intercept measurement.

Note: *No new measurement is done. Only the currently available trace selected for the TOI measurement is used*

Parameter

ONCE

Example

```
CALC:MARK:FUNC:TOI:SEAR ONCE
```

Executes the search for 2 signals and their intermodulation product at the currently available trace.

Characteristics

*RST value: –

SCPI: conforming

Mode

A

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CENTer

This command sets the center frequency equal to the frequency of the indicated marker.

If marker 2, 3 or 4 is selected and used as delta marker, the marker is switched to the marker mode.

This command is an "event" and therefore has no *RST value and no query.

Example

```
CALC:MARK2:FUNC:CENT
```

Sets the center frequency to the frequency of marker 2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CSTep

This command sets the step size of the center frequency to the X value of the current marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to the marker mode.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:MARK3:FUNC:CST
```

Sets the center frequency to the same value as the frequency of marker 3.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence

This command sets the reference level to the power measured by the indicated marker. If marker 2, 3 or 4 is selected and used as delta marker, it is switched to marker mode.

This command is an event and therefore has no *RST value and no query.

Example

CALC:MARK2:FUNC:REF

Sets the reference level to the level of marker 2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate:MARKer:FUNCtion:HARMonics Subsystem

The CALCulate:MARKer:FUNCtion:POWER subsystem contains the commands to define the settings for harmonics measurement. This subsystem is available from firmware version 1.10.

Commands of the CALCulate:MARKer:FUNCtion:HARMonics Subsystem

- CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics[:STATe]
- CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:BANDwidth:AUTO
- CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:NHARMonics
- CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:PRESet
- CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:DISToRTion?
- CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:LIST?

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics[:STATe]

This command activates/deactivates the harmonic distortion measurement. The numeric suffixes <1/2> and <1...4> are not relevant.

If the measurement is started in span > 0, the last span defines the search range for the first harmonic. The level is determined for the first harmonic.

If the measurement is started in zero span, center frequency and level are used unchanged.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

CALC:MARK:FUNC:HARM ON

Activates the harmonic distortion measurement.

Characteristics

RST value: OFF

SCPI: device-specific

Mode

A-F, A-T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:BANDwidth:AUTO

This command defines the resolution bandwidth of the harmonic in respect to the bandwidth of the first harmonic. For details refer to chapter "Instrument Functions", section "Harmonic RBW Auto".

This command is available from firmware version 1.10.

Parameter

OFF identical
ON a multiple

Example

```
CALC:MARK:FUNC:HARM:BAND:AUTO OFF
```

Deactivates the automatic bandwidth enlargement.

Characteristics

RST value: ON

SCPI: device-specific

Mode

A-F, A-T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:NHARmonics

This command sets the number of harmonics to be measured. The numeric suffixes <1/2> and <1...4> are not relevant.

This command is available from firmware version 1.10.

Parameter

1...26

Example

```
CALC:MARK:FUNC:HARM:NHARM 3
```

Sets the number of harmonics to be measured to 3.

Characteristics

RST value: 10

SCPI: device-specific

Mode

A-F, A-T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:PRESet

This command optimizes the device settings depending on the span setting:

span > 0: Frequency and level of the first harmonic are determined and used for the measurement list.

zero span The level of the first harmonic is determined. The frequency remains unchanged.

The numeric suffixes <1/2> and <1...4> are not relevant. This command is an event and therefore has no *RST value.

This command is available from firmware version 1.10.

Example

```
CALC:MARK:FUNC:HARM:PRES
```

Optimizes the device settings for the harmonic measurement.

Characteristics

RST value: –

SCPI: device-specific

Mode

A-F, A-T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:DISToRtion?

This command queries the distortion results (THD: total harmonic distortion). Two values separated by a comma are returned: <THD in %>, <THD in dB>. The numeric suffixes <1/2> and <1...4> are not relevant.

To obtain a correct result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single sweep mode.

This command is available from firmware version 1.10.

Parameter

TOTAL

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:HARM:NHARM 3
```

Sets the number of harmonics to be measured to 3.

```
CALC:MARK:FUNC:HARM ON
```

Activates the harmonic distortion measurement.

```
INIT;*WAI
```

Starts a sweep and waits for the end of the sweep.

```
CALC:MARK:FUNC:HARM:DIS? TOT
```

Returns the total distortion in % and dB.

Characteristics

RST value: –

SCPI: device-specific

Mode

A-F, A-T

CALCulate<1|2>:MARKer<1...4>:FUNCtion:HARMonics:LIST?

This command reads out the list of the harmonics. The first value is the absolute power of the first harmonic (the unit is set via the CALCulate<1|2>:UNIT:POWER command). The following values are relative to the carrier signal and have the unit dB. They are separated by commas and correspond to the harmonics to be measured (set via the CALC:MARK:FUNC:HARM:NHARM command).

The numeric suffixes <1/2> and <1...4> are not relevant.

To obtain a correct result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single sweep mode.

This command is available from firmware version 1.10.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:HARM:NHARM 3
```

Sets the number of harmonics to be measured to 3.

```
CALC:MARK:FUNC:HARM ON
```

Activates the harmonic distortion measurement.

```
INIT;*WAI
```

Starts a sweep and waits for the end of the sweep.

```
CALC:MARK:FUNC:HARM:LIST?
```

Returns the values for the 3 measured harmonics.

Characteristics

RST value: –

SCPI: device-specific

Mode

A–F, A–T

CALCulate:MARKer:FUNCTION:POWER Subsystem

The CALCulate:MARKer:FUNCTION:POWER subsystem contains the commands for control of power measurement.

Commands of the CALCulate:MARKer:FUNCTION:POWER Subsystem

- [CALCulate<1|2>:MARKer:FUNCTION:POWER:SElect](#)
- [CALCulate<1|2>:MARKer:FUNCTION:POWER:RESult?](#)
- [CALCulate<1|2>:MARKer:FUNCTION:POWER:PRESet](#)
- [CALCulate<1|2>:MARKer:FUNCTION:POWER\[:STATE\]](#)

Further information

- [CDMA standard abbreviations](#)

CDMA standard abbreviations

| Parameter | Standard |
|----------------|----------------------------|
| FIS95A, F8CDma | CDMA IS95A forward |
| RIS95A, R8CDma | CDMA IS95A reverse |
| FJ008, F19CDma | CDMA J–STD008 forward |
| RJ008, R19CDma | CDMA J–STD008 reverse |
| FIS95C0 | CDMA IS95C Class 0 forward |
| RIS95C0 | CDMA IS95C Class 0 reverse |
| FIS95C1 | CDMA IS95C Class 1 forward |

| Parameter | Standard |
|----------------|---|
| RIS95C1 | CDMA IS95C Class 1 reverse |
| FWCDma | W-CDMA 4.096 MHz forward |
| RWCDma | W-CDMA 4.096 MHz reverse |
| FW3Gppcdma | W-CDMA 3.84 MHz forward |
| RW3Gppcdma | W-CDMA 3.84 MHz reverse |
| D2CDma | CDMA 2000 direct sequence |
| S2CDma | CDMA 2000 MC1 multi carrier with 1 carrier |
| M2CDma | CDMA 2000 MC3 multi carrier with 3 carriers |
| FTCDMa / TCDMa | TD-SCDMA forward |
| RTCDMA | TD-SCDMA reverse |

CALCulate<1|2>:MARKer:FUNCtion:POWER:SELect

This command selects – and switches on – specified power measurement type.

The channel spacings and channel bandwidths are configured in the `SENSe:POWer:ACHannel` subsystem.

Note: *If CPower is selected, the number of adjacent channels ([SENSe:]POWer:ACHannel:ACPairs) is set to 0. If ACPower is selected, the number of adjacent channels is set to 1, unless adjacent-channel power measurement is switched on already. The channel/adjacent-channel power measurement is performed for the trace selected with SENSe:POWer:TRACe 1|2|3|4.*

The occupied bandwidth measurement is performed for the trace on which marker 1 is positioned. To select another trace for the measurement, marker 1 is to be positioned on the desired trace by means of `CALC:MARK:TRAC 1|2|3|4`.

Parameter

| | |
|----------------------|--|
| ACPower | Adjacent-channel power measurement with a single carrier signal |
| CPower | Channel power measurement with a single carrier signal (equivalent to adjacent-channel power measurement with <code>NO. OF ADJ CHAN = 0</code>) |
| MCACpower | Channel/adjacent-channel power measurement with several carrier signals |
| OBANdwidth OBWidth | Measurement of occupied bandwidth |
| CN | Measurement of carrier-to-noise ratio |
| CN0 | Measurement of carrier-to-noise ratio referenced to 1 Hz bandwidth |

Example

```
CALC:MARK:FUNC:POW:SEL ACP
Switches on adjacent-channel power measurement.
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCTION:POWER:RESult?

This command queries the result of the performed power measurement. If necessary, the measurement is switched on prior to the query.

The channel spacings and channel bandwidths are configured in the `SENSe:POWer:ACHannel` subsystem.

To obtain a correct result, a complete sweep with synchronization to the end of the sweep must be performed before a query is output. Synchronization is possible only in the single sweep mode.

This command is a query and therefore has no *RST value.

Parameter**ACPower**

Adjacent–channel power measurement

Results are output in the following sequence, separated by commas:

Power of transmission channel
 Power of lower adjacent channel
 Power of upper adjacent channel
 Power of lower alternate channel 1
 Power of upper alternate channel 1
 Power of lower alternate channel 2
 Power of upper alternate channel 2

The number of measured values returned depends on the number of adjacent/alternate channels selected with

`SENSe:POWer:ACHannel:ACPairs`.

With logarithmic scaling (RANGE LOG), the power is output in the currently selected level unit; with linear scaling (RANGE LIN dB or LIN %), the power is output in W. If `SENSe:POWer:ACHannel:MODE REL` is selected, the adjacent/alternate–channel power is output in dB.

CPOWer

Channel power measurement

With logarithmic scaling (RANGE LOG), the channel power is output in the currently selected level unit; with linear scaling (RANGE LIN dB or LIN %), the channel power is output in W.

MCACpower

Channel/adjacent–channel power measurement with several carrier signals

Results are output in the following sequence, separated by commas:

Power of carrier signal 1 to 12 in ascending order
 Total power of all carrier signals
 Power of lower adjacent channel
 Power of upper adjacent channel
 Power of lower alternate channel 1
 Power of upper alternate channel 1
 Power of lower alternate channel 2
 Power of upper alternate channel 2

The number of measured values returned depends on the number of carrier signals and adjacent/alternate channels selected with

`SENSe:POWer:ACHannel:TXChannel:COUNT` and

`SENSe:POWer:ACHannel:ACPairs`.

If only one carrier signal is measured, the total value of all carrier signals will not be output.

With logarithmic scaling (RANGE LOG), the power is output in dBm; with linear scaling (RANGE LIN dB or LIN %), the power is output in W.

If `SENSe:POWer:ACHannel:MODE REL` is selected, the adjacent/alternate-channel power is output in dB.

| | |
|-------------------------|---|
| OBANdwidth OBWidth | Measurement of occupied bandwidth The occupied bandwidth in Hz is returned. |
| CN | Measurement of carrier-to-noise ratio The carrier-to-noise ratio in dB is returned. |
| CN0 | Measurement of carrier-to-noise ratio referenced to 1 Hz bandwidth. The carrier-to-noise ratio in dB/Hz is returned. |

Example of channel/adjacent-channel power measurement

```
SENS:POW:ACH:ACP 3
```

Sets the number of adjacent/alternate channels to 3.

```
SENS:POW:ACH:BAND 30KHZ
```

Sets the bandwidth of the transmission channel to 30 kHz.

```
SENS:POW:ACH:BAND:ACH 40KHZ
```

Sets the bandwidth of each adjacent channel to 40 kHz.

```
SENS:POW:ACH:BAND:ALT1 50KHZ
```

Sets the bandwidth of each alternate channel to 50 kHz.

```
SENS:POW:ACH:BAND:ALT2 60KHZ
```

Sets the bandwidth of alternate channel 2 to 60 kHz.

```
SENS:POW:ACH:SPAC 30KHZ
```

Sets the spacing between the transmission channel and the adjacent channel to 30 kHz, the spacing between the transmission channel and alternate channel 1 to 60 kHz, and the spacing between the transmission channel and alternate channel 2 to 90 kHz.

```
SENS:POW:ACH:SPAC:ALT1 100KHZ
```

Sets the spacing between the transmission channel and alternate channel 1 to 100 kHz, and the spacing between the transmission channel and alternate channel 2 to 150 kHz.

```
SENS:POW:ACH:SPAC:ALT2 140KHZ
```

Sets the spacing between the transmission channel and alternate channel 2 to 140 kHz.

```
SENS:POW:ACH:MODE ABS
```

Switches on absolute power measurement.

```
CALC:MARK:FUNC:POW:SEL ACP
```

Switches on the adjacent-channel power measurement.

```
INIT:CONT OFF
```

Switches over to single sweep mode.

```
INIT;*WAI
```

Starts a sweep and waits for the end of the sweep.

```
CALC:MARK:FUNC:POW:RES? ACP
```

Queries the result of adjacent-channel power measurement.

```
SENS:POW:ACH:REF:AUTO ONCE
```

Defines the measured channel power as the reference value for relative power measurements.

Note: *If the channel power only is to be measured, all commands relating to adjacent/alternate channel bandwidth and channel spacings are omitted. The number of adjacent/alternate channels is set to 0 with `SENS2:POW:ACH:ACP 0`.*

Example of occupied bandwidth measurement

```
SENS:POW:BAND 90PCT
```

Defines 90% as the percentage of the power to be contained in the bandwidth range to be measured.

```
INIT:CONT OFF
```

Switches over to single sweep mode.

```
INIT;*WAI
```

Starts a sweep and waits for the end of the sweep.

```
CALC:MARK:FUNC:POW:RES? OBW
```

Queries the occupied bandwidth measured.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:POWer:PRESet

This command selects the power measurement setting for a standard and previously switches on the corresponding measurement, if required.

The configuration for a standard comprises of the parameters weighting filter, channel bandwidth and spacing, resolution and video bandwidth, as well as detector and sweep time.

Note: *The settings for standards IS95A and C differ as far as the calculation method of channel spacings is concerned. For IS95A and J-STD008 the spacing is calculated from the center of the main channel to the center of the corresponding adjacent channel, for IS95C from the center of the main channel to the nearest border of the adjacent channel.*

Parameter

NADC | TETRA | PDC | PHS | CDPD | FWCDma | RWCDma | F8CDma | R8CDma | F19Cdma | R19Cdma | FW3Gppcdma | RW3Gppcdma | D2CDma | S2CDma | M2CDma | FIS95A | RIS95A | FIS95C0 | RIS95C0 | FJ008 | RJ008 | FIS95C1 | RIS95C1 | FTCDMa | RTCDMa | TCDMa | AWLan | BWLan | NONE

For further details refer to "[CDMA standard abbreviations](#)" on page 6.64.

Example

```
CALC:MARK:FUNC:POW:PRES NADC
```

Selects the standard setting for NADC

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCtion:POWer[:STATe]

This command switches off the power measurement.

This command is an event and therefore has no *RST value.

Parameter

OFF

Example

```
CALC:MARK:FUNC:POW OFF
```

Switches off the power measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

CALCulate:MARKer:FUNCtion:STRack Subsystem

The CALCulate:MARKer:FUNCtion:STRack subsystem defines the settings of the signal track.

Commands of the CALCulate:MARKer:FUNCtion:STRack Subsystem

- CALCulate<1|2>:MARKer:FUNCtion:STRack[:STATe]
- CALCulate<1|2>:MARKer:FUNCtion:STRack:BANDwidth or
CALCulate<1|2>:MARKer:FUNCtion:STRack:BWIDth
- CALCulate<1|2>:MARKer:FUNCtion:STRack:THReshold
- CALCulate<1|2>:MARKer:FUNCtion:STRack:TRACe

CALCulate<1|2>:MARKer:FUNCtion:STRack[:STATe]

This command switches the signal-track function on or off.

With signal track activated, the maximum signal is determined after each frequency sweep and the center frequency is set to the frequency of this signal. Thus with drifting signals the center frequency follows the signal.

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:STR ON
```

Switches on the signal track function.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A–F

**CALCulate<1|2>:MARKer:FUNCtion:STRack:BANDwidth or
CALCulate<1|2>:MARKer:FUNCtion:STRack:BWIDth**

These commands have the same function. They define the bandwidth around the center frequency within which the largest signal is searched.

Note: *The entry of the search bandwidth is only possible if the Signal Track function is switched on (CALC:MARK:FUNC:STR ON).*

Parameter

10Hz to MAX (span)

Example

```
CALC:MARK:FUNC:STR:BAND 1MHZ
```

Sets the search bandwidth to 1 MHz.

```
CALC:MARK:FUNC:STR:BWID 1MHZ
```

Alternative command for the same function.

Characteristics

*RST value: – (= span/10 on activating the function)

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCTION:STRack:THReshold

This command defines the threshold above which the largest signal is searched for.

The response unit depends on the settings defined with `CALC:UNIT`.

Note: *The entry of the search bandwidth is only possible if the Signal Track function is switched on (CALC:MARK:FUNC:STR ON).*

Parameter

–330dBm to +30dBm

Example

```
CALC:MARK:FUNC:STR:THR -50DBM
```

Sets the threshold for signal tracking to –50 dBm.

Characteristics

*RST value: –120 dBm

SCPI: device-specific

Mode

A–F

CALCulate<1|2>:MARKer:FUNCTION:STRack:TRACe

This command defines the trace on which the largest signal is searched for.

Parameter

1 to 4

Example

```
CALC:MARK:FUNC:STR:TRAC 3
```

Defines trace 3 as the trace for signal tracking.

Characteristics

*RST value: 1

SCPI: device-specific

Mode

A–F

CALCulate:MARKer:FUNCTION:SUMMARY Subsystem

This subsystem contains the commands for controlling the power functions in zero span.

Commands of the CALCulate:MARKer:FUNCTION:SUMMARY Subsystem

- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY[:STATe]
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:PPEak[:STATe]
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:PPEak:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:PPEak:AVERAge:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:PPEak:PHOLd:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:RMS[:STATe]
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:RMS:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:RMS:AVERAge:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:RMS:PHOLd:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:MEAN[:STATe]
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:MEAN:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:MEAN:AVERAge:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:MEAN:PHOLd:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:SDEVIation[:STATe]
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:SDEVIation:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:SDEVIation:AVERAge:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:SDEVIation:PHOLd:RESult?
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:PHOLd
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:AVERAge
- CALCulate<1|2>:MARKer<1 to 4>:FUNCTION:SUMMARY:MODE
- CALCulate<1|2>:MARKer<1 to 4>:FUNCTION:SUMMARY:REFerence:AUTO
- CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:AOFF
- CALCulate<1|2>:MARKer:FUNCTION:MSUMmary?

CALCulate<1|2>:MARKer:FUNCTION:SUMMARY[:STATe]

This command switches on or off the previously selected power measurements in zero span. Thus one or several measurements can be first selected and then switched on and off together with `CALC:MARK:FUNC:SUMM:STATe`.

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:SUMM:STAT ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak[:STATe]

This command switches on or off the measurement of the positive peak value.

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:SUMM:PPE ON
Switches on the function.
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:RESult?

This command is used to query the result of the measurement of the positive peak value. The measurement may have to be switched on previously.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
Switches to single sweep mode.
CALC:MARK:FUNC:SUMM:PPE ON
Switches on the function.
INIT;*WAI
Starts a sweep and waits for the end.
CALC:MARK:FUNC:SUMM:PPE:RES?
Outputs the result.
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:AVERage:RESult?

This command is used to query the result of the measurement of the averaged positive peak value. The query is only possible if averaging has been activated previously using

```
CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage.
```

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:PPE ON
```

Switches on the function.

```
CALC:MARK:FUNC:SUMM:AVER ON
```

Switches on the calculation of average.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:PPE:AVER:RES?
```

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PPEak:PHOLd:RESult?

This command is used to query the result of the measurement of the positive peak value with active peak hold function. The query is only possible if the peak hold function has been activated previously using CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:PPE ON
```

Switches on the function.

```
CALC:MARK:FUNC:SUMM:PHOL ON
```

Switches on the measurement of the peak value.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:PPE:PHOL:RES?
```

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS[:STATe]

This command switches on or off the measurement of the effective (RMS) power. If necessary the function is switched on previously.

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:SUM:RMS ON  
Switches on the function.
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:RESult?

This command queries the result of the measurement of the RMS power value.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF  
Switches to single sweep mode.  
CALC:MARK:FUNC:SUMM:RMS ON  
Switches on the function.  
INIT;*WAI  
Starts a sweep and waits for the end.  
CALC:MARK:FUNC:SUMM:RMS:RES?  
Outputs the result.
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:RMS:AVERAge:RESult?

This command queries the result of the measurement of the averaged RMS value. The query is only possible if averaging has been activated previously using
`CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERAge`.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:RMS ON
```

Switches on the function.

```
CALC:MARK:FUNC:SUMM:AVER ON
```

Switches on the average value calculation.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:RMS:AVER:RES?
```

Outputs the result.

Characteristics

*RST– value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:RMS:PHOLD:RESult?

This command queries the result of the measurement of the RMS value with active peak hold. The query is only possible only if the peak hold function has been activated previously using CALCulate<1|2>:MARKer: FUNCTION:SUMMARY:PHOLD.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:RMS ON
```

Switches on the function.

```
CALC:MARK:FUNC:SUMM:PHOL ON
```

Switches on the peak value measurement.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:RMS:PHOL:RES?
```

Outputs the result.

Characteristics

*RST– value: –

SCPI: device–specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:MEAN[:STATe]

This command switches on or off the measurement of the mean value.

Note: The measurement is performed on the trace on which marker 1 is positioned. In order to evaluate another trace, marker 1 must be positioned on another trace with

```
CALC:MARK:TRAC 1|2|3|4.
```

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:SUMM:MEAN ON
```

Switches on the function.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:RESult?

This command queries the result of the measurement of the mean value.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:MEAN ON
```

Switches on the function.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:MEAN:RES?
```

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:MEAN:AVERage:RESult?

This command queries the result of the measurement of the averaged mean value. The query is only possible if averaging has been activated previously using

```
CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage.
```

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:MEAN ON
```

Switches on the function.

```
CALC:MARK:FUNC:SUMM:AVER ON
```

Switches on the average value calculation.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:MEAN:AVER:RES?
```

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:MEAN:PHOLD:RESult?

This command queries the result of the measurement of the mean value with active peak hold. The query is only possible if the peak hold function has been switched on previously using `CALCulate<1|2>:MARKer:FUNCTION:SUMMARY: PHOLD`.

The query is possible only if the peak hold function is active.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:MEAN ON
```

Switches on the function.

```
CALC:MARK:FUNC:SUMM:PHOL ON
```

Switches on the peak value measurement.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:MEAN:PHOL:RES?
```

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCTION:SUMMARY:SDEVIation[:STATE]

This command switches on or off the measurement of the standard deviation.

On switching on the measurement, the mean power measurement is switched on as well.

Parameter

ON | OFF

Example

```
CALC:MARK:FUNC:SUMM:SDEV ON
```

Switches on the measurement of the standard deviation.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:RESult?

This command queries the results of the standard deviation measurement.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:SDEV ON
```

Switches on the function.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

```
CALC:MARK:FUNC:SUMM:SDEV:RES?
```

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:AVERage:RESult?

This command queries the result of the averaged standard deviation determined in several sweeps. The query is possible only if averaging is active.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:SDEV ON
```

Switches on the function.

CALC:MARK:FUNC:SUMM:AVER ON
Switches on the calculation of average.

INIT;*WAI

Starts a sweep and waits for the end.

CALC:MARK:FUNC:SUMM:MEAN:SDEV:RES?
Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?

This command queries the maximum standard deviation value determined in several sweeps. The query is possible only if the peak hold function is active.

A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a correct query result. This is only possible in single sweep mode.

This command is only a query and therefore has no *RST value.

Example

INIT:CONT OFF

Switches to single sweep mode.

CALC:MARK:FUNC:SUMM:SDEV ON

Switches on the function.

CALC:MARK:FUNC:SUMM:PHOL ON

Switches on the peak value measurement.

INIT;*WAI

Starts a sweep and waits for the end.

CALC:MARK:FUNC:SUMM:SDEV:PHOL:RES?

Outputs the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:PHOLd

This command switches on or off the peak–hold function for the active power measurement in zero span.

The peak–hold function is reset by switching it off and on again.

Parameter

ON | OFF

Example

CALC:MARK:FUNC:SUMM:PHOL ON

Switches on the function.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer:FUNCtion:SUMMary:AVERage

This command switches on or off averaging for the active power measurement in zero span.

Averaging is reset by switching it off and on again.

The number of results required for the calculation of average is defined with

```
[SENSe<1|2>:]AVERage:COUNT.
```

Synchronization to the end of averaging is only possible in single sweep mode.

Parameter

ON | OFF

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
CALC:MARK:FUNC:SUMM:AVER ON
```

Switches on the calculation of average.

```
AVER:COUN 200
```

Sets the measurement counter to 200.

```
INIT;*WAI
```

Starts a sweep and waits for the end.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MODE

This command selects absolute or relative power measurement in zero span. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> is irrelevant.

The reference power for relative measurement is defined with `CALCulate:MARKer:FUNCtion:SUMMary:REFeRence:AUTO ONCE`. If the reference power is not defined, the value 0 dBm is used.

Parameter

ABSolute | RELative

Example

```
CALC:MARK:FUNC:SUMM:MODE REL
```

Switches the power measurement in zero span to relative.

Characteristics

RST value: ABSolute

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer<1 to 4>:FUNction:SUMMary:REFerence:AUTO

This command sets the currently measured average value (. . . :SUMMary:MEAN) and RMS value (. . . :SUMMary:RMS) as reference values for relative measurements in zero span. The function is independent of the marker selection, i.e. the numeric suffix <1 to 4> is irrelevant. If the measurement of RMS value and average is not activated, the reference value 0 dBm is used.

If the function . . . :SUMMary:AVErAge or . . . :SUMMary:PHOLd is switched on, the current value is the accumulated measurement value at the time considered.

This command is an event and therefore has no *RST value and no query.

Parameter

ONCE

Example

```
CALC:MARK:FUNC:SUMM:REF:AUTO ONCE
```

Takes the currently measured power as reference value for the relative power measurement in zero span.

Characteristics

RST value: –

SCPI: device-specific

Mode

A-T

CALCulate<1|2>:MARKer:FUNction:SUMMary:AOFF

This command switches off all measurements in zero span.

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:MARK:FUNC:SUMM:AOFF
```

Switches off the functions for power measurement in zero span.

Characteristics

*RST value: –

SCPI: device-specific

Mode

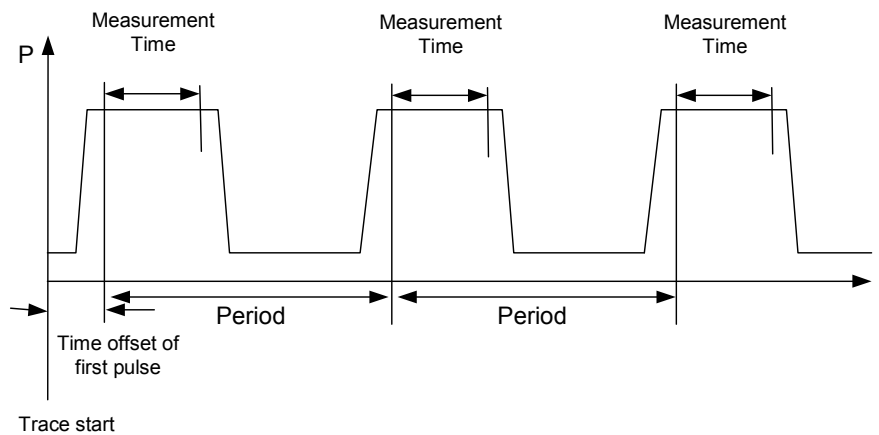
A-T

CALCulate<1|2>:MARKer:FUNction:MSUMmary?

The commands of this subsystem are used to determine the power of a sequence of signal pulses having the same interval, as are typical for the slots of a GSM signal, for example. The number of pulses to be measured as well as the measurement time and the period can be set. To define the position of the first pulse in the trace, a suitable offset can be entered.

The evaluation is performed on the measurement data of a previously recorded trace. The data recorded during the set measurement time is combined to a measured value for each pulse according to the detector specified and the indicated number of results is output as a list.

Trace 1 is always used by the function.



Parameter

<time offset of first pulse>, <measurement time>, <period>, < # of pulses to measure>

Example

```
DISP:WIND:TRAC:Y:RLEV -10dBm
```

Sets the reference level to 10 dB

```
INP:ATT 30 dB
```

Sets the input attenuation to 30 dB

```
FREQ:CENT 935.2MHz;SPAN 0Hz
```

Sets the receive frequency to 935.2 MHz and the span to 0 Hz

```
BAND:RES 1MHz;VID 3MHz
```

Sets the resolution bandwidth to 1 MHz and the video bandwidth to 3 MHz

```
DET RMS
```

Sets the RMS detector

```
TRIG:SOUR VID;LEV:VID 50 PCT
```

Selects the trigger source VIDEO and sets the level of the video trigger source to 50 PCT

```
SWE:TIME 50ms
```

Sets the sweep time to 50 ms

```
INIT;*WAI
```

Starts the measurement with synchronization

```
CALC:MARK:FUNC:MSUM? 50US,450US,576.9US,8
```

Queries 8 bursts with an offset of 50 μ s, a test time of 450 μ s and a period of 576.9 μ s

Characteristics

*RST value: –

SCPI: device-specific

Mode

A-T

CALCulate:STATistics Subsystem

The CALCulate:STATistics subsystem controls the statistical measurement functions in the instrument.

Commands of the CALCulate:STATistics Subsystem

- CALCulate:STATistics:APD[:STATe]
- CALCulate:STATistics:CCDF[:STATe]
- CALCulate:STATistics:NSAMples
- CALCulate:STATistics:SCALE:AUTO
- CALCulate:STATistics:SCALE:X:RLEVel
- CALCulate:STATistics:SCALE:X:RANGe
- CALCulate:STATistics:SCALE:Y:UPPer
- CALCulate:STATistics:SCALE:Y:LOWer
- CALCulate:STATistics:PRESet
- CALCulate:STATistics:RESult<1...4>?

CALCulate:STATistics:APD[:STATe]

This command switches on or off the measurement of amplitude distribution (APD). On activating this function, the CCDF measurement is switched off.

Parameter

ON | OFF

Example

CALC:STAT:APD ON
Switches on the APD measurement.

Characteristics

*RST value: OFF
SCPI: device-specific

Mode

A

CALCulate:STATistics:CCDF[:STATe]

This command switches on or off the measurement of the complementary cumulative distribution function (CCDF). On activating this function, the APD measurement is switched off.

Parameter

ON | OFF

Example

CALC:STAT:CCDF ON
Switches on the CCDF measurement.

Characteristics

*RST value: OFF
SCPI: device-specific

ModeA

CALCulate:STATistics:NSAMples

This command sets the number of measurement points to be acquired for the statistical measurement functions.

Parameter

100 to 1E9

Example

```
CALC:STAT:NSAM 500
```

Sets the number of measurement points to be acquired to 500.

Characteristics

*RST value: 100000

SCPI: device-specific

ModeA

CALCulate:STATistics:SCALE:AUTO

This command optimizes the level setting of the instrument depending on the measured peak power, in order to obtain maximum instrument sensitivity.

To obtain maximum resolution, the level range is set as a function of the measured spacing between peak power and the minimum power for the APD measurement and of the spacing between peak power and mean power for the CCDF measurement. In addition, the probability scale for the number of test points is adapted.

This command is an event and therefore has no *RST value and no query.

Note: *Subsequent commands have to be synchronized with *WAI, *OPC or *OPC? to the end of the auto range process which would otherwise be aborted.*

Parameter

ONCE

Example

```
CALC:STAT:SCALE:AUTO ONCE;*WAI
```

Adapts the level setting for statistical measurements.

Characteristics

*RST value: –

SCPI: device-specific

ModeA

CALCulate:STATistics:SCALE:X:RLEVel

This command defines the reference level for the X axis of the measurement diagram. The setting is identical to the reference level setting using the command

```
DISPlay:WINDow:TRACe:Y: RLEVel.
```

With the reference level offset $\neq 0$ the indicated value range of the reference level is modified by the offset.

The unit depends on the setting performed with `CALC:UNIT`.

Parameter

-120dBm to 20dBm

Example

```
CALC:STAT:SCAL:X:RLEV -60dBm
```

Characteristics

*RST value: -20dBm

SCPI: device-specific

Mode

A

CALCulate:STATistics:SCALE:X:RANGE

This command defines the level range for the X axis of the measurement diagram. The setting is identical to the level range setting defined with the command

`DISPlay:WINDow:TRACe:Y:SCALE`.

Parameter

10dB to 200dB

Example

```
CALC:STAT:SCAL:X:RANG 20dB
```

Characteristics

*RST value: 100dB

SCPI: device-specific

Mode

A

CALCulate:STATistics:SCALE:Y:UPPer

This command defines the upper limit for the Y axis of the diagram in statistical measurements. Since probabilities are specified on the Y axis, the entered numerical values are dimensionless.

Parameter

1E-8 to 1.0

Example

```
CALC:STAT:Y:UPP 0.01
```

Characteristics

*RST value: 1.0

SCPI: device-specific

Mode

A

CALCulate:STATistics:SCALe:Y:LOWer

This command defines the lower limit for the Y axis of the diagram in statistical measurements. Since probabilities are specified on the Y axis, the entered numerical values are dimensionless.

Parameter

1E-9 to 0.1

Example

```
CALC:STAT:SCAL:Y:LOW 0.001
```

Characteristics

*RST value: 1E-6

SCPI: device-specific

Mode

A

CALCulate:STATistics:PRESet

This command resets the scaling of the X and Y axes in a statistical measurement. The following values are set:

x-axis ref level: -20 dBm

x-axis range APD: 100 dB

x-axis range CCDF: 20 dB

y-axis upper limit: 1.0

y-axis lower limit: 1E-6

This command is an event and therefore has no *RST value and no query.

Example

```
CALC:STAT:PRES
```

Resets the scaling for statistical functions

Characteristics

*RST value: -

SCPI: device-specific

Mode

A

CALCulate:STATistics:RESult<1...4>?

This command reads out the results of statistical measurements of a recorded trace. The trace is selected with the numeric suffix <1...4> attached to RESult.

Parameter

The required result is selected via the following parameters:

MEAN Average (=RMS) power in dBm measured during the measurement time.

PEAK Peak power in dBm measured during the measurement time.

CFACtor Determined CREST factor (= ratio of peak power to average power) in dB.

ALL Results of all three measurements mentioned before, separated by commas:
<mean power>,<peak power>,<crest factor>

Example

```
CALC:STAT:RES2? ALL
```

Reads out the three measurement results of trace 2. Example of answer string:
5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, CREST factor 13.69 dB

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

CALCulate:THReshold Subsystem

The CALCulate:THReshold subsystem controls the threshold value for the maximum/minimum search of markers.

Commands of the CALCulate:THReshold Subsystem

- CALCulate<1|2>:THReshold
- CALCulate<1|2>:THReshold:STATe

CALCulate<1|2>:THReshold

This command defines the threshold value for the maximum/minimum search of markers with marker search functions. The associated display line is automatically switched on.

Parameter

MINimum to MAXimum (depending on current unit)

Example

```
CALC:THR -82DBM
```

Sets the threshold value to –82 dBm.

Characteristics

*RST value: – (STATe to OFF)

SCPI: device-specific

Mode

A, ADEMOD

CALCulate<1|2>:THReshold:STATe

This command switches on or off the threshold line. The unit depends on the setting performed with CALC:UNIT.

Parameter

ON | OFF

Example

```
CALC:THR:STAT ON
```

Switches on the threshold line.

Characteristics

*RST value: OFF

SCPI: device-specific

ModeA, ADEM0D

CALCulate:TLINe Subsystem

The CALCulate:TLINe subsystem defines the position of the time lines.

Commands of the CALCulate:TLINe Subsystem

- CALCulate<1|2>:TLINe<1|2>
- CALCulate<1|2>:TLINe<1|2>:STATe

CALCulate<1|2>:TLINe<1|2>

This command defines the position of the time lines that mark the times.

Parameter

0 to 1000s

Example

CALC:TLIN 10ms

Characteristics

*RST value: – (STATe to OFF)

SCPI: device-specific

ModeA–T

CALCulate<1|2>:TLINe<1|2>:STATe

This command switches the time line on or off.

Parameter

ON | OFF

Example

CALC:TLIN2:STAT ON

Characteristics

*RST value: OFF

SCPI: device-specific

ModeA–T

CALCulate:UNIT Subsystem

The CALCulate:Unit subsystem defines the units for the parameters that can be set and the measurement results.

Commands of the CALCulate:UNIT Subsystem

– [CALCulate<1|2>:UNIT:POWER](#)

CALCulate<1|2>:UNIT:POWER

This command selects the unit for power.

Parameter

DBM | V | A | W | DBPW | WATT | DBPT | DBUV | DBMV | VOLT | DBUA | AMPere

Example

```
CALC:UNIT:POW DBM
```

Sets the power unit to dBm.

Characteristics

*RST value: dBm

SCPI: device-specific

Mode

A

DISPlay Subsystem

The DISPlay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

- DISPlay[:WINDow<1|2>]:SIZE
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:MODE
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVEL
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVEL:OFFSet
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue (models 13, 16)
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue:AUTO
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RPOSition (models 13, 16)
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE
- DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:HCONtinuous
- DISPlay[:WINDow<1|2>]:TRACe<1...4>[:STATe]

DISPlay[:WINDow<1|2>]:SIZE

This command switches the measurement window for channel and adjacent-channel power measurements to full screen or half screen. Only "1" is allowed as a numerical suffix.

Parameter

LARGE | SMALL

Example

```
DISP:SIZE LARG
```

Displays the measurement diagram in full screen size.

Characteristics

*RST value: SMALL

SCPI: device-specific

Mode

A, ADEMOD

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]

This command defines the display range of the Y axis (level axis) with logarithmic scaling (DISP:TRAC:Y:SPAC LOG).

For linear scaling, (DISP:TRAC:Y:SPAC LIN) the display range is fixed and cannot be modified. The numeric suffix in TRACe<1...4> is irrelevant.

Parameter

10dB to 200dB

Example

```
DISP:TRAC:Y 110dB
```

Characteristics

*RST value: 100dB

SCPI: device-specific

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:MODE

This command defines the scale type of the Y axis (absolute or relative).

When `SYSTEM:DISPlay` is set to `OFF`, this command has no immediate effect on the screen. The numeric suffix in `TRACe<1...4>` is irrelevant.

Parameter

ABSolute | RELative

Example

```
DISP:TRAC:Y:MODE REL
```

Characteristics

*RST value: ABS

SCPI: device-specific

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVel

This command defines the reference level.

With the reference level offset $\neq 0$, the indicated value range of the reference level is modified by the offset.

The unit depends on the setting defined with `CALCulate:UNIT`. The numeric suffix in `TRACe<1...4>` is irrelevant.

Parameter

-130dBm to 30dBm

Example

```
DISP:TRAC:Y:RLEV -60dBm
```

Characteristics

*RST value: -20dBm

SCPI: conforming

Mode

A

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVel:OFFSet

This command defines the offset of the reference level.

The numeric suffix of `TRACe<1...4>` is irrelevant.

Parameter

–200dB to 200dB

Example

DISP:TRAC:Y:RLEV:OFFS –10dB

Characteristics

*RST value: 0dB

SCPI: conforming

Mode

A

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue (models 13, 16)

This command requires a tracking generator and active normalization in the **Tracking Generator** mode. The command defines the power value assigned to the reference position. The numeric suffix of TRACe<1...4> is irrelevant.

Parameter

<numeric_value>

Example

DISP:TRAC:Y:RVAL –20dBm
(Analyzer)

DISP:TRAC:Y:RVAL 0

Sets the power value assigned to the reference position to 0 dB (tracking generator)

Characteristics

*RST value: 0 dB, coupled to reference level

SCPI: device-specific

Mode

A, ADEMOD, BT

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue:AUTO

This command defines whether the reference value for the Y axis is coupled to the reference level (default) or not.

The numeric suffix of TRACe<1...4> is irrelevant.

Parameter

ON | OFF

Example

DISP:TRAC:Y:RVAL:AUTO ON

Characteristics

*RST value: ON

SCPI: device-specific

Mode

A

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALE]:RPOSition (models 13, 16)

This command requires a tracking generator and active normalization in the **Tracking Generator** mode. It defines the position of the reference value.

The numeric suffix in TRACe<1...4> is irrelevant.

Parameter

0 to 100PCT

Example

```
DISP:TRAC:Y:RPOS 50PCT
```

Characteristics

*RST value:

100 PCT **Spectrum Analyzer** mode

50 PCT **Tracking Generator** mode

SCPI: conforming

Mode

A, ADEMOD, BT

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing

This command toggles between linear and logarithmic display. On a linear scale, switchover between the units % (command `DISP:WIND:TRAC:Y:SPAC LIN`) and dB (command `DISP:WIND:TRAC:Y:SPAC LDB`) is also possible.

The numeric suffix in TRACe<1...4> is irrelevant.

Parameter

LINear | LOGarithmic | PERCent | LDB

Example

```
DISP:TRAC:Y:SPAC LIN
```

Characteristics

*RST value: LOGarithmic

SCPI: conforming

Mode

A, ADEMOD

DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE

This command defines the type of display and the evaluation of the traces. WRITE corresponds to the Clr/Write mode of manual operation. The trace is switched off (= BLANK in manual operation) with `DISP:WIND:TRAC:STAT OFF`.

The number of measurements for AVERAge, MAXHold and MINHold is defined with the command `SENSe:AVERAge:COUNT` or `SENSe:SWEep:COUNT`. It should be noted that synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

If calculation of average values is active, selection between logarithmic and linear averaging is possible. For more detail see command `SENSe:AVERAge:TYPE`.

Parameter

WRITe | VIEW | AVERAge | MAXHold | MINHold |RMS

For details on trace modes refer to chapter "Instrument Functions", section "Trace mode overview" or the online help.

Example

```
SWE:CONT OFF
```

Switching to single sweep mode.

```
SWE:COUN 16
```

Sets the number of measurements to 16.

```
DISP:TRAC3:MODE MAXH
```

Switches on the calculation of the for trace 3.

```
INIT;*WAI
```

Starts the measurement and waits for the end of the 16 sweeps.

Characteristics

*RST value: WRITe for TRACe1, STATe OFF for TRACe2/3/4

SCPI: device-specific

Mode

all

DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:HCONtinuous

This command defines, whether traces in Min Hold, Max Hold and Average mode are reset after parameter change or not.

Normally, the measurement is started anew after parameter changes, before the measurement results are evaluated (e.g. using a marker). In all cases that require a new measurement after parameter changes, the trace is reset automatically to avoid false results (e.g. with span changes). For applications that require no reset after parameter changes, the automatic reset can be switched off.

Parameter

OFF: After certain parameter changes the traces are reset.

ON: The automatic reset is switched off.

Example

```
DISP:WIND:TRAC3:MODE:HCON ON
```

Switches off the reset function.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

DISPlay[:WINDow<1|2>]:TRACE<1...4>[:STATe]

This command switches on or off the display of the corresponding trace.

Parameter

ON | OFF

Example

```
DISP:TRAC3 ON
```

Characteristics

*RST value: ON for TRACe1, OFF for TRACe2 to 4

SCPI: conforming

Mode

all

FORMat Subsystem

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

Commands of the FORMat Subsystem

- [FORMat:DEXPort:DSEPARATOR](#)

FORMat:DEXPort:DSEPARATOR

This command defines which decimal separator (decimal point or comma) is to be used for outputting measurement data to the file in ASCII format. Different languages of evaluation programs (e.g. MS-Excel) can thus be supported.

Parameter

POINT | COMMA

Example

```
FORM:DEXP:DSEP POIN
```

Sets the decimal point as separator.

Characteristics

*RST value: – (factory setting is POINT; *RST does not affect setting)

SCPI: device-specific

Mode

all

INITiate Subsystem

The INITiate subsystem is used to control the init–measurement function.

Commands of the INITiate Subsystem

- INITiate<1|2>:CONTInuous
- INITiate<1|2>:CONMeas
- INITiate<1|2>[:IMMediate]
- INITiate<1|2>:DISPlay

INITiate<1|2>:CONTInuous

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

In the **Spectrum Analyzer** mode, this setting refers to the sweep sequence (switching between continuous/single sweep).

Parameter

ON | OFF

Example

```
INIT:CONT OFF
```

Switches the sequence single sweep.

```
INIT:CONT ON
```

Switches the sequence to continuous sweep.

Characteristics

*RST value: ON

SCPI: conforming

Mode

all

INITiate<1|2>:CONMeas

This command continues a stopped measurement at the current position in single sweep mode. The function is useful especially for trace functions MAXHold, MINHold and AVERage, if the previous results are not to be cleared with sweep count > 0 or average count > 0 on restarting the measurement (INIT:IMMediate resets the previous results on restarting the measurement).

The single sweep mode is automatically switched on. Synchronization to the end of the indicated number of measurements can then be performed with the command *OPC, *OPC? or *WAI. In the continuous sweep mode, synchronization to the sweep end is not possible since the overall measurement "never" ends.

This command is an event and therefore has no *RST value and no query.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
DISP:WIND:TRAC:MODE AVER Switches on trace averaging.
```

```
SWE:COUN 20
```

Setting the sweep counter to 20 sweeps.

```
INIT;*WAI
```

Starts the measurement and waits for the end of the 20 sweeps.

```
INIT:CONM;*WAI
```

Continues the measurement (next 20 sequences) and waits for the end.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

INITiate<1|2>[:IMMediate]

The command initiates a new measurement sequence.

With sweep count > 0 or average count > 0, this means a restart of the indicated number of measurements. With trace functions MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

In single sweep mode, synchronization to the end of the indicated number of measurements can be achieved with the command *OPC, *OPC? or *WAI. In continuous-sweep mode, synchronization to the sweep end is not possible since the overall measurement never ends.

This command is an event and therefore has no *RST value and no query.

Example

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
DISP:WIND:TRAC:MODE AVER Switches on trace averaging.
```

```
SWE:COUN 20
```

Setting the sweep counter to 20 sweeps.

```
INIT;*WAI
```

Starts the measurement and waits for the end of the 20 sweeps.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

INITiate<1|2>:DISPlay

This command switches the display during a single sweep measurement on (ON) or off (OFF). The numeric suffix of INITiate is irrelevant with this command.

Parameter

ON | OFF

Example

```
INIT:CONT OFF
```

Switches to single sweep mode

```
INIT:DISP OFF
```

Sets the display behavior to OFF

```
INIT;*WAI
```

Starts the measurement with display switched off.

Characteristics

*RST value: ON

SCPI: device-specific

Mode

A

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

- INPut<1|2>:ATTenuation
- INPut<1|2>:ATTenuation:AUTO
- INPut<1|2>:IMPedance
- INPut<1|2>:UPORt[:VALue]?
- INPut<1|2>:UPORt:STATe
- INPut<1|2>:GAIN:STATe

INPut<1|2>:ATTenuation

This command programs the input attenuator. To protect the input mixer against damage from overloads, the setting 0 dB can be obtained by entering numerals, not by using the command DEC.

The attenuation can be set in 5 dB steps between 0 and 30 dB. If the defined reference level cannot be set for the set RF attenuation, the reference level will be adjusted accordingly.

In the default state with **Spectrum Analyzer** mode, the attenuation set on the step attenuator is coupled to the reference level of the instrument. If the attenuation is programmed directly, the coupling to the reference level is switched off.

Parameter

0 to 30 dB

Example

```
INP:ATT 30dB
```

Sets the attenuation on the attenuator to 30 dB and switches off the coupling to the reference level.

Characteristics

*RST value: 0 dB (AUTO is set to ON)

SCPI: conforming

Mode

all

INPut<1|2>:ATTenuation:AUTO

This command automatically couples the input attenuation to the reference level (state ON) or switches the input attenuation to manual entry (state OFF). The minimum input attenuation set with the coupling switched on is 5 dB.

Parameter

ON | OFF

Example

```
INP:ATT:AUTO ON
```

Couples the attenuation set on the attenuator to the reference level.

Characteristics

*RST value: ON
 SCPI: conforming

Mode

all

INPut<1|2>:IMPedance

This command sets the nominal input impedance of the instrument. The set impedance is taken into account in all level indications of results.

The setting 75 Ω should be selected, if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The correction value in this case is 1.76 dB = 10 log (75 Ω / 50 Ω).

Parameter

50 | 75

Example

INP:IMP 75

Characteristics

*RST value: 50 Ω
 SCPI: conforming

Mode

all

INPut<1|2>:UPORt[:VALue]?

This command queries the control lines of the user ports.

This command is a query and therefore has no *RST value.

Example

INP:UPOR?

Characteristics

RST value: –
 SCPI: device-specific

Mode

all

INPut<1|2>:UPORt:STATe

This command toggles the control lines of the user ports between INPut and OUTPut. With ON, the user port is switched to INPut, with OFF to OUTPut.

Parameter

ON | OFF

Example

INP:UPOR:STAT ON

Characteristics

RST value: ON

SCPI: device-specific

Mode

all

INPut<1|2>:GAIN:STATe

This command switches on the preamplifier for the instrument.

Parameter

ON | OFF

Example

INP:GAIN ON

Switches on 20 dB preamplification.

Characteristics

*RST value: OFF

SCPI: conforming

Mode

A

OUTPut Subsystem

The OUTPut subsystem controls the output features of the instrument.

Commands of the OUTPut Subsystem

- `OUTPut<1|2>[:STATe]` (models 13 and 16)
- `OUTPut:UPORt[:VALue]`
- `OUTPut:UPORt:STATe`

OUTPut<1|2>[:STATe] (models 13 and 16)

This command switches the tracking generator on or off.

Note: *With the tracking generator switched on, the maximum stop frequency is limited to 3 GHz. This upper limit is automatically modified by the set frequency offset of the generator.*

If measurements in compliance with specs are to be performed with the tracking generator, the start frequency has to be $\geq 3 \times$ resolution bandwidth.

If a sweep time shorter than recommended in the data sheet is selected, the sweep time indicator SWT on the screen is marked with a red asterisk and the message UNCAL is also displayed.

With the tracking generator switched on, the FFT filters (BAND:MODE:FFT) are not available.

Parameter

ON | OFF

Example

OUTP ON

Switches on the tracking generator.

Characteristics

*RST value: –

SCPI: conforming

Mode

A

OUTPut:UPORt[:VALue]

This command sets the control lines of the user ports.

The user port is written to with the given binary pattern. If the user port is programmed to INPut instead of OUTPut, the output value is temporarily stored.

Parameter

#B00000000 to #B11111111

Example

OUTP:UPOR #B10100101

Characteristics

*RST value: –

SCPI: device-specific

Modeall

OUTPut:UPORt:STATe

This command switches the control line of the user ports between INPut and OUTPut. The user port is switched to OUTPut with parameter ON, to INPut with OFF.

Parameter

ON | OFF

Example

```
OUTP:UPOR:STAT ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Modeall

SENSe Subsystem

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

- "SENSe:AVERAge Subsystem" on page 6.105
- "SENSe:BANDwidth Subsystem" on page 6.107
- "SENSe:CORRection Subsystem (Models 13 and 16)" on page 6.110
- "SENSe:DETEctor Subsystem" on page 6.112
- "SENSe:FREQuency Subsystem" on page 6.113
- "SENSe:LIST Subsystem" on page 6.117
- "SENSe:MPOWer Subsystem" on page 6.122
- "SENSe:POWer Subsystem" on page 6.126
- "SENSe:SWEep Subsystem" on page 6.134

SENSe:AVERAge Subsystem

The SENSe:AVERAge subsystem calculates the average of the acquired data. A new test result is obtained from several successive measurements.

There are two types of average calculation: logarithmic and linear. In case of logarithmic average calculation (denoted with VIDEo), the average value of the measured logarithmic power is calculated and in case of linear average calculation, the linear power is averaged before the logarithm is applied.

Commands of the SENSe:AVERAge Subsystem

- [SENSe<1|2>:]AVERAge:COUNT
- [SENSe<1|2>:]AVERAge:COUNT:AUTO
- [SENSe<1|2>:]AVERAge[:STATe<1...4>]

[SENSe<1|2>:]AVERAge:COUNT

This command defines the number of measurements which contribute to the average value.

It should be noted that continuous averaging will be performed after the indicated number has been reached in continuous sweep mode.

In single sweep mode, the sweep is stopped as soon as the indicated number of measurements (sweeps) is reached. Synchronization to the end of the indicated number of measurements is only possible in single sweep mode.

The command [SENSe<1|2>:]AVERAge:COUNT is the same as command [SENSe<1|2>:]SWEep:COUNT. In both cases, the number of measurements is defined whether the average calculation is active or not.

The number of measurements applies to all traces.

Parameter

0 to 32767

Example

SWE:CONT OFF

Switching to single sweep mode.

AVER:COUN 16

Sets the number of measurements to 16.

AVER:STAT ON

Switches on the calculation of average.

INIT;*WAI

Starts the measurement and waits for the end of the 16 sweeps.

Characteristics

*RST value: 0

SCPI: conforming

Mode

all

[SENSe<1|2>:]AVERAge:COUNT:AUTO

This command selects a suitable number of counts for the selected measurement type.

Parameter

ON | OFF

Example

AVER:COUN:AUTO ON

Characteristics

RST value: OFF

SCPI: conforming

Mode

all

[SENSe<1|2>:]AVERAge[:STATe<1...4>]

This command switches on or off the average calculation for the selected trace (STATe<1...4>).

Parameter

ON | OFF

Example

AVER OFF

Switches off the average calculation for trace 1.

SENS:AVER:STAT3 ON

Switches on the average calculation for trace 3.

Characteristics

*RST value: OFF

SCPI: conforming

Mode

all

SENSe:BANDwidth Subsystem

This subsystem controls the setting of the instruments filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions.

Commands of the SENSe:BANDwidth Subsystem

- [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]
- [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO
- [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio
- [SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE
- [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo
- [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO
- [SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio
- [SENSe<1|2>:]BANDwidth:VIDeo:TYPE

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]

This command defines the analyzers resolution bandwidth.

The resolution bandwidth can be set in 1, 3, 10 steps in the range between 1 kHz and 3 MHz (10 Hz to 3 MHz with option Narrow IF Filters, R&S FSL–B7). For details on the correlation between resolution bandwidth and filter type refer to chapter "Instrument Functions", section "To choose the appropriate filter type".

If the resolution bandwidth is modified, the coupling to the span is automatically switched off.

Parameter

<numeric_value>

Example

```
BAND 1MHz
```

Sets the resolution bandwidth to 1 MHz

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: conforming

Mode

all, except ADEMOD

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO

This command either automatically couples the resolution bandwidth of the instrument to the span or cancels the coupling.

The automatic coupling adapts the resolution bandwidth to the currently set frequency span according to the relationship between frequency span and resolution bandwidth. The 6 dB bandwidths 200 Hz, 9 kHz and 120 kHz and the channel filters available are not set by the automatic coupling.

The ratio resolution bandwidth/span can be modified with the command

```
[SENSe<1|2>:]BANDwidth[:RESolution]:RATio.
```

Parameter

ON | OFF

Example

```
BAND:AUTO OFF
```

Switches off the coupling of the resolution bandwidth to the span.

Characteristics

*RST value: ON

SCPI: conforming

Mode

A–F

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:RATio

This command defines the ratio resolution bandwidth (Hz) / span (Hz). The ratio to be entered is reciprocal to the ratio span/RBW used in manual control.

Parameter

0.0001 to 1

Example

```
BAND:RAT 0.1
```

Characteristics

*RST value: 0.02 with BAND:TYPE NORMal or RBW > 30 kHz; 0.01 with BAND:TYPE FFT for RBW ≤ 30 kHz

SCPI: conforming

Mode

A

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:TYPE

This command switches the filter type for the resolution bandwidth between "normal" analog or FIR filters in 1, 3, 10 steps and the FFT filtering for bandwidths <100 kHz.

For detailed information on filters see chapter "Instrument Functions", section "To choose the appropriate filter" and "List of available RRC and channel filters".

Note: *When changing the filter type, the next larger filter bandwidth is selected if the same filter bandwidth is not available for the new filter type.*

Parameter

NORMal | FFT | CFILter | RRC

Example

```
BAND:TYPE NORM
```

Characteristics

*RST value: NORMal

SCPI: device-specific

Mode

all, except ADEMOD

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo

This command defines the instruments video bandwidth. Bandwidths from 1 Hz to 10 MHz in 1, 3, 10 steps are available. The command is not available if FFT filtering is switched on and the set bandwidth is ≤ 30 kHz or if the quasi-peak detector is switched on.

Parameter

1Hz to 10MHz

Example

BAND:VID 10kHz

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: conforming

Mode

A

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:AUTO

This command either automatically couples the instruments video bandwidth to the resolution bandwidth or cancels the coupling.

The ratio video bandwidth/resolution bandwidth can be modified with the command

[SENSe<1|2>:]BANDwidth:VIDeo:RATio.

Parameter

ON | OFF

Example

BAND:VID:AUTO OFF

Characteristics

*RST value: ON

SCPI: conforming

Mode

A

[SENSe<1|2>:]BANDwidth|BWIDth:VIDeo:RATio

This command defines the ratio video bandwidth (Hz) / resolution bandwidth (Hz). The ratio to be entered is reciprocal to the ratio RBW/VBW used in manual control.

Parameter

0.01 to 1000

Example

BAND:VID:RAT 3

Sets the coupling of video bandwidth to video bandwidth = 3*resolution bandwidth

Characteristics

*RST value: 3

SCPI: conforming

Mode

A

[SENSe<1|2>:]BANDwidth:VIDeo:TYPE

This command selects the position of the video filter in the signal path, provided that the resolution bandwidth is ≤ 100 kHz.

The essential difference between the two modes is the transient response at falling signal edges: If LINear is selected, the measurement with logarithmic level scaling yields a much "flatter" falling edge than LOGarithmic. This behavior is due to the conversion of linear power into logarithmic level. If the linear power is halved, the level decreases by only 3 dB.

Parameter

LINear The video filter is connected ahead of the logarithmic amplifier (default).
LOGarithmic The video filter follows the logarithmic amplifier

Example

```
BAND:VID:TYPE LIN
Video filter ahead of the logarithmic amplifier
```

Characteristics

RST value: LIN
SCPI: device-specific

Mode

A

SENSe:CORRection Subsystem (Models 13 and 16)

This subsystem controls calibration and normalization during operation with the tracking generator.

Commands of the SENSe:CORRection Subsystem

- [SENSe<1|2>:]CORRection:METhod
- [SENSe<1|2>:]CORRection:COLLect[:ACQuire]
- [SENSe<1|2>:]CORRection[:STATe]
- [SENSe<1|2>:]CORRection:RECall
- [SENSe<1|2>:]CORRection:EGAI:n:INPut[:MAGNI:tude]

[SENSe<1|2>:]CORRection:METhod

This command selects the type of measurement with active tracking generator (transmission/reflection).

Parameter

TRANsmission | REFLection

Example

```
CORR:METh TRAN
Sets the type of measurement to "transmission".
```

Characteristics

*RST value: TRANsmission
SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:COLLect[:ACQuire]

When the tracking generator is active, this command determines the type of result acquisition for the normalization reference measurement and starts the measurement selected:

To obtain a correct reference measurement, a complete sweep with synchronization to the end of the sweep must have been carried out. This is only possible in the single sweep mode.

This command is an "event" and therefore has no *RST value and no query.

Parameter

| | | |
|---------|-----------------------------------|--|
| THRough | "TRANsmission" mode | calibration with direct connection between tracking generator and device input |
| | "REFLectioN" mode | calibration with short circuit at the input |
| OPEN | only allowed in "REFLectioN" mode | calibration with open input |

Example

```
INIT:CONT OFF
```

Selects single sweep operation

```
CORR:COLL THR;*WAI
```

Starts the measurement of reference data using direct connection between generator and device input and waits for the sweep end.

Characteristics

*RST value: –

SCPI: conforming

Mode

A

[SENSe<1|2>:]CORRection[:STATe]

This command activates/deactivates the normalization of the measurement results provided that the tracking generator is active. The command is available only after acquisition of a reference trace for the selected type of measurement (transmission/reflection, see command [SENSe<1|2>:]CORRection:COLLect[:ACQuire]).

Parameter

ON | OFF

Example

```
CORR ON
```

Activates normalization.

Characteristics

*RST value: OFF

SCPI: conforming

Mode

A

[SENSe<1|2>:]CORRection:RECall

This command restores the instrument setting that was applied to the measurement of the reference data, provided that the tracking generator is active.

This command is an event and therefore has no *RST value and no query.

Example

CORR:REC

Characteristics

*RST value: –

SCPI: conforming

Mode

A

[SENSe<1|2>:]CORRection:EGAI:n:INPut[:MAGNitude]

This command makes an external gain known to the analyzer, which will take it into account during the display of measurement results. With this function the gain of an antenna or of an external preamplifier can be taken into account for the measurement values.

Parameter

–200...200dB

Example

CORR:EGA:INP 10DB

Takes 10 dB external gain into account.

Characteristics

*RST value: 0 dB

SCPI: device-specific

Mode

A

SENSe:DETECTOR Subsystem

The SENSe:DETECTOR subsystem controls the acquisition of measurement data via the selection of the detector for the corresponding trace.

Commands of the SENSe:DETECTOR Subsystem

- [SENSe<1|2>:]DETECTOR<1...4>[:FUNCTION]
- [SENSe<1|2>:]DETECTOR<1...4>[:FUNCTION]:AUTO

[SENSe<1|2>:]DETECTOR<1...4>[:FUNCTION]

This command switches on the detector for the data acquisition in the selected trace.

The trace is indicated as numeric suffix in DETECTOR.

Parameter

APEak | NEGative | POSitive | SAMPLe | RMS | AVERAge | QPEak

For details on detectors refer to chapter "Instrument Functions", section "Detector overview".

Example

DET POS

Sets the detector to "positive peak".

Characteristics

*RST value: APEak

SCPI: conforming

Mode

A

[SENSe<1|2>:]DETEctor<1...4>[:FUNction]:AUTO

This command either couples the detector to the current trace setting or turns coupling off. The trace is selected by the numeric suffix at DETector.

Parameter

ON | OFF

Example

DET:AUTO OFF

Characteristics

*RST value: ON

SCPI: conforming

Mode

A

SENSe:FREQUency Subsystem

The SENSe:FREQUency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

Commands of the SENSe:FREQUency Subsystem

- [SENSe<1|2>:]FREQUency:CENTer
- [SENSe<1|2>:]FREQUency:CENTer:STEP
- [SENSe<1|2>:]FREQUency:CENTer:STEP:AUTO
- [SENSe<1|2>:]FREQUency:CENTer:STEP:LINK
- [SENSe<1|2>:]FREQUency:CENTer:STEP:LINK:FACTor
- [SENSe<1|2>:]FREQUency:SPAN
- [SENSe<1|2>:]FREQUency:SPAN:FULL
- [SENSe<1|2>:]FREQUency:START
- [SENSe<1|2>:]FREQUency:STOP
- [SENSe<1|2>:]FREQUency:MODE
- [SENSe<1|2>:]FREQUency:OFFSet

[SENSe<1|2>:]FREQUency:CENTer

This command defines the center frequency of the analyzer or the measuring frequency for span = 0.

Parameter

0 to f_{\max}

Example

```
FREQ:CENT 100MHz
```

Characteristics

*RST value: $f_{\max} / 2$ with f_{\max} = maximum frequency

SCPI: conforming

Mode

all

[SENSe<1|2>:]FREQUency:CENTer:STEP

This command defines the step size of the center frequency.

Parameter

0 to f_{\max}

Example

```
FREQ:CENT:STEP 120MHz
```

Characteristics

*RST value: – (AUTO 0.1 × SPAN is switched on)

SCPI: conforming

Mode

all

[SENSe<1|2>:]FREQUency:CENTer:STEP:AUTO

This command couples the step size of the center frequency to the span (ON) or sets the value of the center frequency entered via `FREQ:CENT:STEP` (OFF).

Parameter

ON | OFF

Example

```
FREQ:CENT:STEP:AUTO ON
```

Activates the coupling of the step size to the span.

Characteristics

*RST value: ON

SCPI: device-specific

Mode

all

[SENSe<1|2>:]FREQUency:CENTer:STEP:LINK

This command couples the step size of the center frequency to span (span > 0) or to the resolution bandwidth (span = 0) or cancels the couplings.

Parameter

SPAN coupling to frequency display range (for span > 0)

RBW coupling to resolution bandwidth (for span = 0)

OFF manual input, no coupling

Example

```
FREQ:CENT:STEP:LINK SPAN
```

Characteristics

*RST value: SPAN

SCPI: device-specific

Mode

A, ADEMODO

[SENSe<1|2>:]FREQUENCY:CENTer:STEP:LINK:FACTor

This command couples the step size of the center frequency with a factor to the span (span >0) or to the resolution bandwidth (span = 0).

Parameter

1 to 100 PCT

Example

```
FREQ:CENT:STEP:LINK:FACT 20PCT
```

Characteristics

*RST value: – (AUTO 0.1 × SPAN is switched on)

SCPI: device-specific

Mode

A

[SENSe<1|2>:]FREQUENCY:SPAN

This command defines the frequency span in the **Spectrum Analyzer** mode.

Parameter

0 to f_{\max}

Example

```
FREQ:SPAN 10MHz
```

Characteristics

*RST value: f_{\max} with f_{\max} = maximum frequency

SCPI: conforming

Mode

A

[SENSe<1|2>:]FREQUENCY:SPAN:FULL

This command sets the frequency span in the **Spectrum Analyzer** mode to its maximum.

Example

```
FREQ:SPAN:FULL
```

Characteristics

*RST value: –

SCPI: conforming

Mode

A

[SENSe<1|2>:]FREQUENCY:START

This command defines the start frequency of the analyzer. This command is only available with span > 0.

Parameter0 to f_{\max} **Example**

FREQ:STAR 20MHz

Characteristics

*RST value: 0

SCPI: conforming

Mode

A–F

[SENSe<1|2>:]FREQUENCY:STOP

This command defines the stop frequency of the analyzer. This command is only available with span > 0.

Parameter0 to f_{\max} **Example**

FREQ:STOP 2000MHz

Characteristics*RST value: f_{\max}

SCPI: conforming

Mode

A–F

[SENSe<1|2>:]FREQUENCY:MODE

This command switches between span > 0 (SWEep) and zero span (CW | FIXed) in the **Spectrum Analyzer** mode.

For CW and FIXed, the frequency setting is via command `FREQUENCY:CENTer`. In the SWEep mode, the setting is via commands `FREQUENCY:START`, `STOP`, `CENTer` and `SPAN`.

Parameter

CW | FIXed | SWEep

Example

FREQ:MODE SWE

Characteristics

*RST value: SWEep

SCPI: conforming

Mode

A

[SENSe<1|2>:]FREQUency:OFFSet

This command defines the frequency offset of the instrument.

Parameter

<numeric_value>

Example

FREQ:OFFS 1GHZ

Characteristics

*RST value: 0 Hz

SCPI: conforming

Mode

A, ADEMOD

SENSe:LIST Subsystem

The commands of this subsystem are used for measuring the power at a list of frequency points with different device settings. The measurement is always performed in zero span. A new trigger event is required for each test point (exception: Trigger FREE RUN).

The results are output as a list in the order of the entered frequency points. The number of results per test point depends on the number of concurrently active measurements (peak/RMS/average). The number of frequencies is limited to 100 entries.

Selection of concurrently active measurements and setting of parameters that are constant for the whole measurement is performed via a configuration command (SENSe:LIST:POWer:SET). This also includes the setting for trigger and gate parameters.

Note: Settings that are not directly included in commands of this subsystem can be configured by sending the corresponding commands prior to the SENSe:LIST commands. Please note that changes to the trigger level have to be executed in zero span in order to take effect for the SENSe:LIST commands.

Commands of the SENSe:LIST Subsystem

- [SENSe<1|2>:]LIST:POWer:RESult?
- [SENSe<1|2>:]LIST:POWer[:SEQuence]
- [SENSe<1|2>:]LIST:POWer:SET
- [SENSe<1|2>:]LIST:POWer:STATe

Further information

- [More details on the SENSe:LIST Subsystem](#)

More details on the SENSe:LIST Subsystem

The following setting parameters can be selected independently for each frequency point:

- analyzer frequency
- reference level
- resolution filter
- resolution bandwidth
- video bandwidth
- measurement time
- detector

The commands of this subsystem can be used in two different ways:

- Instrument setup, measurement and querying of the results in a single command line. With this method, there is the least delay between the measurement and the result output. However, it requires the control computer to wait for the response from the instrument.
- Instrument setup and querying of the result list at the end of the measurement: With this method, the control computer may be used for other activities while the measurement is being performed. However, more time is needed for synchronization via service request.

[SENSe<1|2>:]LIST:POWer:RESult?

This command queries the result of a previous list measurement as configured and initiated with `SENSe:LIST:POWer[:SEQuence]`. The measured results are output in a list of floating point values separated by commas. The unit of the results depends on the setting made with the `CALC:UNIT` command.

This command may be used to obtain measurement results in an asynchronous way, using the service request mechanism for synchronization with the end of the measurement.

If no measurement results are available, the command will return a query error.

Example

```
*ESE 1
*SRE 32
```

Configuration of the status reporting system for the generation of an SRQ on operation complete

```
SENSe:LIST:POWer
935.2MHz,-20dBm,10dB,OFF,NORM,1MHz,3MHz,434us,0,
935.4MHz,-20dBm,10dB,10dB,NORM,30kHz,100kHz,434us,0,
935.6MHz,-20dBm,10dB,20dB,NORM,30kHz,100kHz,434us,0;
*OPC
```

Configuring and starting the measurement

...

Further actions of the control computer during measurement

```
On SRQ:
SENSe:LIST:POWer:RESult?
Response to service request
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

A-F, A-T

[SENSe<1|2>:]LIST:POWer[:SEQUence]

This command configures the list of settings (max. 200 entries) for the multiple power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as all frequency points are processed and the defined number of individual measurements is reached.

To reduce the setting time, all indicated parameters are set up simultaneously at each test point.

The query form of the command processes the list and immediately returns the list of results.

The number of results per test point depends on the setting of the `SENSe:LIST:POWer:SET` command.

Parameter

The following parameters are the settings for an individual frequency point. They are repeated for every other frequency point.

| | |
|-----------------|---|
| <analyzer freq> | Receive frequency for the signal to be measured (= center frequency in manual operation) Range of values: 0 Hz to max. frequency, depending on the instrument model. |
| <ref level> | Reference level Range of values: +20 dBm to -130 dBm in 0.1 dB steps |
| <rf att> | RF input attenuation Range of values: 0 dB to 30 dB in 5 dB steps |
| <filter type> | NORMAL: normal resolution filter CFILter (channel filter): These are especially steep-edged filters, which are used for example in Fast ACP measurement to ensure the band-limiting of a transmission channel in zero span. RRC (Root Raised Cosine filter): This special filter form is used to determine the channel power for some mobile radio standards. |
| <rbw> | Resolution bandwidth For the range of values refer to chapter "Instrument Functions", section "Res BW Manual". Refer to chapter "Instrument Functions", section "To choose the appropriate filter type", for possible combinations of filter type and filter bandwidth for the <filter type> = CFILter and <filter type> = RRC. |
| <vbw> | Video bandwidth Range of values: 1 Hz to 10 MHz in 1, 3, 10 steps. The value is ignored for <filter type> = CFILter or RRC |
| <meas time> | Measurement time Range of values: 1us to 16000s For details refer to chapter "Instrument Functions", section "Sweeptime Manual" |
| <trigger level> | Reserved. Must be set to 0. |

Return values

The query command returns a list of comma-separated values (CSV) which contains the power measurement results in floating-point format. The unit depends on the setting with CALC:UNIT.

The command

```
SENSe:LIST:POWer?
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,NORM,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,NORM,30kHz,100kHz,440us,0
```

thus returns the following list, for example:

```
-28.3,-30.6,-38.1
```

If the command sequence is extended to

```
SENSe:LIST:POWer:SET ON,ON,ON,IMM,POS,0,0
SENSe:LIST:POWer?
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,NORM,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,NORM,30kHz,100kHz,440us,0
```

the result list is extended to 3 results per frequency point (peak, RMS and average):

```
-28.3,-29.6,1.5,-30.6,-31.9,0.9,-38.1,-40.0,2.3
```

Example

```
SENSe:LIST:POWer
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,CFIL,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,CFIL,30kHz,100kHz,440us,0
```

Performs a measurement sequence with the following settings:

| Step | Freq. [MHz] | Ref Level [dBm] | RF Att [dB] | el Att [dB] | Filter type | RBW | VBW | Meas Time [us] | TRG Level (reserved) |
|------|-------------|-----------------|-------------|-------------|-------------|--------|---------|----------------|----------------------|
| 1 | 935.2 | 0 | 10 | OFF | Normal | 1 MHz | 3 MHz | 440 | 0 |
| 2 | 935.4 | 0 | 10 | 10 | Channel | 30 kHz | 100 kHz | 440 | 0 |
| 3 | 935.6 | 0 | 10 | 20 | Channel | 30 kHz | 100 kHz | 440 | 0 |

```
SENSe:LIST:POWer?
935.2MHz,0dBm,10dB,OFF,NORM,1MHz,3MHz,440us,0,
935.4MHz,0dBm,10dB,10dB,CFIL,30kHz,100kHz,440us,0,
935.6MHz,0dBm,10dB,20dB,CFIL,30kHz,100kHz,440us,0
```

Performs the same measurement and returns the result list immediately after the last frequency point.

Note: *The measurement is performed in zero span and therefore the span is set to 0 Hz. If the span > 0 is set, the function is automatically switched off.*

The measurement is not compatible with other measurements, especially as far as marker, adjacent channel power measurement or statistics are concerned. The corresponding commands thus automatically deactivate the function.

The function is only available in REMOTE operation. It is deactivated when switching the instrument back to LOCAL.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A-F, A-T

[SENSe<1|2>:]LIST:POWer:SET

This command defines the constant settings for the list during multiple power measurement. Parameters <PEAK meas>, <RMS meas> and <AVG meas> define, which measurements are to be performed at the same time at the frequency point. Correspondingly, one, two or three results per frequency point are returned for the `SENSe:LIST:POW?` command. If all three parameters are set to OFF, the command generates an execution error.

Parameter

| | |
|------------------|---|
| <PEAK meas> | ON: activates the measurement of the peak power (peak detector) OFF: deactivates the measurement of the peak power |
| <RMS meas> | ON: activates the measurement of the RMS power (RMS detector) OFF: deactivates the measurement of the RMS power |
| <AVG meas> | ON: activates the measurement of the average power (average detector) OFF: deactivates the measurement of the average power |
| <trigger mode> | Selection of the trigger source used for the list measurement Possible values: IMMEDIATE EXTERNAL IFPOWER |
| <trigger slope> | Used trigger slope Possible values: POSITIVE NEGATIVE |
| <trigger offset> | Offset between the detection of the trigger signal and the start of the measurement at the next frequency point. Range of values: 0 s, 125 ns to 100s |
| <gate length> | Gate length with gated sweep Range of values: 0 s, 125 ns to 100s The value 0 s deactivates the use of gated trigger; other values activate the gated trigger function. Values <> 0 s are only possible if <trigger mode> is different from IMMEDIATE. Otherwise, an execution error is triggered. |

Return values

The query command returns a list of comma-separated values (CSV) of the settings, i.e.

ON, ON, ON, IMM, POS, 0, 0

if the configuration has been set with the command

`SENSe:LIST:POWer:SET ON, ON, ON, IMM, POS, 0, 0`

Example

`SENSe:LIST:POWer:SET ON, OFF, OFF, EXT, POS, 10US, 434US`

Characteristics

*RST value: ON, OFF, OFF, IMM, POS, 0S, 0S

SCPI: device-specific

Mode

A-F, A-T

[SENSe<1|2>:]LIST:POWer:STATe

This command deactivates the list measurement.

Parameter

OFF

Example

SENSe:LIST:POWer:STATe OFF

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F, A–T

SENSe:MPOWer Subsystem

The commands of this subsystem are used to determine the mean burst power or peak burst power for a given number of signal bursts, and for outputting the results in a list. Since all the settings required for a measurement are combined in a single command, the measurement speed is considerably higher than when using individual commands.

For measuring the signal bursts, the gated sweep function is used in zero span. The gate is controlled either by an external trigger signal or by the video signal. An individual trigger event is required for each burst to be measured. If an external trigger signal is used, the threshold is fixed to TTL level, while with a video signal the threshold can be set as desired.

Commands of the SENSe:MPOWer Subsystem

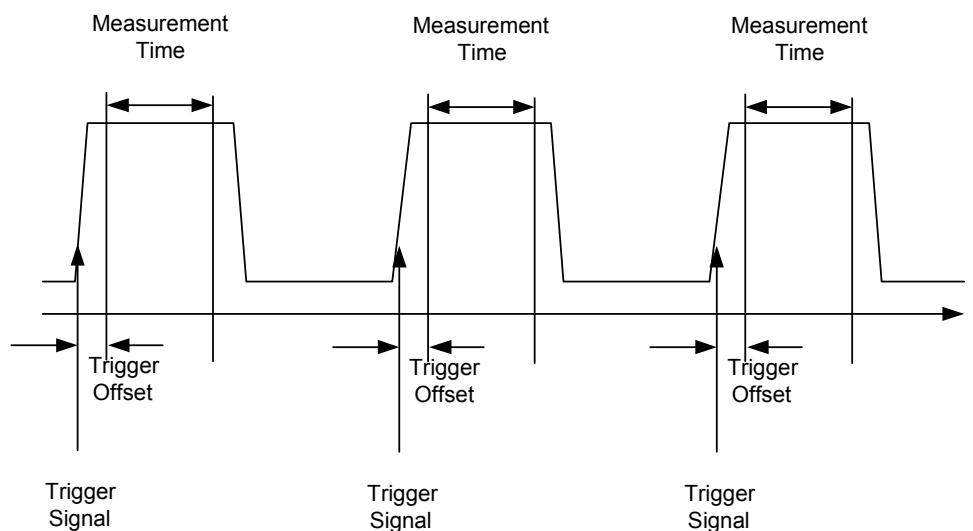
- [\[SENSe<1|2>:\]MPOWer\[:SEQuence\]](#)
- [\[SENSe<1|2>:\]MPOWer:FTYPE](#)
- [\[SENSe<1|2>:\]MPOWer:RESult\[:LIST\]?](#)
- [\[SENSe<1|2>:\]MPOWer:RESult:MIN?](#)

Further information

- [More details on the SENSe:MPOWer Subsystem](#)

More details on the SENSe:MPOWer Subsystem

The following graphics shows the relation between trigger time, trigger offset (for delayed gate opening) and measurement time.



Depending on the settings made, the measurements are performed with the RMS detector for RMS power or the PEAK detector for peak power. For all these measurements, trace 1 of the selected system is used.

The setting parameters for this measurement are:

- analyzer frequency
- resolution bandwidth
- measurement time used for a single burst
- trigger source
- trigger level
- trigger offset
- type of power measurement (PEAK, MEAN)
- number of bursts to be measured

The commands of this subsystem can be used in two different ways:

- Setting up the instrument and at the same time querying the result list: This method ensures the smallest delay between measurement and the output of the measured values, but requires the control computer to wait actively for the response of the instrument.
- Setting up the instrument and querying the result list after synchronization to the end of measurement: With this method the control computer can be used for other activities while the instrument is performing the measurement at the cost of additional time needed for synchronization via service request.

[SENSe<1|2>:]MPOWER[:SEquence]

This command configures the instrument setup for multiple burst power measurement and starts a measurement sequence. When synchronizing the command with *OPC, a service request is generated as soon as the defined number of individual measurements (# of meas) is reached. To reduce the setting time, the setup is performed simultaneously for all selected parameters. The command in the form of a query makes the instrument settings, performs the defined number of measurements and outputs the measurement results list.

Parameter

| | |
|------------------|--|
| <analyzer freq> | Receive frequency for the burst signals to be measured (= center frequency in manual operation) Range: 0 Hz to max. frequency, depending on instrument model |
| <rbw> | resolution bandwidth for the measurement Range: 10 Hz to 10 MHz in steps of 1, 3, 10 |
| <meas time> | Time span during which measurement samples are sampled for RMS / peak measurement. The type of measurement is selected by <type of meas>. Range: 1us to 30s |
| <trigger source> | trigger signal source. Possible settings: EXTernal: The trigger signal is fed from the "Ext. Trigger/Gate" input on the rear of the unit. VIDeo: The internal video signal is used as trigger signal. |
| <trigger level> | Signal level at which the trigger becomes active. For <trigger source> = VIDeo this is the level of the video signal as a percentage of the diagram height. If <trigger source> = EXTernal is selected, the value entered here is ignored, as in this case the trigger input uses TTL levels. Range: 0 – 100PCT(<trigger source> = VIDeo) |
| <trigger offset> | Offset between the detection of the trigger signal and the start of the measurement. Range: 125 ns to 100s |
| <type of meas> | Determines whether mean power (RMS) or peak power (PEAK) is to be measured. The detector is selected accordingly. Possible values: MEAN, PEAK |
| <# of meas> | Number of individual bursts to be measured. Range: 1 to 32001 |

Return values

The query command returns a list separated by commas (comma separated values = CSV), which contains the power measurement results in floating–point format. The unit used for the return values is always dBm.

The command `SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20` may, for instance, cause the following list to be returned:

18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9,18.3,18.6,18.1,18.0,17.9

Example

`SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20`

Performs a measurement sequence with the following settings:

Frequency = 935.2 MHz,

Resolution bandwidth = 1 MHz

Measurement time = 434 μ s

Trigger source = VIDEO

Trigger threshold = 50%

Trigger offset = 5 μ s

Type of measurement = MEAN power

No. of measurements = 20

SENSe:MPOWer? 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20

Performs the same measurement and in addition returns the results list immediately after completion of the last measurement.

Note: *The measurement function always uses trace 1.*

Repeated use of the command without changes to its parameters (i.e. using the same settings again) will speed up the measurement since the previous hardware settings will be cached and therefore additional hardware settling times will be avoided. This also holds true if only part of the parameters (e.g. only the trigger delay) are changed, as in this case the rest of the parameters will be cached.

This measurement is not compatible with other measurements, especially as far as marker functions, adjacent-channel measurement or statistics are concerned. The corresponding functions are therefore automatically switched off. In return incompatible commands will automatically deactivate the multi burst power function.

The function is only available in the REMOTE operation. It is deactivated on switching back to LOCAL.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

[SENSe<1|2>:]MPOWer:FTYPE

This command defines the filter type for the measurement.

Parameter

NORMal | CFILter | RRC

Example

SENSe:MPOWer:FTYPE CFILter

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

[SENSe<1|2>:]MPOWer:RESult[:LIST]?

This command queries the results of a multiple burst power measurement as configured and initiated with `SENSe:MPOWer[:SEQuence]`. The results are output in a comma-separated list of floating point values. The unit used for the return values is always dBm.

This command may be used to obtain measurement results in an asynchronous way using the service request mechanism for synchronization with the end of the measurement.

If no measurement results are available, the command will return a query error.

Example

*ESE 1

*SRE 32

Configuration of status reporting systems for the generation of an SRQ on operation complete

SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC

Configuring and starting the measurement

...

Further actions of the control computer during measurement

On SRQ:

Response to service request

SENSe:MPOWer:RESult?

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

[SENSe<1|2>:]MPOWer:RESult:MIN?

This command queries the minimum power value in a multiple burst power measurement as configured and initiated with `SENSe:MPOWer[:SEquence]`. The unit used for the return values is always dBm.

If no measurement result is available, the command will return a query error.

Example

*ESE 1

*SRE 32

Configuration of status reporting systems for the generation of an SRQ on operation complete

SENSe:MPOWer 935.2MHz,1MHz,434us,VIDEO,50PCT,5us,MEAN,20;*OPC

Configuring and starting the measurement

...

Further actions of the control computer during measurement

On SRQ:

Response to service request

SENSe:MPOWer:RESult:MIN?

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

SENSe:POWer Subsystem

This subsystem controls the setting of the instruments channel and adjacent channel power measurements.

Commands of the SENSe:POWer Subsystem

- [SENSe<1|2>:]POWer:ACHannel:SPACing:CHANnel
- [SENSe<1|2>:]POWer:ACHannel:SPACing[:ACHannel]
- [SENSe<1|2>:]POWer:ACHannel:SPACing:ALTerminate<1|2>
- [SENSe<1|2>:]POWer:ACHannel:TXCHannel:COUNt
- [SENSe<1|2>:]POWer:ACHannel:ACPairs
- [SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]
- [SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

- [SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2>
- [SENSe<1|2>:]POWer:ACHannel:MODE
- [SENSe<1|2>:]POWer:ACHannel:REFeRence:AUTO
- [SENSe<1|2>:]POWer:ACHannel:REFeRence:TXCHannel:AUTO
- [SENSe<1|2>:]POWer:ACHannel:REFeRence:TXCHannel:MANual
- [SENSe<1|2>:]POWer:ACHannel:PRESet
- [SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel
- [SENSe<1|2>:]POWer:BANDwidth|BWIDth
- [SENSe<1|2>:]POWer:HSPeed
- [SENSe<1|2>:]POWer:TRACe

[SENSe<1|2>:]POWer:ACHannel:SPACing:CHANnel

This command defines the channel spacing for the carrier signals.

Parameter

100 Hz to 2000 MHz

Example

POW:ACH:SPAC:CHAN 25kHz

Characteristics

*RST value: 20 kHz

SCPI: device-specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:SPACing[:ACHannel]

This command defines the channel spacing of the adjacent channel to the TX channel. At the same time, the spacing of alternate adjacent channels 1 and 2 is set to the double or triple of the entered value.

Parameter

100 Hz to 2000 MHz

Example

POW:ACH:SPAC:ACH 33kHz

Sets the spacing between the carrier signal and the adjacent channel to 33 kHz or the alternate adjacent channel 1 to 66 kHz or the alternate adjacent channel 2 to 99 kHz

Characteristics

*RST value: 14 kHz

SCPI: device-specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:SPACing:ALTernate<1|2>

This command defines the spacing between the first (ALTernate1) or the second alternate adjacent channel (ALTernate2) and the TX channel. If the spacing to the alternate adjacent

channel ALTERNate1 is modified, the spacing to alternate adjacent channel 2 is set to 1.5 times the entered value.

Parameter

100 Hz to 2000 MHz

Example

POW:ACH:SPAC:ALT1 100kHz

Sets the spacing between TX channel and alternate adjacent channel 1 to 100 kHz and between TX channel and alternate adjacent channel 2 to 150 kHz.

Characteristics

*RST value: 40 kHz (ALT1), 60 kHz (ALT2)

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:TXChannel:COUNT

This command selects the number of carrier signals.

The command is available only for multicarrier channel and adjacent-channel power measurements (CALC:MARK:FUNC:POW:SEL MCAC) with span > 0.

Parameter

1 to 12

Example

POW:ACH:TXCH:COUN 3

Characteristics

*RST value: 4

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:ACPairs

This command sets the number of adjacent channels (upper and lower channel in pairs). The figure 0 stands for pure channel power measurement.

Parameter

0 | 1 | 2 | 3

Example

POW:ACH:ACP 3

Sets the number of adjacent channels to 3, i.e. the adjacent channel and alternate adjacent channels 1 and 2 are switched on.

Characteristics

*RST value: 1

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]

This command sets the channel bandwidth of the radio communication system. The bandwidths of adjacent channels are not influenced by this modification.

With `SENS:POW:HSP ON` steep-edged channel filters are available. For further information on filters refer to chapter "Instrument Functions", section "List of available RRC and channel filters".

Parameter

100 Hz to 1000 MHz

Example

```
POW:ACH:BWID 30kHz
```

Sets the bandwidth of the TX channel to 30 kHz.

Characteristics

*RST value: 14 kHz

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

This command defines the channel bandwidth of the adjacent channel of the radio transmission system. If the bandwidth of the adjacent channel is changed, the bandwidths of all alternate adjacent channels are automatically set to the same value.

With `SENS:POW:HSP ON` steep-edged channel filters are available. For further information on filters refer to chapter "Instrument Functions", section "List of available RRC and channel filters".

Parameter

100 Hz to 1000 MHz

Example

```
POW:ACH:BWID:ACH 30kHz
```

Sets the bandwidth of all adjacent channels to 30 kHz.

Characteristics

*RST value: 14 kHz

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:BANDwidth|BWIDth:ALTErnate<1|2>

This command defines the channel bandwidth of the first/second alternate adjacent channel of the radio transmission system. If the channel bandwidth of alternate adjacent channel 1 is changed, the bandwidth of alternate adjacent channel 2 is automatically set to the same value.

With `SENS:POW:HSP ON` steep-edged channel filters are available. For further information on filters refer to chapter "Instrument Functions", section "List of available RRC and channel filters".

Parameter

100 Hz to 1000 MHz

Example

```
POW:ACH:BWID:ALT2 30kHz
```

Characteristics

*RST value: 14 kHz

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:MODE

This command switches between absolute and relative adjacent channel measurement. The command is only available with span > 0 and if the number of adjacent channel is greater than 0.

This command is available from firmware version 1.10.

Parameter

ABSolute | RELative

Example

```
POW:ACH:MODE REL
```

Sets the adjacent channel measurement mode to relative.

Characteristics

RST value: RELative

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:REFerence:AUTO

This command sets the reference value to the currently measured channel power for the relative measurement.

This command is an event and therefore has no *RST value and no query.

Parameter

ONCE

Example

```
POW:ACH:REF:AUTO ONCE
```

Characteristics

RST value: –

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:AUTO

This command activates the automatic selection of a transmission channel to be used as a reference channel in relative adjacent-channel power measurements.

The transmission channel with the highest power, the transmission channel with the lowest power, or the transmission channel nearest to the adjacent channels can be defined as a reference channel.

The command is available only for multicarrier channel and adjacent-channel power measurements (`CALC:MARK:FUNC:POW:SEL MCAC`) with `span > 0`.

Parameter

| | |
|----------|--|
| MINimum | Transmission channel with the lowest power |
| MAXimum | Transmission channel with the highest power |
| LHIGhest | Lowermost transmission channel for the lower adjacent channels, uppermost transmission channel for the upper adjacent channels |

Example

```
POW:ACH:REF:TXCH:AUTO MAX
```

The transmission channel with the highest power is used as a reference channel.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:REFerence:TXCHannel:MANual

This command selects a transmission channel to be used as a reference channel in relative adjacent-channel power measurements.

The command is available only for multicarrier channel and adjacent-channel power measurements (`CALC:MARK:FUNC:POW:SEL MCAC`) with `span > 0`.

Parameter

1 to 12

Example

```
POW:ACH:REF:TXCH:MAN 3
```

Transmission channel 3 is used as a reference channel.

Characteristics

*RST value: 1

SCPI: device-specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:PRESet

This command adjusts the frequency span, the measurement bandwidths and the detector as required for the number of channels, the channel bandwidths and the channel spacings selected in the active power measurement. If necessary, adjacent-channel power measurement is switched on prior to the adjustment.

To obtain correct results, a complete sweep with synchronization to the end of the sweep must be performed after the adjustment. Synchronization is possible only in the single sweep mode.

The result is queried with the command `CALCulate:MARKer:FUNction:POWer:RESult?`.

Parameter

ACPower | CPOWer | MCACpower | OBANdwidth | OBWidth | CN | CNO

Example

```
POW:ACH:PRES ACP
```

Sets the frequency span, the measurement bandwidths and the detector as required for the ACP measurement.

```
INIT:CONT OFF
```

Switches over to single sweep mode.

```
INIT;*WAI
```

Starts a sweep and waits for the end of the sweep.

```
CALC:MARK:FUNC:POW:RES? ACP
```

Queries the result of the adjacent-channel power measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

[SENSe<1|2>:]POWer:ACHannel:PRESet:RLEVel

This command adapts the reference level to the measured channel power and – if required – switches on previously the adjacent channel power measurement. This ensures that the signal path of the instrument is not overloaded. Since the measurement bandwidth is significantly smaller than the signal bandwidth in channel power measurements, the signal path can be overloaded although the trace is still significantly below the reference level. If the measured channel power equals the reference level, the signal path is not overloaded.

Note: *Subsequent commands have to be synchronized with *WAI, *OPC or *OPC? to the end of the auto range process which would otherwise be aborted.*

Example

```
POW:ACH:PRES:RLEV;*WAI
```

Adapts the reference level to the measured channel power.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–F

[SENSe<1|2>:]POWer:BANDwidth|BWIDth

This command defines the percentage of the power with respect to the total power. This value is the basis for the occupied bandwidth measurement (POWer:ACHannel:PRESet OBW).

Parameter

10 to 99.9PCT

Example

```
POW:BWID 95PCT
```

Characteristics

*RST value: 99PCT

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:HSPeEd

This command switches on or off the high-speed channel/adjacent channel power measurement. The measurement itself is performed in zero span on the center frequencies of the individual channels. The command automatically switches to zero span and back.

Depending on the selected mobile radio standard, weighting filters with $\sqrt{\cos}$ characteristic or very steep-sided channel filters are used for band limitation.

Parameter

ON | OFF

Example

POW:HSP ON

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-F

[SENSe<1|2>:]POWer:TRACe

This command assigns the channel/adjacent channel power measurement to the indicated trace. The corresponding trace must be active, i.e. its state must be different from blank.

Note: *The measurement of the occupied bandwidth (OBW) is performed on the trace on which marker 1 is positioned. To evaluate another trace, marker 1 must be positioned to another trace with CALCulate:MARKer:TRACe.*

Parameter

1 to 4

Example

POW:TRAC 2

Assigns the measurement to trace 2.

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

SENSe:SWEEp Subsystem

This subsystem controls the sweep parameters.

Commands of the SENSe:SWEEp Subsystem

- [SENSe<1|2>:]SWEEp:TIME
- [SENSe<1|2>:]SWEEp:TIME:AUTO
- [SENSe<1|2>:]SWEEp:COUNT
- [SENSe<1|2>:]SWEEp:COUNT:CURRENT?
- [SENSe<1|2>:]SWEEp:EGATE
- [SENSe<1|2>:]SWEEp:EGATE:TYPE
- [SENSe<1|2>:]SWEEp:EGATE:POLARITY
- [SENSe<1|2>:]SWEEp:EGATE:HOLDOFF
- [SENSe<1|2>:]SWEEp:EGATE:LENGTH
- [SENSe<1|2>:]SWEEp:EGATE:SOURCE
- [SENSe<1|2>:]SWEEp:POINTS

[SENSe<1|2>:]SWEEp:TIME

This command defines the sweep time. The available time values vary depending on the span setting.

If SWEEp:TIME is directly programmed, automatic coupling to resolution bandwidth and video bandwidth is switched off.

Parameter

| | |
|-----------|-------------------|
| span > 0 | 2,5 ms to 16000 s |
| zero span | 1 ms to 16000 s |

Example

```
SWEEp:TIME 10s
```

Characteristics

*RST value: – (AUTO is set to ON)

SCPI: conforming

Mode

A, ADEMOD, NF&GM

[SENSe<1|2>:]SWEEp:TIME:AUTO

This command controls the automatic coupling of the sweep time to the frequency span and bandwidth settings.

If SWEEp:TIME is directly programmed, automatic coupling is switched off.

Parameter

ON | OFF

Example

```
SWE:TIME:AUTO ON
```

Switches on the coupling to frequency span and bandwidths.

Characteristics

*RST value: ON

SCPI: conforming

Mode

A

[SENSe<1|2>:]SWEep:COUNT

This command defines the number of sweeps started with single sweep, which are used for calculating the average or maximum value. If the values 0 or 1 are set, one sweep is performed.

Parameter

0 to 32767

Example

```
SWE:COUN 64
```

Sets the number of sweeps to 64.

```
INIT:CONT OFF
```

Switches to single sweep mode.

```
INIT;*WAI
```

Starts a sweep and waits for its end.

Characteristics

*RST value: 0

SCPI: conforming

Mode

A, ADEMOD

[SENSe<1|2>:]SWEep:COUNT:CURRent?

This query command returns the current number of started sweeps. A sweep count value should be set and the device should be in single sweep mode.

Example

```
SWE:COUNT 64
```

Sets sweep count to 64

```
INIT:CONT OFF
```

Switches to single sweep mode

```
INIT
```

Starts a sweep (without waiting for the sweep end!)

```
SWE:COUN:CURR?
```

Queries the number of started sweeps

Characteristics

*RST value: 0

SCPI: conforming

Mode

A, ADEM0D

[SENSe<1|2>:]SWEep:EGATe

This command switches on/off the sweep control by an external gate signal. If the external gate is selected the trigger source is automatically switched to EXTeRnal as well.

In case of measurement with external gate, the measured values are recorded as long as the gate is opened. During a sweep the gate can be opened and closed several times. The synchronization mechanisms with *OPC, *OPC? and *WAI remain completely unaffected.

The sweep end is detected when the required number of measurement points (501 in **Spectrum Analyzer** mode) has been recorded.

Parameter

ON | OFF

Example

SWE:EGAT ON

Switches on the external gate mode.

SWE:EGAT:TYPE EDGE

Switches on the edge-triggered mode.

SWE:EGAT:HOLD 100US

Sets the gate delay to 100 μ s.

SWE:EGAT:LEN 500US

Sets the gate opening time to 500 μ s.

INIT;*WAI

Starts a sweep and waits for its end.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:TYPE

This command sets the type of triggering (level or edge) by the external gate signal.

The gate is edge-triggered (SWEep:EGATe:TYPE EDGE):

After detection of the set gate signal edge, the gate remains open until the gate delay (SWEep:EGATe:HOLDoff) has expired.

The gate is level-triggered (SWEep:EGATe:TYPE LEVel):

After detection of the gate signal, the gate remains open until the gate signal disappears. The gate opening time cannot be defined with the parameter EGATe:LENGth.

A delay between applying the gate signal and the start of recording measured values can be defined with SWEep:EGATe:HOLDoff.

Parameter

LEVel | EDGE

Example

```
SWE:EGAT:TYPE EDGE
```

Characteristics

*RST value: EDGE

SCPI: device-specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:POLarity

This command determines the polarity of the external gate signal. The setting applies both to the edge of an edge-triggered signal and the level of a level-triggered signal.

Parameter

POSitive | NEGative

Example

```
SWE:EGAT:POL POS
```

Characteristics

*RST value: POSitive

SCPI: device-specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:HOLDoff

This command defines the delay time between the external gate signal and the continuation of the sweep.

Parameter

125 μ s to 100 s

Example

```
SWE:EGAT:HOLD 100us
```

Characteristics

*RST value: 0s

SCPI: device-specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:LENGth

In case of edge triggering, this command determines the time interval during which the instrument sweeps.

Parameter

0 to 100 s

Example

```
SWE:EGAT:LENG 10ms
```

Characteristics

*RST value: 0s

SCPI: device-specific

Mode

A

[SENSe<1|2>:]SWEep:EGATe:SOURce

This command toggles between external gate signal and IF power signal as a signal source for the gate mode. If an IF power signal is used, the gate is opened as soon as a signal at > -20 dBm is detected within the IF path bandwidth (10 MHz).

Parameter

EXTernal | IFPower

Example

```
SWE:EGAT:SOUR IFP
```

Switches the gate source to IF power.

Characteristics

*RST value: IFPower

SCPI: device-specific

Mode

A

[SENSe<1|2>:]SWEep:POINts

This command defines the number of measurement points to be collected during one sweep.

Parameter

125 | 251 | 501 | 1001 | 2001 | 4001 | 8001 | 16001 | 32001

Example

```
SWE:POIN 251
```

Characteristics

*RST value: 501

SCPI: conforming

Mode

A

SOURce Subsystem (Models 13 and 16)

The SOURce subsystem controls the output signals of the instrument for the models with tracking generator, 13 and 16.

The following subsystem is included:

- "SOURce:POWer Subsystem" on page 6.139

SOURce:POWer Subsystem

The SOURce:POWer subsystem controls the power of the tracking generator signal.

Commands of the SOURce:POWer Subsystem

- SOURce<1|2>:POWer[:LEVel][:IMMediate][:AMPLitude]
- SOURce<1|2>:POWer[:LEVel][:IMMediate]:OFFSet

SOURce<1|2>:POWer[:LEVel][:IMMediate][:AMPLitude]

This command defines the output level of the tracking generator.

Parameter

–20 dBm to 0 dBm

Example

```
SOUR:POW -20dBm
```

Sets the tracking generator level to –20 dBm.

Characteristics

*RST value: –20 dBm

SCPI: conforming

Mode

all

SOURce<1|2>:POWer[:LEVel][:IMMediate]:OFFSet

This command defines a level offset for the tracking generator level. Thus, for example, attenuators or amplifiers at the output of the tracking generator can be taken into account for the setting.

Parameter

–200 dB to +200 dB

Example

```
SOUR:POW:OFFS -10dB
```

Sets the level offset of the tracking generator to – 20 dBm.

Characteristics

*RST value: 0dB

SCPI: conforming

Mode

all

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (see chapter "Remote Control – Basics", section "Status Reporting System"). *RST does not influence the status registers.

The following subsystem is included:

- "STATus:QUESTIONable Subsystem" on page 6.140

STATus:QUESTIONable Subsystem

The STATus:QUESTIONable subsystem contains information about the observance of limits during adjacent power measurements, the reference and local oscillator, the observance of limit lines and limit margins and possible overloads of the unit.

Commands of the STATus:QUESTIONable Subsystem

- STATus:QUESTIONable:LIMit<1|2> [:EVENT]?
- STATus:QUESTIONable:LIMit<1|2>:CONDition?
- STATus:QUESTIONable:LIMit<1|2>:ENABLE
- STATus:QUESTIONable:LIMit<1|2>:PTRansition
- STATus:QUESTIONable:LIMit<1|2>:NTRansition
- STATus:QUESTIONable:POWer[:EVENT]?
- STATus:QUESTIONable:POWer:CONDition?
- STATus:QUESTIONable:POWer:ENABLE
- STATus:QUESTIONable:POWer:PTRansition
- STATus:QUESTIONable:POWer:NTRansition
- STATus:QUESTIONable:LMARgin<1|2>[:EVENT]?
- STATus:QUESTIONable:LMARgin<1|2>:CONDition?
- STATus:QUESTIONable:LMARgin<1|2>:ENABLE
- STATus:QUESTIONable:LMARgin<1|2>:PTRansition
- STATus:QUESTIONable:LMARgin<1|2>:NTRansition
- STATus:QUESTIONable:ACPLimit[:EVENT]?
- STATus:QUESTIONable:ACPLimit:CONDition?
- STATus:QUESTIONable:ACPLimit:ENABLE
- STATus:QUESTIONable:ACPLimit:PTRansition
- STATus:QUESTIONable:ACPLimit:NTRansition
- STATus:QUESTIONable:FREQuency[:EVENT]?
- STATus:QUESTIONable:FREQuency:CONDition?
- STATus:QUESTIONable:FREQuency:ENABLE
- STATus:QUESTIONable:FREQuency:PTRansition
- STATus:QUESTIONable:FREQuency:NTRansition

STATus:QUESTIONable:LIMit<1|2> [:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESTIONable:LIMit register. Readout deletes the contents of the EVENT section.

This command is available from firmware version 1.10.

Example

```
STAT:QUES:LIM?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTIONable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUESTIONable:LIMit register.

Readout does not delete the contents of the CONDition section.

This command is available from firmware version 1.10.

Example

```
STAT:QUES:LIM:COND?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTIONable:LIMit<1|2>:ENABle

This command sets the bits of the ENABle section of the STATus:QUESTIONable register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit.

This command is available from firmware version 1.10.

Parameter

0 to 65535

Example

```
STAT:QUES:ENAB 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:LIMit<1|2>:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 0 to 1 for the transitions of the CONDition bit.

This command is available from firmware version 1.10.

Parameter

0 to 65535

Example

STAT:QUES:PTR 65535

Characteristics

*RST value: –

SCPI: device-specific

Mode

all, except NF&GM

STATus:QUEStionable:LIMit<1|2>:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 1 to 0 for the transitions of the CONDition bit.

This command is available from firmware version 1.10.

Parameter

0 to 65535

Example

STAT:QUES:NTR 65535

Characteristics

*RST value: –

SCPI: device-specific

Mode

all, except NF&GM

STATus:QUEStionable:POWer[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUEStionable:POWer register. Readout deletes the contents of the EVENT section.

Example

STAT:QUES?

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEStionable:POWer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:POWer register. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:COND?
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEStionable:POWer:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit.

Parameter

0 to 65535

Example

```
STAT:QUES:ENAB 65535
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEStionable:POWer:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:PTR 65535
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEStionable:POWer:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:NTR 65535

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUESTionable:LMARgin<1|2>[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESTionable:LMARgin register. Readout deletes the contents of the EVENT section.

Example

STAT:QUES:LMAR?

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTionable:LMARgin<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUESTionable:LMARgin register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:LMAR:COND?

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTionable:LMARgin<1|2>:ENABLE

This command sets the bits of the ENABLE section of the STATus:QUESTionable:LMARgin register. The ENABLE register selectively enables the individual events of the associated EVENT section for the summary bit.

Parameter

0 to 65535

Example

```
STAT:QUES:LMAR:ENAB 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTionable:LMARgin<1|2>:PTRansition

This command sets the edge detectors of all bits of the STATus:QUESTionable:LMARgin register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:LMAR:PTR 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTionable:LMARgin<1|2>:NTRansition

This command sets the edge detectors of all bits of the STATus:QUESTionable:LMARgin register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:LMAR:NTR 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUESTionable:ACPLimit[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESTionable:ACPLimit register. Readout deletes the contents of the EVENT section.

Example

```
STAT:QUES:ACPL?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:ACPLimit:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:ACPLimit register. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:ACPL:COND?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:ACPLimit:ENABLE

This command sets the bits of the ENABLE section of the STATus:QUEStionable:ACPLimit register. The ENABLE register selectively enables the individual events of the associated EVENT section for the summary bit.

Parameter

0 to 65535

Example

```
STAT:QUES:ACPL:ENAB 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:ACPLimit:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:ACPL:PTR 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:ACPLimit:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:ACPL:NTR 65535
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:FREQuency[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUEStionable: FREQuency register.

Readout deletes the contents of the EVENT section.

Example

```
STAT:QUES:FREQ?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:FREQuency:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:FREQuency register. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:FREQ:COND?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:FREQuency:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:FREQuency register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:ENAB 65535

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

STATus:QUEStionable:FREQuency:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:PTR 65535

Characteristics

*RST value: –

SCPI: device-specific

Mode

all, except NF&GM

STATus:QUEStionable:FREQuency:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

STAT:QUES:FREQ:NTR 65535

Characteristics

*RST value: –

SCPI: device-specific

Mode

all, except NF&GM

SYSTEM Subsystem

This subsystem contains a series of commands for general functions.

The following subsystem is included:

- ["SYSTEM:SPEaker Subsystem"](#) on page 6.149

SYSTEM:SPEaker Subsystem

This subsystem controls the headset functions.

Commands of the SYSTEM:SPEaker Subsystem

- [SYSTEM:SPEaker:VOLume](#)

SYSTEM:SPEaker:VOLume

This command sets the volume of the headset for demodulated signals.

Parameter

0 to 1; value 0 is the lowest volume, value 1 the highest volume.

Example

```
SYST:SPE:VOL 0.5
```

Characteristics

*RST value: 0

SCPI: device-specific

Mode

all

TRACe Subsystem

The TRACe subsystem controls access to the instruments internal trace memory.

The following subsystem is included:

- ["TRACe:IQ Subsystem"](#) on page 6.151

Commands of the TRACe Subsystem

- [TRACe<1|2>\[:DATA\]](#)
- [TRACe:COPY](#)

TRACe<1|2>[:DATA]

This command transfers trace data from the control computer to the instrument, the query reads trace data out of the instrument. The transfer of trace data from the control computer to the instrument takes place by indicating the trace name and then the data to be transferred.

For details on saving and recalling data refer to chapter "Remote Control – Basics", section "MMEMory Subsystem".

Return values

501 results are returned. The returned values are scaled in the current level unit.

FORMat REAL, 32 is used as format for binary transmission, and FORMat ASCii for ASCII transmission. For details on formats refer to ["Formats for returned values: ASCII format and binary format"](#) on page 6.178.

Note: *With the AUTO PEAK detector, only positive peak values can be read out.*

Parameter

TRACE1 | TRACE2 | TRACE3 | TRACE4 , <block> | <numeric_value>

TRACE1 to TRACE4 = trace memory to be read out.

<block> or <numeric_value> = data to be transferred.

Example

```
TRAC TRACE1
TRAC? TRACE1
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

TRACe:COPY

This command copies data from one trace to another.

This command is an event and therefore has no query and no *RST value.

Parameter

TRACE1 | TRACE2 | TRACE3 | TRACE4 , TRACE1 | TRACE2 | TRACE3 | TRACE4

The first operand the destination of the data to be copied, the second operand describes the source.

Example

```
TRAC:COPY TRACE1,TRACE2
```

Characteristics

*RST value: –

SCPI: conforming

Mode

A

TRACe:IQ Subsystem

The commands of this subsystem are used for collection and output of measured IQ data. A special memory is therefore available in the instrument with 512k words for the I and Q data. The measurement is always performed in zero span at the selected center frequency. The number of samples to be collected and the sample rate can be set (for details refer to "Sample rate" on page 6.152). Prior to being stored in memory or output via GPIB, the measurement data are corrected in terms of frequency response.

The block diagram below shows the analyzer hardware from the IF section to the processor. The A/D converter samples the IF signal (47.9 MHz) at a rate of 65.83 MHz.

The digital signal is down-converted to the complex baseband, lowpass-filtered, and the sampling rate is reduced. The output sampling rate is set between 10 kHz and 65.83 MHz. The continuously adjustable sampling rates are realized using an optimal decimation filter and subsequent resampling on the set sampling rate.

The I/Q data are written to separate memories of 512 k words each. The memories are hardware-triggered. 512 samples are designated as buffer for triggering, which leads to a max. recording length of (512k – 512) samples.

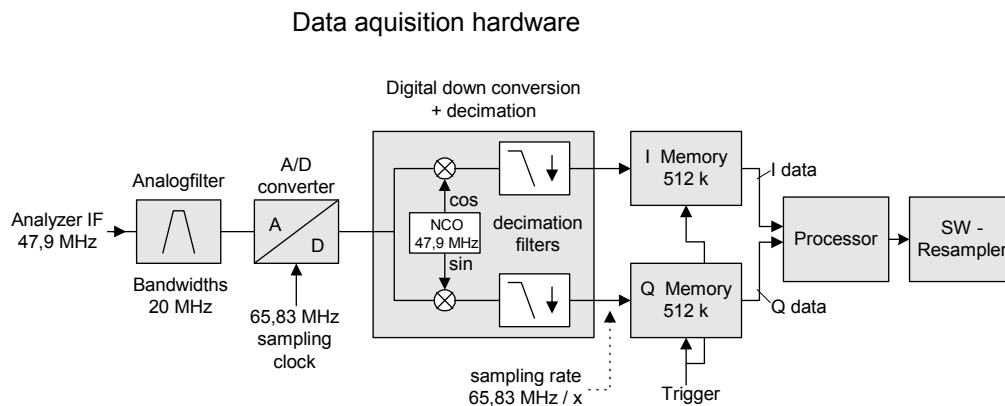


Fig. 6–1 Block diagram illustrating signal processing in analyzer

The trigger sources EXT (external trigger) and IFP (IF Power Trigger) can be used for triggering, additionally IMM (Free Run). The number of test points to be recorded prior to the trigger point can be selected for all available trigger sources, except for FREE RUN.

The measurement results are output in the form of a list, with the Q values following immediately after the list of I values in the output buffer. The `FORMAT` command can be used to select between binary output (32 bit IEEE 754 floating-point values) and output in ASCII format.

For details on formats refer to "Formats for returned values: ASCII format and binary format" on page 6.178.

The commands of this subsystem can be used in two ways:

- Measurement and result query with one

This method causes the least delay between measurement and output of the result data, but it requires the control computer to wait actively for the response data.

- Setting up the instrument, start of the measurement via "INIT" and query of the result list at the end of the measurement:

With this method the control computer can be used for other activities during the measurement. In this case the additional time needed for synchronization via service request must be taken into account.

Commands of the TRACe:IQ Subsystem

- TRACe<1|2>:IQ:AVERAge[:STATe]
- TRACe<1|2>:IQ:AVERAge:COUNT
- TRACe<1|2>:IQ:DATA?
- TRACe<1|2>:IQ:DATA:MEMory?
- TRACe<1|2>:IQ:SET
- TRACe<1|2>:IQ:SRATe
- TRACe<1|2>:IQ[:STATe]
- TRACe<1|2>:IQ:SYNChronize[:STATe]

Further information

- [Sample rate](#)

Sample rate

Depending on the sample rate, the maximum bandwidths listed in the table can be obtained during the measurement. The sample rate can be set in the range from 10 kHz to 65.83 MHz.

- [65.8 MHz to 10.7 MHz](#)
- [10.7 MHz to 3.2 MHz](#)
- [3.2 MHz to 1 MHz](#)
- [1 MHz to 105 kHz](#)
- [105 kHz to 10 kHz](#)

65.8 MHz to 10.7 MHz

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 65 800 000.000 | 32 916 666.670 | 20 000 000.000 |
| 22 500 000.000 | 20 248 687.500 | 17 998 833.330 |
| 20 248 687.500 | 16 401 436.880 | 14 579 055.000 |
| 16 401 436.880 | 14 812 500.000 | 13 166 666.670 |
| 14 812 500.000 | 13 331 250.000 | 11 850 000.000 |
| 13 331 250.000 | 11 998 125.000 | 10 665 000.000 |
| 11 998 125.000 | 10 798 312.500 | 9 598 500.000 |

10.7 MHz to 3.2 MHz

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 10 798 312.500 | 9 875 000.000 | 8 777 777.778 |
| 9 875 000.000 | 8 887 500.000 | 7 900 000.000 |
| 8 887 500.000 | 7 998 750.000 | 7 110 000.000 |
| 7 998 750.000 | 7 406 250.000 | 6 583 333.333 |
| 7 406 250.000 | 6 665 625.000 | 5 925 000.000 |
| 6 665 625.000 | 6 583 333.333 | 5 851 851.852 |
| 6 583 333.333 | 5 925 000.000 | 5 266 666.667 |
| 5 925 000.000 | 5 332 500.000 | 4 740 000.000 |
| 5 332 500.000 | 4 937 500.000 | 4 388 888.889 |
| 4 937 500.000 | 4 443 750.000 | 3 950 000.000 |
| 4 443 750.000 | 4 232 142.857 | 3 761 904.762 |
| 4 232 142.857 | 3 950 000.000 | 3 511 111.111 |
| 3 950 000.000 | 3 703 125.000 | 3 291 666.667 |
| 3 703 125.000 | 3 332 812.500 | 2 962 500.000 |
| 3 332 812.500 | 3 291 666.667 | 2 925 925.926 |

3.2 MHz to 1 MHz

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 3 291 666.667 | 2 962 500.000 | 2 633 333.333 |
| 2 962 500.000 | 2 821 428.571 | 2 507 936.508 |
| 2 821 428.571 | 2 539 285.714 | 2 257 142.857 |
| 2 539 285.714 | 2 468 750.000 | 2 194 444.444 |
| 2 468 750.000 | 2 370 000.000 | 2 106 666.667 |
| 2 370 000.000 | 2 194 444.444 | 1 950 617.284 |
| 2 194 444.444 | 2 116 071.429 | 1 880 952.381 |
| 2 116 071.429 | 1 975 000.000 | 1 755 555.556 |
| 1 975 000.000 | 1 851 562.500 | 1 645 833.333 |
| 1 851 562.500 | 1 795 454.545 | 1 595 959.596 |
| 1 795 454.545 | 1 645 833.333 | 1 462 962.963 |
| 1 645 833.333 | 1 481 250.000 | 1 316 666.667 |
| 1 481 250.000 | 1 346 590.909 | 1 196 969.697 |
| 1 346 590.909 | 1 234 375.000 | 1 097 222.222 |
| 1 234 375.000 | 1 139 423.077 | 1 012 820.513 |
| 1 139 423.077 | 1 039 473.684 | 923 976.608 |

1 MHz to 105 kHz

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 1 039 473.684 | 940 476.191 | 835 978.836 |
| 940 476.191 | 846 428.571 | 752 380.952 |

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 846 428.571 | 779 605.263 | 692 982.456 |
| 779 605.263 | 705 357.143 | 626 984.127 |
| 705 357.143 | 637 096.774 | 566 308.244 |
| 637 096.774 | 580 882.353 | 516 339.869 |
| 580 882.353 | 529 017.857 | 470 238.095 |
| 529 017.857 | 477 822.581 | 424 731.183 |
| 477 822.581 | 435 661.765 | 387 254.902 |
| 435 661.765 | 395 000.000 | 351 111.111 |
| 395 000.000 | 359 090.909 | 319 191.919 |
| 359 090.909 | 323 770.492 | 287 795.993 |
| 323 770.492 | 294 776.119 | 262 023.217 |
| 294 776.119 | 266 891.892 | 237 237.237 |
| 266 891.892 | 240 853.659 | 214 092.141 |
| 240 853.659 | 217 032.967 | 192 918.193 |
| 217 032.967 | 195 544.555 | 173 817.382 |
| 195 544.555 | 176 339.286 | 156 746.032 |
| 176 339.286 | 159 274.194 | 141 577.061 |
| 159 274.194 | 143 810.680 | 127 831.715 |
| 143 810.680 | 129 934.211 | 115 497.076 |
| 129 934.211 | 117 559.524 | 104 497.355 |
| 117 559.524 | 105 803.571 | 94 047.619 |

105 kHz to 10 kHz

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 105 803.571 | 95 410.628 | 84 809.447 |
| 95 410.628 | 85 869.565 | 76 328.502 |
| 85 869.565 | 77 450.980 | 68 845.316 |
| 77 450.980 | 69 787.986 | 62 033.765 |
| 69 787.986 | 62 898.089 | 55 909.413 |
| 62 898.089 | 56 752.874 | 50 446.999 |
| 56 752.874 | 51 077.586 | 45 402.299 |
| 51 077.586 | 46 001.553 | 40 890.269 |
| 46 001.553 | 41 404.612 | 36 804.100 |
| 41 404.612 | 37 264.151 | 33 123.690 |
| 37 264.151 | 33 588.435 | 29 856.387 |
| 33 588.435 | 30 229.592 | 26 870.748 |
| 30 229.592 | 27 228.860 | 24 203.431 |
| 27 228.860 | 24 524.007 | 21 799.117 |
| 24 524.007 | 22 075.261 | 19 622.454 |
| 22 075.261 | 19 869.215 | 17 661.525 |
| 19 869.215 | 17 889.493 | 15 901.771 |

| Sample rate from [Hz] | Sample rate to [Hz] | Max bandwidth [Hz] |
|-----------------------|---------------------|--------------------|
| 17 889.493 | 16 100.543 | 14 311.594 |
| 16 100.543 | 14 493.640 | 12 883.235 |
| 14 493.640 | 13 044.914 | 11 595.479 |
| 13 044.914 | 11 741.974 | 10 437.310 |
| 11 741.974 | 10 572.805 | 9 398.049 |
| 10 572.805 | 10 000.000 | 8 460.509 |

TRACe<1|2>:IQ:AVERage[:STATe]

The command enables averaging of the recorded I/Q data provided that I/Q data acquisition was previously enabled with `TRAC:IQ ON`.

Parameter

ON | OFF

Example

```
TRAC:IQ ON
```

Switches on acquisition of I/Q data.

```
TRAC:IQ:AVER ON
```

Enables averaging of the I/Q measurement data.

```
TRAC:IQ:AVER:COUN 10
```

Selects averaging over 10 data sets.

```
TRAC:IQ:DATA?
```

Starts the measurement and reads out the averaged data.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A-T

TRACe<1|2>:IQ:AVERage:COUNT

This command defines the number of I/Q data sets that are to serve as a basis for averaging.

Parameter

0 to 32767

Example

```
TRAC:IQ ON
```

Switches on acquisition of I/Q data.

```
TRAC:IQ:AVER ON
```

Enables averaging of the I/Q measurement data

```
TRAC:IQ:AVER:COUN 10
```

Selects averaging over 10 data sets

```
TRAC:IQ:DATA?
```

Starts the measurement and reads out the averaged data.

Characteristics

*RST value: 0

SCPI: conforming

Mode

all

TRACe<1|2>:IQ:DATA?

This command starts a measurement with the settings defined via `TRACe:IQ:SET` and returns the list of measurement results immediately after they are corrected in terms of frequency response. The number of measurement results depends on the settings defined with `TRACe:IQ:SET`, the output format depends on the settings of the `FORMat` subsystem.

Note: *The command requires that all response data are read out completely before the instrument accepts further commands.*

Return values

The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument. In ASCII format, the number of the returned values is 2 * the number of samples. The first set contains the I–data, the second the Q–data.

Note: *If the sampling rate exceeds 512k (= 524288), the data are output in 512k blocks.*

In binary format, the number of I– and Q–data can be calculated as follows:

$$\# \text{ of I-Data} = \# \text{ of Q-Data} = \frac{\# \text{ of DataBytes}}{8}$$

The offset of Q–data in the output buffer can be calculated as follows:

$$Q\text{-Data-Offset} = \frac{(\# \text{ of DataBytes})}{2} + \text{LengthIndicatorDigits}$$

with `LengthIndicatorDigits` being the number of digits of the length indicator including the #. In the example above (#41024...) this results in a value of 6 for `LengthIndicatorDigits` and the offset for the Q–data will result in 512 + 6 = 518.

For further details on formats refer to "[Formats for returned values: ASCII format and binary format](#)" on page 6.178.

Example

```
TRAC:IQ:STAT ON
Enables acquisition of I/Q data
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,4096
Measurement configuration:
Sample Rate: 32 MHz
Trigger Source: External
Trigger Slope: Positive
Pretrigger Samples: 0
# of Samples: 4096
FORMat REAL,32
Selects format of response data
TRAC:IQ:DATA?
Starts measurement and reads results
```

Characteristics

*RST value: –

Note: *Using the command with the *RST values for command `TRAC:IQ:SET` the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, Binary format: 2 kBytes*

SCPI: device–specific

Mode

A–T

TRACe<1|2>:IQ:DATA:MEMory?

This command permits the readout of previously acquired (and frequency response corrected) I/Q data from the memory, with indication of the offset related to the start of measurement and with indication of the number of measurement values. Therefore a previously acquired data set can be read out in smaller portions. The maximum amount of available data depends on the settings of command TRACe: IQ: SET, the output format on the settings in the FORMat subsystem.

Note: *The command requires that all response data are read out completely before the instrument accepts further commands.
If there are not I/Q data available in memory because the corresponding measurement had not been started, the command will cause a Query Error.*

Parameter

- <offset samples> Offset of the values to be read related to the start of the acquired data.
Value range: 0 to <# of samples> – 1, with <# of samples> being the value indicated with command TRACe: IQ: SET.
- <# of samples> Number of measurement values to be read.
Value range: 1 to <# of samples> – <offset samples> with <# of samples> being the value indicated with command TRACe: IQ: SET.

Return values

The returned values are scaled linear in unit Volt and correspond to the voltage at the RF input of the instrument.

The format of the output buffer corresponds to the command TRACe: IQ: DATA?

Example

```
TRAC: IQ: STAT ON
```

Enables acquisition of I/Q data

```
TRAC: IQ: SET NORM, 10MHz, 32MHz, EXT, POS, 100, 4096
```

To configure the measurement:

Sample Rate: 32 MHz

Trigger Source: External

Slope: Positive

Pretrigger Samples: 100

of Samples: 4096

```
INIT; *WAI
```

Starts measurement and wait for sync

```
FORMat REAL, 32
```

Determines output format

To read the results:

```
TRAC: IQ: DATA: MEM? 0, 2048
```

Reads 2048 I/Q data starting at the beginning of data acquisition

```
TRAC: IQ: DATA: MEM? 2048, 1024
```

Reads 1024 I/Q data from half of the recorded data

```
TRAC: IQ: DATA: MEM? 100, 512
```

Reads 512 I/Q data starting at the trigger point (<Pretrigger Samples> was 100)

Characteristics

*RST value: –

SCPI: device-specific

Mode

A–T

TRACe<1|2>:IQ:SET

This command defines the settings of the analyzer hardware for the measurement of I/Q data. This allows setting the bandwidth of the analog filters in front of the A/D converter as well as setting the sample rate, trigger conditions and the record length.

Note: *If this command is omitted, the current analyzer settings will be used for the corresponding parameters.*

This command switches to IQ mode automatically (TRAC:IQ:STATE ON).

The parameter <filter_type> and <sample_rate> have no effect but are indicated for reasons of compatibility with the FSP family.

The trigger level can be set using the command TRIG:LEV:IFP.

Parameter

| | |
|----------------------|--|
| <filter type> | can be omitted |
| <rbw> | can be omitted |
| <sample rate> | Sampling rate for the data acquisition. Value range: 10 kHz to 65.83 MHz, continuously adjustable |
| <trigger mode> | Selection of the trigger source used for the measurement. Values: IMMEDIATE EXTERNAL IFPOWER |
| <trigger slope> | Used trigger slope. Values: POSITIVE |
| <pretrigger samples> | Number of measurement values to be recorded before the trigger point. Range: –16253439 (= $-(2^{24}-1-512k-512)$) ... 523775 (= $512*1024 - 512 - 1$). Negative values correspond to a trigger delay. |
| <# of samples> | Number of measurement values to record. Value range: 1 ... 523776 (= $512*1024 - 512$) |

Example

```
TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,2048
```

Reads 2048 I/Q-values starting at the trigger point.

sample rate: 32 MHz

trigger: External

slope: Positive

```
TRAC:IQ:SET NORM,10MHz,4MHz,EXT,POS,1024,512
```

Reads 512 I/Q-values from 1024 measurement points before the trigger point.

filter type: NORMAL

RBW: 10 MHz

sample rate: 4 MHz

trigger: External

slope: Positive

Characteristics

*RST values: –,–,32MHz,IMM,POS,0,128

Note: For using these default settings with command `TRAC:IQ:DATA?` the following minimum buffer sizes for the response data are recommended: ASCII format 10 kBytes, Binary format 2 kBytes.

SCPI: device-specific

Mode

A–T

TRACe<1|2>:IQ:SRATe

This command sets the sampling rate for the I/Q data acquisition. Thus the sample rate can be modified without affecting the other settings.

Parameter

10 kHz to 65.83 MHz, continuously adjustable

Example

`TRAC:IQ:SRAT 4MHZ`

Characteristics

*RST value: 32 MHz

SCPI: device-specific

Mode

A–T

TRACe<1|2>:IQ[:STATe]

This command switches the I/Q data acquisition on or off.

Note: The I/Q data acquisition is not compatible with other measurement functions. Therefore all other measurement functions will be switched off as soon as the I/Q measurement function is switched on. Additionally a trace display is not possible in this operating mode. Therefore all traces are set to "BLANK".

Parameter

ON | OFF

Example

`TRAC:IQ ON`

Switches on I/Q data acquisition

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A–T

TRACe<1|2>:IQ:SYNChronize[:STATe]

This command activates the synchronization of I/Q data acquisition and trigger point. Prerequisites are that the I/Q data acquisition is activated using the command `TRAC:IQ ON` and the sampling rate is set to 32 MHz.

The synchronization ensures that the data acquisition starts always with the same phase shift to the trigger point. The constant phase shift is necessary for correct I/Q data averaging.

Parameter

ON|OFF

Example`TRAC:IQ ON`

Activates the I/Q data acquisition.

`TRAC:IQ:SYNC ON`

Activates the synchronization of I/Q data acquisition and trigger point.

`TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,2048`

Reads 2048 I/Q values from the trigger point.

filter type: NORMAL

RBW: 10 MHz

sample rate: 32 MHz

trigger: External

slope: Positive

`TRAC:IQ:AVER ON`

Activates the I/Q data averaging.

`TRAC:IQ:AVER:COUN 10`

Selects averaging over 10 data sets.

`TRAC:IQ:DATA?`

Starts the measurement and reads the averaged data.

Characteristics

RST value: ON

SCPI: device-specific

ModeA-T

TRIGger Subsystem

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep.

Commands of the TRIGger Subsystem

- TRIGger<1|2>[:SEQuence]:SOURce
- TRIGger<1|2>[:SEQuence]:LEVel:IFPower
- TRIGger<1|2>[:SEQuence]:LEVel:VIDeo
- TRIGger<1|2>[:SEQuence]:HOLDoff[:TIME]
- TRIGger<1|2>[:SEQuence]:SLOPe
- TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame (option TV Trigger, B6)
- TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer (option TV Trigger, B6)
- TRIGger<1|2>[:SEQuence]:VIDeo:FIELD:SElect (option TV Trigger, B6)
- TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity (option TV Trigger, B6)

TRIGger<1|2>[:SEQuence]:SOURce

This command selects the trigger source for the start of a sweep.

Parameter

IMMediate (Free Run) | EXTern | IFPower | VIDeo

TV (option TV Trigger, B6, available from firmware version 1.10)

For details on trigger modes refer to chapter "Instrument Functions", section "Trigger mode overview".

Example

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Characteristics

*RST value: IMMediate

SCPI: conforming

Mode

A, ADEMOD

TRIGger<1|2>[:SEQuence]:LEVel:IFPower

This command sets the level of the IF power trigger source.

Parameter

–30 to –10 DBM

Example

```
TRIG:LEV:IFP -20DBM
```

Characteristics

*RST value: –20 DBM

SCPI: device-specific

Mode

all

TRIGger<1|2>[:SEQuence]:LEVel:VIDeo

This command sets the level of the video trigger source.

Parameter

0 to 100 PCT

Example

```
TRIG:LEV:VID 50PCT
```

Characteristics

*RST value: 50 PCT

SCPI: device-specific

Mode

all, except ADEMOD

TRIGger<1|2>[:SEQuence]:HOLDoff[:TIME]

This command defines the length of the trigger delay.

A negative delay time (pretrigger) can be set in zero span only.

Parameter

-100 s to +100 s

for TV trigger (option B6, available from firmware version 1.10): -50 μ s to +50 μ s**Example**

```
TRIG:HOLD 500us
```

Characteristics

*RST value: 0 s

SCPI: conforming

Mode

all

TRIGger<1|2>[:SEQuence]:SLOPe

This command selects the slope of the trigger signal. The selected trigger slope applies to all trigger signal sources except the TV trigger (option B6, available from firmware version 1.10).

Parameter

POSitive | NEGative

Example

```
TRIG:SLOP NEG
```

Characteristics

*RST value: POSitive

SCPI: conforming

Mode

all

TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame (option TV Trigger, B6)

This command defines the line system in use (525 or 625 lines) with active TV trigger. Option TV Trigger, B6, is available from firmware version 1.10.

Parameter

525 | 625

Example

```
TRIG:VID:FORM:LPFR 525
```

Characteristics

*RST value: 625

SCPI: conforming

Mode

A-T

TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer (option TV Trigger, B6)

With active TV trigger this command activates triggering at the horizontal sync signal of the indicated line number.

Option TV Trigger, B6, is available from firmware version 1.10.

Parameter

<numeric_value>

Example

```
TRIG:VID:LINE:NUMB 17
```

Characteristics

*RST value: –

SCPI: conforming

Mode

A-T

TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SElect (option TV Trigger, B6)

With active TV trigger this command activates triggering at the vertical sync signal.

Option TV Trigger, B6, is available from firmware version 1.10.

Parameter

ALL (both fields) | ODD (odd fields) | EVEN (even fields)

Example

```
TRIG:VID:FIEL:SEL ALL
```

Characteristics

*RST value: –

SCPI: conforming

Mode

A-T

TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity (option TV Trigger, B6)

With active TV trigger this command selects the polarity of the video sync signal.
Option TV Trigger, B6, is available from firmware version 1.10.

Parameter

NEGative | POSitive

Example

```
TRIG:VID:SSIG:POL NEG
```

Characteristics

*RST value: NEGative

SCPI: conforming

Mode

A-T

UNIT Subsystem

The UNIT subsystem sets the basic unit of the setting parameters.

Commands of the UNIT Subsystem

- [UNIT<1|2>:POWer](#)

UNIT<1|2>:POWer

This command selects the default unit.

Parameter

DBM | V | A | W | DBPW | WATT | DBPT | DBUV | DBMV | VOLT | DBUA | AMPere

Example

```
UNIT:POW DBUV
```

Sets the power unit to dBm.

Characteristics

*RST value: DBM

SCPI: conforming

Mode

A

Remote Commands of the Analog Demodulation Option (K7)

In this section all remote control commands for Analog Demodulation option are described in detail. For details on conventions used in this chapter refer to the introduction at the beginning of this chapter.

This option is available from firmware version 1.10.

Subsystems of the Analog Demodulation option (K7)

- [CALCulate Subsystem \(Analog Demodulation, K7\)](#)
- [DISPlay Subsystem \(Analog Demodulation, K7\)](#)
- [SENSe Subsystem \(Analog Demodulation, K7\)](#)
- [TRACe Subsystem \(Analog Demodulation, K7\)](#)
- [TRIGger Subsystem \(Analog Demodulation, K7\)](#)
- [UNIT Subsystem \(Analog Demodulation, K7\)](#)

CALCulate Subsystem (Analog Demodulation, K7)

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSE subsystem.

The following subsystems are included:

- "CALCulate:DELTamarker Subsystem" on page 6.167
- "CALCulate:FEED Subsystem" on page 6.167
- "CALCulate:FORMat Subsystem" on page 6.168
- "CALCulate:MARKer Subsystem" on page 6.169
- "CALCulate:UNIT Subsystem" on page 6.174

CALCulate:DELTamarker Subsystem (Analog Demodulation, K7)

The CALCulate:DELTamarker subsystem controls the delta marker functions in the instrument.

Commands of the CALCulate:DELTamarker Subsystem

– [CALCulate<1|2>:DELTamarker<1...4>:Y?](#)

CALCulate<1|2>:DELTamarker<1...4>:Y?

Depending on the unit defined with `CALC:UNIT` or on the activated measuring functions, the query result is output in the units below:

| Result display | Output unit |
|--------------------------------|--|
| AM result display (R&S FSL-K7) | % (lin) dB (log) |
| FM result display (R&S FSL-K7) | Hz (lin) dB (log) |
| PM result display (R&S FSL-K7) | rad deg (lin) dB (log) |
| RF result display (R&S FSL-K7) | output unit defined with <code>CALC:UNIT</code> |

For further details refer to "[CALCulate<1|2>:DELTamarker<1...4>:Y?](#)" on page 6.9.

CALCulate:FEED Subsystem (Analog Demodulation, K7)

The CALCulate:FEED subsystem selects the type of evaluation of the measured data. This corresponds to the selection of the result display in manual mode.

Commands of the CALCulate:FEED Subsystem

– [CALCulate<1|2>:FEED](#)

CALCulate<1|2>:FEED

This command selects the measured data that are to be displayed.

Parameter

| | |
|--------------------------------------|---|
| 'XTIM:AM:RELative[:TDOMain]' | Demodulated AM signal in standardized display |
| 'XTIM:AM:RELative:AFSPectrum<1...4>' | AF spectrum of the demodulated AM signal in standardized display, results referenced to traces 1 to 4 |
| 'XTIM:AM[:ABSolute][:TDOMain]' | Demodulated AM signal in level display Same as 'XTIM:RFPower' |
| 'XTIM:RFPower[:TDOMain]' | RF power of the signal |
| 'XTIM:FM[:TDOMain]' | Demodulated FM signal |
| 'XTIM:FM:AFSPectrum<1...4>' | AF spectrum of the demodulated FM signal, results referenced to traces 1 to 4 |
| 'XTIM:PM[:TDOMain]' | Demodulated PM signal |
| 'XTIM:PM:AFSPectrum<1...4>' | AF spectrum of the demodulated PM signal, results referenced to traces 1 to 4 |
| 'XTIM:AMSummary<1...4>[:ABSolute]' | AM results in level display, referenced to traces 1 to 4 |
| 'XTIM:AMSummary<1...4>:RELative' | AM results in standardized display, referenced to traces 1 to 4 |
| 'XTIM:FMSummary<1...4>' | FM results, referenced to traces 1 to 4 |
| 'XTIM:PMSummary<1...4>' | PM results, referenced to traces 1 to 4 |
| 'XTIM:SPECTrum' | RF spectrum of the signal determined from the measured data via FFT |

Example

```
INST:SEL ADEM
Activates analog demodulator.
CALC:FEED 'XTIM:FM'
Selects the display of the FM signal.
```

Characteristics

RST value: –
SCPI: conforming

Mode

ADEMOD

CALCulate:FORMat Subsystem (Analog Demodulation, K7)

The CALCulate:FORMat subsystem defines the conversion of measured data.

Commands of the CALCulate:FORMat Subsystem

– [CALCulate<1|2>:FORMat](#)

CALCulate<1|2>:FORMat

This command activates the limitation to $\pm 180^\circ$.

Parameter

PHASe: Limitation to $\pm 180^\circ$
 UPHase: Unwrapped

Example

CALC:FORM PHAS
 Activates the limitation to $\pm 180^\circ$.

Characteristics

RST value: UPHase
 SCPI: conforming

Mode

ADEMOM

CALCulate:MARKer Subsystem (Analog Demodulation, K7)

The CALCulate:MARKer subsystem checks the marker functions in the instrument.

The following subsystem is included:

- ["CALCulate:MARKer:FUNCTion:ADEMOM Subsystem \(Analog Demodulation, K7\)"](#) on page 6.170

Commands of the CALCulate:MARKer Subsystem

- [CALCulate<1|2>:MARKer<1...4>:Y?](#)
- [CALCulate<1|2>:MARKer<1...4>:PEXCursion](#)

CALCulate<1|2>:MARKer<1...4>:Y?

If the analog demodulator (option Analog Demodulation, R&S FSL–K7) is activated, the query result is output in the following units:

| Result display | Output unit |
|----------------|------------------------------------|
| AM | % |
| FM | Hz |
| PM | rad/deg (defined with UNIT:ANGLE) |
| RF | output unit defined with CALC:UNIT |

For further details refer to ["CALCulate<1|2>:MARKer<1...4>:Y?"](#) on page 6.169.

CALCulate<1|2>:MARKer<1...4>:PEXCursion

The unit depends on the active display.

Example

CALC:MARK:PEXC 100 HZ
 Defines peak excursion 100 Hz

Characteristics

*RST value:
 6dB RF displays

5 PCT AM displays
 50 kHz FM displays
 0.5 RAD PM displays

For further details refer to "[CALCulate<1|2>:MARKer<1...4>:PEXCursion](#)" on page 6.48.

CALCulate:MARKer:FUNCtion:ADEMod Subsystem (Analog Demodulation, K7)

The CALCulate:MARKer:FUNCtion:ADEMod subsystem contains the marker functions for the option Analog Demodulation, R&S FSL–K7.

Commands of the CALCulate:MARKer:FUNCtion:ADEMod Subsystem

- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AM\[:RESult<1...4>?\]](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FM\[:RESult<1...4>?\]](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:PM\[:RESult<1...4>?\]](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AFRequency\[:RESult<1...4>?\]](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FERRor\[:RESult<1...4>?\]](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:SINad:RESult<1...4>?](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:THD:RESult<1...4>?](#)
- [CALCulate<1|2>:MARKer:FUNCtion:ADEMod:CARRier\[:RESult<1...4>?\]](#)

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:AM[:RESult<1...4>?]

This command queries the results of the AM modulation measurement. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

Parameter

| | |
|--------|---|
| PPEak | Result of measurement with detector +PK |
| MPEak | Result of measurement with detector –PK |
| MIDDLE | Result of averaging \pm PK/2 |
| RMS | Result of rms measurement |

Example

```
ADEM ON
Switches on the analog demodulator.
CALC:FEED 'XTIM:AM:REL:TDOM'
Switches on the AM result display.
DISP:TRAC ON
Switches on the trace.
CALC:MARK:FUNC:ADEM:AM? PPE
Queries the peak value.
```

Characteristics

RST value: –
 SCPI: device-specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:FM[:RESult<1...4>?]

This command queries the results of FM modulation measurement. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

Parameter

| | |
|--------|---|
| PPEak | Result of measurement with detector +PK |
| MPEak | Result of measurement with detector –PK |
| MIDDLE | Result of averaging \pm PK/2 |
| RMS | Result of rms measurement |

Example

```
ADEM ON
Switches on the analog demodulator.
CALC:FEED 'XTIM:FM:TDOM'
Switches on the FM result display.
CALC:MARK:FUNC:ADEM:FM? PPE
Queries the peak value.
```

Characteristics

*RST value: –
SCPI: device–specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:PM[:RESult<1...4>?]

This command queries the results of PM modulation measurement of analog demodulation. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

Parameter

| | |
|--------|---|
| PPEak | Result of measurement with detector +PK |
| MPEak | Result of measurement with detector –PK |
| MIDDLE | Result of averaging \pm PK/2 |
| RMS | Result of rms measurement |

Example

```
ADEM ON
Switches on the analog demodulator.
CALC:FEED 'XTIM:PM:TDOM'
Switches on the FM result display.
CALC:MARK:FUNC:ADEM:PM? PPE
Queries the peak value.
```

Characteristics

*RST value: –
SCPI: device–specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCTION:ADEMod:AFRequency[:RESult<1...4>?]

This command queries the audio frequency with analog demodulation. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

Note: *If several demodulation modes are activated simultaneously (e.g. with the command SENS:ADEM:FM:TYPE), the audio frequency of the display mode selected with CALC:FEED is returned.*

Example

```
ADEM ON
```

Switches on analog demodulator

```
CALC:FEED 'XTIM:AM:TDOM'
```

Switches on AM result display.

or

```
CALC:FEED 'XTIM:FM:TDOM'
```

Switches on FM result display.

or

```
CALC:FEED 'XTIM:FM:AFSP'
```

```
DISP:TRAC ON
```

Switches on AF spectrum result display of FM and trace.

```
CALC:MARK:FUNC:ADEM:AFR?
```

Queries the audio frequency.

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEM0D

CALCulate<1|2>:MARKer:FUNCTION:ADEMod:FERRor[:RESult<1...4>?]

This command queries the frequency error with FM and PM demodulation. With FM demodulation, trace 1 to 4 is selected with the numeric suffix (:RESult<1...4>). With PM demodulation, the frequency error is determined from the current measurement data (CLR/WRITE trace).

The offset thus determined differs from that calculated in the command

[SENSe:]ADEMod:FM:OFFSet?, since, for determination of the frequency deviation, the modulation is removed by means of lowpass filtering, producing results that are different from those obtained by averaging with the SENSe command.

This command is only available for traces in the FM and PM result display. If another result display is selected, the command is disabled.

Example

```
ADEM ON
```

Switches on analog demodulator

```
CALC:FEED 'XTIM:FM:TDOM'
```

Switches on FM result display

```
CALC:MARK:FUNC:ADEM:FERR?
```

Queries the frequency error of trace 1

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:SINad:RESult<1...4>?

This command queries the result of the SINAD measurement. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

This command is a query only and thus has no *RST value.

Example

ADEM ON

Switches on analog demodulator

CALC:FEED 'XTIM:FM:AFSP'

DISP:TRAC ON

Switches on AF spectrum of FM and trace

CALC:MARK:FUNC:ADEM:SIN:RES?

Queries SINAD value

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:THD:RESult<1...4>?

This command queries the result of the THD measurement. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

This command is a query only and thus has no *RST value.

Example

ADEM ON

Switches on analog demodulator

CALC:FEED 'XTIM:FM:AFSP'

Switches on AF spectrum of FM and trace

DISP:TRAC ON

Switches on the trace

CALC:MARK:FUNC:ADEM:THD:RES?

Queries THD result

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

CALCulate<1|2>:MARKer:FUNCtion:ADEMod:CARRier[:RESult<1...4>?]

This command queries the carrier power. The numeric suffix (:RESult<1...4>) indicates whether trace 1, 2, 3 or 4 is selected.

With RF Power result display, the carrier power is determined from trace 1 to 4 indicated in the numeric suffix. With all other result displays, the carrier power is determined from the current trace data (CLR/WRITE trace).

This command is only a query and therefore has no *RST value.

Example

```
ADEM ON
Switches on analog demodulator
CALC:FEED 'XTIM:RFP'
Switches on RF power result display
CALC:MARK:FUNC:ADEM:CARR?
Queries the carrier power
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

ADEMOD

CALCulate:UNIT Subsystem (Analog Demodulation, K7)

The CALCulate:Unit subsystem defines the units for the parameters that can be set and the measurement results.

Commands of the CALCulate:UNIT Subsystem

– [CALCulate<1|2>: UNIT:ANGLE](#)

CALCulate<1|2>: UNIT:ANGLE

This command selects the unit for angles.

Parameter

DEG | RAD

Example:

```
CALC:UNIT:ANGL DEG
```

Characteristics:

*RST value: RAD
SCPI: device-specific

Mode

ADEMOD

DISPlay Subsystem (Analog Demodulation, K7)

The DISPlay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

- [DISPlay\[:WINDow<1|2>\]:SIZE](#)
- [DISPlay\[:WINDow<1|2>\]:TRACE<1...4>:Y\[:SCALe\]:RVALue](#)
- [DISPlay\[:WINDow<1|2>\]:TRACe<1...4>:Y\[:SCALe\]:RPOSition](#)
- [DISPlay\[:WINDow<1|2>\]:TRACE<1...4>:Y\[:SCALe\]:PDIVision](#)
- [DISPlay\[:WINDow<1|2>\]:TRACe<1...4>:Y:SPACing](#)

[DISPlay\[:WINDow<1|2>\]:SIZE](#)

This command switches the measurement window for active analog demodulation to full screen or half screen.

For further details refer to "[DISPlay\[:WINDow<1|2>\]:SIZE](#)" on page 6.90.

[DISPlay\[:WINDow<1|2>\]:TRACE<1...4>:Y\[:SCALe\]:RVALue](#)

This command defines the reference value assigned to the reference position. Separate reference values are maintained for the various displays.

Example

```
DISP:TRAC:Y:RVAL 0
```

Sets the value assigned to the reference position to 0 Hz (analog demodulation)

Characteristics

*RST value:

| | |
|---------|----------------------------------|
| 0 PCT | AM display |
| 0 Hz | FM display |
| 0 rad | PM display |
| 100 PCT | AF spectrum display of AM signal |
| 250 kHz | AF spectrum display of FM signal |
| 10 rad | AF spectrum display of PM signal |

For further details see also "[DISPlay\[:WINDow<1|2>\]:TRACE<1...4>:Y\[:SCALe\]:RVALue \(models 13, 16\)](#)" on page 6.92.

[DISPlay\[:WINDow<1|2>\]:TRACe<1...4>:Y\[:SCALe\]:RPOSition](#)

Characteristics

*RST value:

| | |
|---------|--------------------------------------|
| 100 PCT | AF spectrum display of AM, FM, or PM |
| 50 PCT | AM, FM, or PM display |

For further details refer to "[DISPlay\[:WINDow<1|2>\]:TRACe<1...4>:Y\[:SCALe\]:RPOsition \(models 13, 16\)](#)" on page 6.93.

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:PDIVision

This command defines the scaling of the Y axis in the current unit. The numeric suffix in TRACE<1...4> is irrelevant.

Parameter

<numeric_value>

Example

```
DISP:TRAC:Y:PDIV +10kHz
```

Sets the Y scale to 10 kHz/div.

Characteristics

*RST value:

| | |
|--------|---------------------------------|
| 20 PCT | linear AM display |
| 50 kHz | linear FM display |
| 2 rad | linear PM display |
| 10 dB | logarithmic AF spectrum display |

SCPI: conforming

Mode

ADEM0D

DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing

When the AF spectrum result display is selected, only the parameters LINear and LOGarithmic are allowed.

For further details refer to "[DISPlay\[:WINDow<1|2>\]:TRACe<1...4>:Y:SPACing](#)" on page 6.93.

SENSe Subsystem (Analog Demodulation, K7)

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

- "SENSe:ADEMod Subsystem" on page 6.177
- "SENSe:BANDwidth Subsystem" on page 6.199
- "SENSe:FILTer Subsystem" on page 6.199
- "SENSe:FREQuency Subsystem" on page 6.202
- "SENSe:SWEEp Subsystem" on page 6.203

SENSe:ADEMod Subsystem (Analog Demodulation, K7)

The SENSe:ADEMod Subsystem contains commands to set up the instrument for the measurement of analog demodulated signals and query the result at the end of the measurement.

Commands of the SENSe:ADEMod Subsystem

- [SENSe:]ADEMod:AF:COUPling
- [SENSe:]ADEMod:AF:CENTer
- [SENSe:]ADEMod:AF:SPAN
- [SENSe:]ADEMod:AF:SPAN:FULL
- [SENSe:]ADEMod:AF:STARt
- [SENSe:]ADEMod:AF:STOP
- [SENSe:]ADEMod:BANDwidth | BWIDth:DEModulation
- [SENSe:]ADEMod:MTIME
- [SENSe:]ADEMod:RLENgth?
- [SENSe:]ADEMod[::STATe]
- [SENSe:]ADEMod:SET
- [SENSe:]ADEMod:SRATE?
- [SENSe:]ADEMod:AM[::ABSolute][::TDOMain][::TYPE]
- [SENSe:]ADEMod:AM[::ABSolute][::TDOMain]:RESult?
- [SENSe:]ADEMod:AM:RELative[::TDOMain][::TYPE]
- [SENSe:]ADEMod:AM:RELative[::TDOMain]:RESult?
- [SENSe:]ADEMod:AM:RELative:AFSPectrum[::TYPE]
- [SENSe:]ADEMod:AM:RELative:AFSPectrum:RESult?
- [SENSe:]ADEMod:FM[::TDOMain][::TYPE]
- [SENSe:]ADEMod:FM[::TDOMain]:RESult?

- [SENSe:]ADEMod:FM:AFSPectrum[:TYPE]
- [SENSe:]ADEMod:FM:AFSPectrum:RESult?
- [SENSe:]ADEMod:FM:OFFSet?
- [SENSe:]ADEMod:PM[:TDOMain][:TYPE]
- [SENSe:]ADEMod:PM[:TDOMain]:RESult?
- [SENSe:]ADEMod:PM:AFSPectrum[:TYPE]
- [SENSe:]ADEMod:PM:AFSPectrum:RESult?
- [SENSe:]ADEMod:PM:RPOint[:X]
- [SENSe:]ADEMod:SPECTrum: BANDwidth|BWIDth[:RESolution]
- [SENSe:]ADEMod:SPECTrum:SPAN[:MAXimum]
- [SENSe:]ADEMod:SPECTrum:SPAN:ZOOM
- [SENSe:]ADEMod:SPECTrum[:TYPE]
- [SENSe:]ADEMod:SPECTrum:RESult?
- [SENSe:]ADEMod:ZOOM[:STATe>]
- [SENSe:]ADEMod:ZOOM:STARt

Further information

- Trace mode result types
- Formats for returned values: ASCII format and binary format

Trace mode result types

The following result types can be set:

| | |
|---------|--|
| WRITE | The current trace results will be obtained |
| AVERage | The trace results will be averaged over the given # of measurements |
| MAXHold | The maximum trace result values will be obtained over the given # of measurements |
| MINHold | The minimum trace result values will be obtained over the given # of measurements |
| VIEW | The trace results are frozen and displayed, i.e. they are not calculated for subsequent measurements. Traces in this mode cannot be queried. |
| OFF | The result type will not be used. |

Note: *It is not possible to query trace data when result type VIEW is selected.
Each value besides OFF can only be assigned to one result type at a time.
If all result types are set to OFF, the AM, FM, or PM demodulator will be deactivated.*

Formats for returned values: ASCII format and binary format

- ASCII Format (FORMat ASCII):
The command reads out a list of comma separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,32):
The command reads out binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating–Point–Format. The schematics of the result string will be as follows:

#41024<value1><value2>...<value n> with

#4 number of digits (= 4 in the example) of the following number of data bytes

1024 number of following data bytes (= 1024 in the example)

<value> 4–byte floating point value

[SENSe:]ADEMod:AF:COUPling

This command selects the coupling of the AF path of the analyzer.

Parameter

AC | DC

Example

ADEMod:AF:COUP DC

Switches on DC coupling.

Characteristics

*RST value: AC (PM); DC (FM)

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:CENTer

This command sets the center frequency for AF spectrum result display.

Parameter

<numeric_value>

Example

ADEMod ON

Switches on the analog demodulator

CALC:FEED 'XTIM:FM:AFSP'

Switches on AF spectrum result display of FM

ADEMod:BAND 5 MHz

Sets the measurement bandwidth to 5 MHz

ADEMod:AF:CENT 500kHz

Sets the AF center frequency to 500 kHz

ADEMod:AF:SPAN 200kHz

Sets the AF span to 200 kHz

Characteristics

*RST value: 1.25 MHz

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:SPAN

This command sets the span for AF spectrum result display.

The span is limited to half the measurement bandwidth of analog demodulation

(SENS:ADEMod:BAND).

Parameter

<numeric_value>

Example

ADEM ON

Switches on the analog demodulator

CALC:FEED 'XTIM:FM:AFSP'

Switches on AF spectrum result display of FM

ADEM:BAND 5 MHz

Sets the measurement bandwidth to 5 MHz

ADEM:AF:CENT 500kHz

Sets the AF center frequency to 500 kHz

ADEM:AF:SPAN 200kHz

Sets the AF span to 200 kHz

Characteristics

*RST value: 2.5 MHz

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:SPAN:FULL

This command sets the maximum span for AF spectrum result display.

The maximum span corresponds to half the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Example

ADEM ON

Switches on the analog demodulator

CALC:FEED 'XTIM:FM:AFSP'

Switches on AF spectrum result display of FM

ADEM:BAND 5 MHz

Sets the measurement bandwidth to 5 MHz

ADEM:AF:SPAN:FULL

Sets the AF span to 2.5 MHz

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:START

This command sets the start frequency for AF spectrum result display.

Parameter

<numeric_value>

Example

```
ADEM ON
Switches on analog demodulator
CALC:FEED 'XTIM:FM:AFSP'
Switches on AF spectrum result display of FM
ADEM:BAND 5 MHz
Sets the measurement bandwidth to 5 MHz
ADEM:AF:STAR 0kHz
Sets the AF start frequency to 0 kHz
ADEM:AF:STOP 500kHz
Sets the AF stop frequency to 500 kHz
```

Characteristics

*RST value: 0 MHz
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AF:STOP

This command sets the stop frequency for AF spectrum result display.
 The stop frequency is limited to half the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Parameter

<numeric_value>

Example

```
ADEM ON
Switches on the analog demodulator
CALC:FEED 'XTIM:FM:AFSP'
Switches on AF spectrum result display of FM
ADEM:BAND 5 MHz
Sets the measurement bandwidth to 5 MHz
ADEM:AF:STAR 0kHz
Sets the AF start frequency to 0 kHz
ADEM:AF:STOP 500kHz
Sets the AF stop frequency to 500 kHz
```

Characteristics

*RST value: 2.5 MHz
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:BANDwidth | BWIDth:DEModulation

This command defines the demodulation bandwidth used for analog demodulation. The required sampling rate is automatically set depending on the selected demodulation bandwidth. The available demodulation bandwidths are determined by the existing sampling rates (see table below).

Parameter

<numeric_value>

For details refer to the correlation of bandwidth and sample rate refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

Example

ADEM:BAND:DEM 1MHz

Sets the demodulation bandwidth to 1 MHz.

Characteristics

*RST value: 5 MHz

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:MTIME

This command defines the measurement time for analog demodulation.

Parameter

<numeric_value>

Example

ADEM:BAND:MTIM 62.5us

Sets the measurement time to 62.5 μ s.

Characteristics

*RST value: 62.5us

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:RLENgth?

This command returns the record length set up for the current analog demodulation measurement.

Example

ADEM:RLEN?

Returns the current record length.

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod[:STATe]

This command activates the analog demodulator of the instrument. The instrument will be set to zero span at the current center frequency. The sample detector will be set, the demodulator itself will be set up according to the parameters of command [SENSe:]ADEMod:SET.

Parameter

ON | OFF

Example

ADEM ON

Switches the analog demodulator on.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:SET

This command configures the analog demodulator of the instrument.

Parameter

| | |
|------------------|---|
| <sample rate> | The frequency at which measurement values are taken from the A/D-converter and stored in I/Q memory. Allowed range: refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset". |
| <record length> | Number of samples to be stored in I/Q memory. Allowed range: 1 to 400001 |
| <trigger source> | Selection of the trigger source to use for the demodulator. Allowed values: IMMEDIATE EXTERNAL IFPOWER RFPower AF AM AMRelative FM PM (see note below) |
| <trigger slope> | Used slope of the trigger signal. Allowed values: POSITIVE NEGATIVE The value indicated here will be ignored for <trigger source> = IMMEDIATE. |
| <offset samples> | Number of samples to be used as an offset to the trigger signal. Allowed range: -65024 to 130559 (= -64 * 1024 + 512 to 128 * 1024 - 513) The value indicated here will be ignored for <trigger source> = IMMEDIATE. |
| <# of meas> | Number of repetitions of the measurement to be executed. The value indicated here is especially necessary for the average/maxhold/minhold function. Allowed range: 0 to 32767 |

Note: After selecting IFPower, the trigger threshold can be set with command TRIG:LEV:IFP or TRIG:LEV:RFP.

Example

ADEM:SET 8MHz, 32000, EXT, POS, -500, 30

Performs a measurement at:

| | |
|-------------|-------|
| sample rate | 8 MHz |
|-------------|-------|

record length 32000
 trigger source EXTernal
 trigger slope POSitive
 offset samples –500 (500 samples before trigger occurred)
 # of meas 30

Characteristics

*RST value:

sample rate 8 MHz
 record length 501
 trigger source IMMEDIATE
 trigger slope POSitive
 offset samples 0
 # of meas 0

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:SRATe?

This command returns the sample rate set up for the current analog demodulation measurement.

Example

ADEM:SRAT?

Returns the current sample rate.

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain][:TYPE]

This command selects the result types of the RF signal to be measured simultaneously in zero span.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "[Trace mode result types](#)" on page 6.178.

Example

ADEM:AM AVER,MAXH,MINH

Determines average, max hold and min hold values at a time.

ADEM:AM WRIT,OFF,OFF

Determines only the current measurement values.

ADEM:AM OFF,OFF,OFF
Switches AM demodulation off.

Characteristics

*RST value: WRITe,OFF,OFF
SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult?

This command reads the result data of the RF signal in zero span for the specified result type. The data format of the output data block is defined by the FORMat command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The result type indicated must be one of those configured by [SENSe:]ADEMod:AM[:TDOMain] [:TYPE]. Otherwise a query error will be generated.*

Return Values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```

Sets up demodulator parameters

```
ADEM:AM AVER,MAXH,MINH
```

Sets up AM results to be measured

```
ADEM ON
```

Switches on demodulator

```
INIT;*WAI
```

Starts measurement and waits for sync

```
FORM ASC
```

Selects output format

```
ADEM:AM:RES? AVER
```

Reads AM average results

```
ADEM:AM:RES? MAXH
```

Reads AM max hold results

```
ADEM:AM:RES? MINH
```

Reads AM min hold results

Characteristics

*RST value: –
SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]

This command selects the result types to be measured simultaneously by AM demodulation.

Parameter

<result type 1|2|3|4>: WRITe, AVERAge, MAXHold, MINHold, VIEW, OFF; for details see "[Trace mode result types](#)" on page 6.178.

Example

ADEM:AM:REL AVER,MAXH,MINH

Determines average, max hold and min hold values simultaneously.

ADEM:AM:REL WRIT,OFF,OFF

Determines only the current measurement values.

ADEM:AM:REL OFF,OFF,OFF

Switches AM demodulation off.

Characteristics

*RST value: OFF,OFF,OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AM:RELative[:TDOMain]:RESult?

This command reads the result data obtained by AM demodulation for the specified result type. The data format of the output data block is defined by the `FORMat` command.

Parameter

<result type>: WRITe, AVERAge, MAXHold, MINHold; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The result type indicated must be one of those configured by [SENSe:]ADEMod:AM:REL[:TDOMain][:TYPE]. Otherwise a query error will be generated.*

Return Values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

ADEM:SET 8MHz,32000,EXT,POS,-500,30

Sets up demodulator parameters

ADEM:FM AVER,MAXH,MINH

Selects FM results to be measured

ADEM:AM:REL WRIT,OFF,OFF

Selects AM results to be measured

ADEM ON

Switches on demodulator

INIT;*WAI

Starts measurement and waits for sync

FORM ASC

Selects output format

ADEM:FM:RES? AVER

Reads FM average results

ADEM:FM:RES? MAXH

Reads FM max hold results

ADEM:FM:RES? MINH

Reads FM min hold results

ADEM:AM:REL:RES? WRIT
 Reads current AM result data

Characteristics

*RST value: –
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE]

This command selects the AF spectrum result types of the AM–demodulated signal to be measured simultaneously.

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW, OFF; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The result type "AF spectrum of AM–demodulated signal" cannot be activated at the same time as "AF spectrum of FM or PM demodulated signal".*

Example

ADEM:AM:REL:AFSP AVER,MAXH,MINH
 Determines average, maximum and minimum value simultaneously
 ADEM:AM:REL:AFSP WRIT,OFF,OFF
 Determines only current measurement results
 ADEM:AM:REL:AFSP OFF,OFF,OFF
 Switches off calculation of the AF spectrum

Characteristics

*RST value: OFF,OFF,OFF
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:AM:RELative:AFSPectrum:RESult?

This command reads out the AF spectrum result data of the AM–demodulated signal for the specified result type. The data format of the output data is determined with the FORMat command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The specified result type must be one of those configured with command [SENSe:]ADEMod:AM:AFSPectrum[:TYPE]. Otherwise a query error will be generated.*

Return Values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```

Sets the demodulator

```
ADEM:FM AVER,MAXH,MINH
```

Selects the FM results to be measured

```
ADEM:AM:REL WRIT,OFF,OFF
```

Selects the AM results to be measured

```
ADEM:AM:REL:AFSP WRIT,OFF,OFF
```

Selects the AF spectrum results of the demodulated AM signal to be measured

```
ADEM ON
```

Switches on the demodulator

```
INIT;*WAI
```

Starts the measurement and waits for the termination

```
FORM ASC
```

Selects the output format

```
ADEM:FM:RES? AVER
```

Reads the FM average result data

```
ADEM:FM:RES? MAXH
```

Reads the FM Maxhold result data

```
ADEM:FM:RES? MINH
```

Reads the FM Minhold result data

```
ADEM:AM:REL:RES? WRIT
```

Reads the current AM result data

```
ADEM:AM:REL:AFSP:RES? WRIT
```

Reads the current AF spectrum result data of the demodulated AM signal

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:FM[:TDOMain][:TYPE]

This command selects the result types to be created in parallel by analog demodulation.

Parameter

<result type 1|2|3|4>: WRITe, AVERAge, MAXHold, MINHold, VIEW, OFF; for details see "[Trace mode result types](#)" on page 6.178.

Example

```
ADEM:FM AVER,MAXH,MINH
```

"Creates average, max hold and min hold values simultaneously

```
DEM:FM WRIT,OFF,OFF
```

Only creates the current measurement values

```
ADEM:FM OFF,OFF,OFF
```

Switches analog demodulator off

Characteristics

*RST value: WRITe,OFF,OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:FM[:TDOMain]:RESult?

This command reads the result data obtained by analog demodulation for the specified result type. The data format of the output data block is defined by the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The result type indicated must be one of those configured by [SENSe:]ADEMod:FM[:TDOMain][:TYPE]. Otherwise a query error will be generated.*

Return Values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

```
ADEM:SET 8MHz, 32000, EXT, POS, -500, 30
```

Sets up demodulator parameters

```
ADEM:FM AVER, MAXH, MINH
```

Selects FM results to be measured

```
ADEM:AM WRIT, OFF, OFF
```

Selects AM results to be measured

```
ADEM ON
```

Switches on demodulator

```
INIT; *WAI
```

Starts measurement and waits for sync

```
FORM ASC
```

Selects output format

```
ADEM:FM:RES? AVER
```

Reads FM average results

```
ADEM:FM:RES? MAXH
```

Reads FM max hold results

```
ADEM:FM:RES? MINH
```

Reads FM min hold results

```
ADEM:AM:RES? WRIT
```

Reads current AM results

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:FM:AFSPectrum[:TYPE]

This command selects the AF spectrum result types of the FM-demodulated signal to be measured simultaneously.

Parameter

<result type 1|2|3|4>: WRITe, AVERAge, MAXHold, MINHold, VIEW, OFF; for details see ["Trace mode result types"](#) on page 6.178.

Note: *The result type "AF spectrum of the FM demodulated signal" cannot be activated at the same time as "AF spectrum of AM or PM demodulated signal".*

Example

```
ADEM:FM:AFSP AVER,MAXH,MINH
```

Determines average, maximum and minimum value simultaneously

```
ADEM:FM:AFSP WRIT,OFF,OFF
```

Determines only current measurement results

```
ADEM:FM:AFSP OFF,OFF,OFF
```

Switches calculation of AF spectrum off

Characteristics

*RST value: OFF,OFF,OFF

SCPI: device-specific

Mode

A

[SENSe:]ADEMod:FM:AFSPectrum:RESult?

This command reads out the AF spectrum result data of the FM demodulated signal for the specified result type. The data format of the output data is determined with the `FORMat` command.

Parameter

<result type>: WRITe, AVERAge, MAXHold, MINHold; for details see ["Trace mode result types"](#) on page 6.178.

Note: *The specified result type must be one of those configured with the command `[SENSe:]ADEMod:FM:AFSPectrum[:TYPE]`. Otherwise a query error will be generated.*

Return Values

ASCII Format (`FORMat ASCII`) or Binary Format (`FORMat REAL,32`); for details see ["Formats for returned values: ASCII format and binary format"](#) on page 6.178. The output units are described in ["CALCulate<1|2>:MARKer<1...4>:Y?"](#) on page 6.169.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```

Sets demodulator

```
ADEM:FM AVER,MAXH,MINH
```

Selects the FM results to be measured

```
ADEM:AM:REL WRIT,OFF,OFF
```

Selects the AM results to be measured

```
ADEM:FM:AFSP WRIT,OFF,OFF
```

Selects the AF spectrum results of the demodulated FM signal to be measured

```
ADEM ON
```

Switches the demodulator on

```
INIT;*WAI
```

Starts the measurement and waits for termination

```
FORM ASC
```

Selects output format

ADEM:FM:RES? AVER
 Reads FM average result data
 ADEM:FM:RES? MAXH
 Reads FM maxhold result data
 ADEM:FM:RES? MINH
 Reads FM minhold result data
 ADEM:AM:RES? WRIT
 Reads current AM result data
 ADEM:FM:AFSP:RES? WRIT
 Reads current AF spectrum result data of demodulated FM signal

Characteristics

*RST value: –
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:FM:OFFSet?

This command calculates the FM offset of the currently available measurement data set. If averaging has been activated before acquiring the data set (using [SENSe:]ADEMod:FM[:TYPE]), the averaged FM offset over several measurements can also be obtained by setting <result type> = AVERage.

The offset thus determined differs from the one calculated by command CALC:MARK:FUNC:ADEM:FERR?, since, for determination of the frequency deviation, the modulation is removed by means of lowpass filtering, producing results that are different from those obtained by averaging.

Parameter

<result type>

IMMediate The current measurement results will be used for calculating the FM offset
 AVERage The measurement results that were averaged over the given # of measurements will be used for calculating the FM offset

Note: *If no average measurement was active during the last measurement sequence only the command [SENSe:]ADEMod:FM:OFFSet? IMMediate will return a correct result (data to calculate the offset are taken from the last measured data set).*

[SENSe:]ADEMod:FM:OFFSet? AVERage will cause a query error in this case.

Example

ADEM:SET 8MHz, 32000, EXT, POS, -500, 30
 Sets up demodulator parameters to execute 30 measurements
 ADEM:FM AVER, OFF, OFF
 Selects FM results to perform averaging
 ADEM:AM OFF, OFF, OFF
 Switches off AM demodulation
 ADEM ON
 Switches on analog demodulator
 INIT; *WAI
 Starts measurement and waits for sync

ADEM:FM:OFFS? IMM

Reads FM offset of last measurement of the sequence of 30

ADEM:FM:OFFS? AVER

Reads FM offset averaged over 30 measurements

Characteristics

*RST values: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:PM[:TDOMain][:TYPE]

This command selects the result types of the PM-demodulated signal to be created simultaneously.

Note: *Only one result type can be assigned at a time. If all result types are set to OFF, the PM demodulator is switched off.*

Parameter

<result type 1|2|3|4>: WRITe, AVERage, MAXHold, MINHold, VIEW; for details see "[Trace mode result types](#)" on page 6.178.

Example

ADEM:PM AVER,MAXH,MINH

Determines average, maximum and minimum value simultaneously

ADEM:PM WRIT,OFF,OFF

Determines only current measurement results

ADEM:PM OFF,OFF,OFF

Switches the PM demodulator off.

Characteristics

RST value: OFF,OFF,OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:PM[:TDOMain]:RESult?

This command reads the result data of the PM demodulation for the specified result type. The data format of the output data is determined with the FORMat command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The specified result type must be one of those configured with the command [SENSe:]ADEMod:PM[:TDOMain][:TYPE]. Otherwise a query error will be generated.*

Return Values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```

Sets the demodulator parameters.

```
ADEM:PM AVER,MAXH,MINH
```

Selects the PM results to be measured.

```
ADEM:AM WRIT,OFF,OFF
```

Selects the AM results to be measured.

```
ADEM ON
```

Switches on the demodulator.

```
INIT;*WAI
```

Starts the measurement and waits for termination.

```
FORM ASC
```

Selects the output format.

```
ADEM:PM:RES? AVER
```

Reads the PM average result data.

```
ADEM:PM:RES? MAXH
```

Reads the PM maxhold result data.

```
ADEM:PM:RES? MINH
```

Reads the PM minhold result data.

```
ADEM:AM:RES? WRIT
```

Reads the current AM result data.

Characteristics

RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:PM:AFSPectrum[:TYPE]

This command selects the AF spectrum result types of the PM-demodulated signal to be measured simultaneously.

Parameter

<result type 1|2|3|4>: WRITe, AVERAge, MAXHold, MINHold, VIEW; for details see "[Trace mode result types](#)" on page 6.178.

Note: The result type "AF spectrum of the PM demodulated signal" cannot be activated at the same time as "AF spectrum of AM or FM demodulated signal".

Example

```
ADEM:PM:AFSP AVER,MAXH,MINH
```

Determines average, maximum and minimum value simultaneously

```
ADEM:PM:AFSP WRIT,OFF,OFF
```

Determines only current measurement results

```
ADEM:PM:AFSP OFF,OFF,OFF
```

Switches calculation of AF spectrum off

Characteristics

RST value: OFF,OFF,OFF

SCPI: device-specific

Mode

A

[SENSe:]ADEMod:PM:AFSPectrum:RESult?

This command reads out the AF spectrum result data of the PM–demodulated signal for the specified result type. The data format of the output data is determined with the `FORMat` command.

Parameter

<result type>: `WRITe`, `AVERage`, `MAXHold`, `MINHold`; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The specified result type must be one of those configured with the command `[SENSe:]ADEMod:PM:AFSPectrum[:TYPE]`. Otherwise a query error will be generated.*

Return Values

ASCII Format (`FORMat ASCII`) or Binary Format (`FORMat REAL,32`); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```

Sets demodulator

```
ADEM:PM AVER,MAXH,MINH
```

Selects the PM results to be measured

```
ADEM:AM:REL WRIT,OFF,OFF
```

Selects the AM results to be measured

```
ADEM:PM:AFSP WRIT,OFF,OFF
```

Selects the AF spectrum results of the demodulated PM signal to be measured

```
ADEM ON
```

Switches the demodulator on

```
INIT;*WAI
```

Starts the measurement and waits for termination

```
FORM ASC
```

Selects output format

```
ADEM:PM:RES? AVER
```

Reads PM average result data

```
ADEM:PM:RES? MAXH
```

Reads PM maxhold result data

```
ADEM:PM:RES? MINH
```

Reads PM minhold result data

```
ADEM:AM:RES? WRIT
```

Reads current AM result data

```
ADEM:PM:AFSP:RES? WRIT
```

Reads current AF spectrum result data of demodulated PM signal

Characteristics

RST value: –

SCPI: device–specific

Mode

ADEMOD

[SENSe:]ADEMod:PM:RPOint[:X]

This command determines the position where the phase of the PM–demodulated signal is set to 0 rad. The maximum possible value depends on the measurement time selected in the instrument; this value is output in response to the query `ADEM:PM:RPO:X? MAX`.

Parameter

0 s to measurement time

Example

```
ADEM:PM:RPO:X 500us
```

Sets the position where the phase to 0 rad setting to 500 μ s.

Characteristics

RST value: 0 s

SCPI: conforming

Mode

ADEMOD

[SENSe:]ADEMod:SPECTrum:BANDwidth|BWIDth[:RESolution]

This command sets the resolution bandwidth for spectrum representation that was determined from the analog demodulation data.

The recording time required is calculated from the sampling rate indirectly set via ADEM:SPEC:SPAN:MAX or ADEM:BAND. If the available recording time is not sufficient for the given bandwidth, the recording time is set to its maximum and the resolution bandwidth is enlarged to the resulting bandwidth.

Parameter

1 Hz to 10 MHz

Example

```
ADEM ON
```

Switches on the analog demodulator

```
CALC:FEED 'XTIM:SPEC'
```

Switches on the RF spectrum result display

or

```
CALC:FEED 'XTIM:FM:AFSP'
```

Switches on the AF spectrum result display of FM signal

```
ADEM:BAND:RES 61.2kHz
```

Sets the resolution bandwidth to 61.2 kHz.

Characteristics

*RST value: 61.2 kHz

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECTrum:SPAN[:MAXimum]

This command sets the maximum frequency range for displaying the RF spectrum that was determined from the FM demodulation data. The maximum span corresponds to the measurement bandwidth of analog demodulation (for details refer to [SENSe:]ADEMod:BANDwidth | BWIDth:DEModulation). For details refer on the relation of bandwidth and sample rate refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

Parameter

<numeric_value>

Example

```
ADEM ON
Switches on the analog demodulator
CALC:FEED 'XTIM:SPEC'
Switches on RF spectrum result display.
ADEM:SPEC:SPAN:MAX 5 MHz
Sets the max. span to 5 MHz
ADEM:SPEC:SPAN:ZOOM 1 MHz
Sets the displayed span to 1 MHz
```

Characteristics

*RST value: 5 MHz
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECTrum:SPAN:ZOOM

This command sets the frequency range for the RF spectrum result display determined from analog demodulation data. The frequency range for result display is limited to the maximum span (`[SENSe:]ADEMod:SPECTrum:SPAN:[:MAXimum]`) or to the measurement bandwidth of analog demodulation (`[SENSe:]ADEMod:BANDwidth | BWIDth:DEModulation`).

Parameter

<numeric_value>

Example

```
ADEM ON
Switches on the analog demodulator
CALC:FEED 'XTIM:SPEC'
Switches on RF spectrum result display"
ADEM:SPEC:SPAN:MAX 5 MHz
Sets the maximum span to 5 MHz
ADEM:SPEC:SPAN:ZOOM 1 MHz
Sets displayed span to 1 MHz
```

Characteristics

*RST value: 5 MHz
 SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECTrum[:TYPE]

This command selects the result types to be created in parallel by the RF spectrum measurement with active analog demodulation.

Parameter

<result type 1|2|3|4>: WRITe, AVERAge, MAXHold, MINHold, VIEW, OFF; for details see "[Trace mode result types](#)" on page 6.178.

Example

```
ADEM:SPEC AVER,MAXH,MINH
```

Creates average, max hold and min hold values at a time

```
ADEM:SPEC WRIT,OFF,OFF
```

Only creates the current measurement values

```
ADEM:SPEC OFF,OFF,OFF
```

Switches analog demodulator off

Characteristics

*RST value: OFF,OFF,OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:SPECTrum:RESult?

This command reads out the RF spectrum result data for the specified result type. The data format of the output data block is defined by the `FORMat` command.

Parameter

<result type>: WRITe, AVERage, MAXHold, MINHold; for details see "[Trace mode result types](#)" on page 6.178.

Note: *The result type indicated must be one of those configured by [SENSe:]ADEMod:SPEC[:TYPE]. Otherwise a query error will be generated.*

Return Values

ASCII Format (FORMat ASCII) or Binary Format (FORMat REAL,32); for details see "[Formats for returned values: ASCII format and binary format](#)" on page 6.178. The output units are described in "[CALCulate<1|2>:MARKer<1...4>:Y?](#)" on page 6.169.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
```

Sets up demodulator parameters

```
ADEM:SPEC AVER,MAXH,MINH
```

Selects RF spectrum results to be measured

```
ADEM:SPEC WRIT,OFF,OFF
```

Selects AM results to be measured

```
ADEM ON
```

Switches on demodulator

```
INIT;*WAI
```

Starts measurement and waits for sync

```
FORM ASC
```

Selects output format

```
ADEM:SPEC:RES? AVER
```

Reads RF spectrum average results

```
ADEM:SPEC:RES? MAXH
```

Reads RF spectrum max hold results

```
ADEM:SPEC:RES? MINH
```

Reads RF spectrum min hold results

```
ADEM:SPEC:RES? WRIT
```

Reads spectrum current results

Characteristics

*RST value: –

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:ZOOM[:STATE>]

The command enables or disables the zoom function for the analog-demodulated measurement data. Depending on the selected measurement time and the demodulation bandwidth, the number of recorded test points may be greater than that shown on the display.

If the zoom function is enabled, 501 test points of the result memory are displayed from the specified start time with [SENS:]ADEM:ZOOM:STARt.

If the zoom function is disabled, data reduction is used to adapt the test points to the number of points available on the display.

Parameter

ON | OFF

Example

```
ADEM:ZOOM ON
```

Switches on the zoom function

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe:]ADEMod:ZOOM:STARt

The command selects the start time for the display of individual measured values of the analog demodulation. The maximum possible value depends on the measurement time, which is set in the instrument and can be queried with command [SENSe]:ADEMod:MTIME?.

If the zoom function is enabled, 501 test points of the result memory are displayed from the specified start time with [SENS:]ADEM:ZOOM:STARt.

Parameter

0 s to measurement time – (500 * 1/sample rate)

Example

```
ADEM:ZOOM ON
```

Switches on the zoom function

```
ADEM:ZOOM:STAR 500us
```

Sets the starting point of the display to 500 µs.

Characteristics

*RST value: 0 s

SCPI: device-specific

Mode

ADEMOD

SENSe:BANDwidth Subsystem (Analog Demodulation, K7)

This subsystem controls the setting of the instruments filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions.

Commands of the SENSe:BANDwidth Subsystem

– [SENSe<1|2>:]BANDwidth|BWIDth:DEMod

[SENSe<1|2>:]BANDwidth|BWIDth:DEMod

This command sets the bandwidth for analog demodulation. Depending on the selected demodulation bandwidth, the instrument selects the required sampling rate.

The available values of the demodulation bandwidths are determined by the sampling rates. For details on the correlation between demodulation bandwidth and sampling rate refer to chapter "Instrument Functions", sections "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

Parameter

<numeric_value>

Example:

```
BAND:DEM 1MHz
```

Sets test bandwidth to 1 MHz

Characteristics:

*RST value: 5 MHz

SCPI: device-specific

Mode

A–F, ADEMOM

SENSe:FILTer Subsystem (Analog Demodulation, K7)

The SENSe:FILTer subsystem selects the filters to reduce the bandwidth of the demodulated signal. The selected filters are used for AM, FM and PM demodulation in common.

Commands of the SENSe:FILTer subsystem

- [SENSe<1|2>:]FILTer:HPASs[:STATE]
- [SENSe<1|2>:]FILTer:HPASs:FREQuency
- [SENSe<1|2>:]FILTer:LPASs[:STATE]
- [SENSe<1|2>:]FILTer:LPASs:FREQuency[:ABSolute]
- [SENSe<1|2>:]FILTer:LPASs:FREQuency:RELative
- [SENSe<1|2>:]FILTer:DEMPHasis[:STATe]
- [SENSe<1|2>:]FILTer:DEMPHasis:TCONstant

[SENSe<1|2>:]FILTer:HPASs[:STATE]

This command activates/deactivates the selected high pass filter.

Parameter

ON | OFF

Example

```
SENS:FILT:HPAS ON
```

Activates the selected high pass filter.

Characteristics

RST value: OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:HPASs:FREQuency

This command selects the high pass filter type. For details on filters refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **High Pass AF Filter** softkey.

Parameter

50 Hz | 300 Hz

Example

```
SENS:FILT:HPAS:FREQ 300 Hz
```

Selects the high pass filter for the demodulation bandwidth range from 800 Hz to 16 MHz.

Characteristics

RST value: 300 Hz

SCPI: device-specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:LPASs[:STATE]

This command activates/deactivates the selected low pass filter.

Parameter

ON | OFF

Example

```
SENS:FILT:LPAS ON
```

Activates the selected low pass filter.

Characteristics

RST value: OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:LPASs:FREQuency[:ABSolute]

This command selects the absolute low pass filter type. For details on filters refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **Low Pass AF Filter** softkey.

Parameter

3 kHz | 15 kHz | 150 kHz

Example

```
SENS:FILT:LPAS:FREQ 150 kHz
```

Selects the low pass filter for the demodulation bandwidth range from 400 kHz to 16 MHz.

Characteristics

RST value: 15 kHz

SCPI: device-specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:LPASs:FREQuency:RELative

This command selects the relative low pass filter type. For details on filters refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **Low Pass AF Filter** softkey.

Parameter

5 PCT | 10 PCT | 25 PCT

Example

```
SENS:FILT:LPAS:FREQ 25 PCT
```

Selects the low pass filter as 25% of the demodulation bandwidth.

Characteristics

RST value: 25 PCT

SCPI: device-specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:DEMPhasis[:STATe]

This command activates/deactivates the selected deemphasis.

Parameter

ON | OFF

Example

```
SENS:FILT:DEMP ON
```

Activates the selected deemphasis.

Characteristics

RST value: OFF

SCPI: device-specific

Mode

ADEMOD

[SENSe<1|2>:]FILTer:DEMPhasis:TCONstant

This command selects the deemphasis. For details on deemphasis refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)", **Deemphasis** softkey.

Parameter

25 us | 50 us | 75 us | 750 us

Example

```
SENS:FILT:DEMP:TCON 750 us
```

Selects the deemphasis for the demodulation bandwidth range from 800 Hz to 4 MHz with a time constant of 750 μ s.

Characteristics

RST value: 50 us

SCPI: device-specific

Mode

ADEM0D

SENSe:FREQUENCY Subsystem (Analog Demodulation, K7)

The SENSe:FREQUENCY subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

Commands of the SENSe:FREQUENCY Subsystem

– [\[SENSe<1|2>:\]FREQUENCY:CENTer:STEP:LINK](#)

[\[SENSe<1|2>:\]FREQUENCY:CENTer:STEP:LINK](#)

Parameter

| | |
|------|---|
| SPAN | coupling to frequency display range (for RF spectrum result display) |
| RBW | coupling to resolution bandwidth (for all result displays except RF spectrum) |
| OFF | manual input, no coupling |

For further details refer to "[\[SENSe<1|2>:\]FREQUENCY:CENTer:STEP:LINK](#)" on page 6.114.

SENSe:SWEep Subsystem (Analog Demodulation, K7)

This subsystem controls the sweep parameters.

Commands of the SENSe:SWEep Subsystem

– [\[SENSe<1|2>:\]SWEep:TIME](#)

[\[SENSe<1|2>:\]SWEep:TIME](#)

Parameter

Refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)" – "Sample rate, measurement time and trigger offset".

For further details refer to "[\[SENSe<1|2>:\]SWEep:TIME](#)" on page 6.134.

TRACe Subsystem (Analog Demodulation, K7)

The TRACe subsystem controls access to the instruments internal trace memory.

Commands of the TRACe Subsystem

– [TRACe<1|2>\[:DATA\]](#)

TRACe<1|2>[:DATA]

If the analog demodulator (option Analog Demodulation, R&S FSL–K7) is active, only the displayed trace data is read out and recalled. A portion of the measurement data that can be called by means of a marker, however, is calculated from the raw measurement data. These results are no longer available after recalling a trace; the associated queries generate a query error.

For further information refer to "[TRACe<1|2>\[:DATA\]](#)" on page 6.150.

TRIGger Subsystem (Analog Demodulation, K7)

The TRIGger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep.

Commands of the TRIGger Subsystem

- TRIGger<1|2>[:SEQuence]:SOURce
- TRIGger<1|2>[:SEQuence]:LEVel:AM[:ABSolute]
- TRIGger<1|2>[:SEQuence]:LEVel:AM:RELative
- TRIGger<1|2>[:SEQuence]:LEVel:FM
- TRIGger<1|2>[:SEQuence]:LEVel:PM

TRIGger<1|2>[:SEQuence]:SOURce

Parameter

IMMediate (Free Run) | EXTern | IFPower | AF | FM | AM | AMRelative | PM

The parameter AM corresponds to the RF power signal, the parameter AMRelative corresponds to the AM signal.

For details on trigger modes refer to chapter "Instrument Functions", section "Analog Demodulation (Option K7)".

Note: For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

For further details refer to "TRIGger<1|2>[:SEQuence]:SOURce" on page 6.161.

TRIGger<1|2>[:SEQuence]:LEVel:AM[:ABSolute]

The command sets the level when RF power signals are used as trigger source.

Note: For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameter

–100 to +30 dBm

Example

```
TRIG:LEV:AM -30 dBm
```

Sets the RF power signal trigger threshold to –30 dBm

Characteristics

*RST value: –20 dBm

SCPI: device-specific

Mode

ADEMODO

TRIGger<1|2>[:SEQuence]:LEVel:AM:RELative

The command sets the level when AM-modulated signals are used as trigger source.

Note: For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameter

–100 to +100 %

Example

```
TRIG:LEV:AM:REL -20 %
```

Sets the AM trigger threshold to –20 %

Characteristics

*RST value: 0 %

SCPI: device-specific

Mode

ADEM0D

TRIGger<1|2>[:SEQuence]:LEVel:FM

The command sets the level when FM–modulated signals are used as trigger source.

Note: For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameter

–10 to +10 MHz

Example

```
TRIG:LEV:FM 10 kHz
```

Sets the FM trigger threshold to 10 kHz

Characteristics

*RST value: 0 Hz

SCPI: device-specific

Mode

ADEM0D

TRIGger<1|2>[:SEQuence]:LEVel:PM

The command sets the level when PM–modulated signals are used as trigger source.

Note: For triggering with AF, AM, AMRelative, FM, and PM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Parameter

–1000 to +1000 RAD

Example

```
TRIG:LEV:PM 1.2 RAD
```

Sets the PM trigger threshold to 1.2 rad

Characteristics

*RST value: 0 RAD

SCPI: device-specific

Mode

ADEM0D

UNIT Subsystem (Analog Demodulation, K7)

The UNIT subsystem sets the basic unit of the setting parameters.

Commands of the UNIT Subsystem

- [UNIT:ANGLE](#)

UNIT:ANGLE

This command selects the unit for angles.

Parameter

DEG | RAD

Example

UNIT:ANGL DEG

Characteristics

RST value: RAD

SCPI: conforming

Mode

ADEMODO

Remote Commands of the Power Meter Option (K9)

In this section all remote control commands for Power Meter option are described in detail. For details on conventions used in this chapter refer to the introduction at the beginning of this chapter.

Subsystems of the Power Meter option (K9)

- [CALCulate Subsystem \(Power Meter, K9\)](#)
- [CALibration Subsystem \(Power Meter, K9\)](#)
- [DISPlay Subsystem \(Power Meter, K9\)](#)
- [FETCh Subsystem \(Power Meter, K9\)](#)
- [READ Subsystem \(Power Meter, K9\)](#)
- [SENSe Subsystem \(Power Meter, K9\)](#)
- [UNIT Subsystem \(Power Meter, K9\)](#)

CALCulate Subsystem (Power Meter, K9)

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquisition, i.e. following the SENSE subsystem.

The following subsystems are included:

- ["CALCulate:PMETer Subsystem"](#) on page 6.209

CALCulate:PMETer Subsystem (Power Meter, K9)

This subsystem controls the instrument settings for power sensor measurements.

Commands of the CALCulate:PMETer Subsystem

- [CALCulate<1|2>:PMETer:RELative\[:MAGNitude\]](#)
- [CALCulate<1|2>:PMETer:RELative\[:MAGNitude\]:AUTO](#)
- [CALCulate<1|2>:PMETer:RELative:STATe](#)

CALCulate<1|2>:PMETer:RELative[:MAGNitude]

This command sets the reference value for relative measurements.

Parameter

–200 to 200

Example

```
:CALC:PMET:REL -30
```

Sets the reference value for relative measurements to –30 dBm.

Characteristics

*RST value: 0

SCPI: device-specific

Mode

PSM

CALCulate<1|2>:PMETer:RELative[:MAGNitude]:AUTO

This command takes the current measurement value as reference value for relative measurements.

Parameter

ONCE

Example

```
:CALC:PMET:REL:AUTO ONCE
```

Takes the current measurement value as reference value for relative measurements.

Characteristics

*RST value: –

SCPI: device-specific

Mode

PSM

CALCulate<1|2>:PMETer:RELative:STATe

This command switches between relative and absolute display of the measured power.

Parameter

ON | OFF

Example

:CALC:PMET:REL:STAT ON

Activates the relative display of the measured value.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

PSM

CALibration Subsystem (Power Meter, K9)

The CALibration subsystem determines the data for system error correction in the instrument.

The following subsystem is included:

- ["CALibration:PMETer Subsystem"](#) on page 6.211

CALibration:PMETer Subsystem (Power Meter, K9)

The CALibration:PMETer Subsystem determines the error correction data for measurements in the power meter mode.

Commands of the CALibration:PMETer Subsystem

- [CALibration:PMETer:ZERO:AUTO](#)

CALibration:PMETer:ZERO:AUTO

This command starts zeroing of the power sensor.

Parameter

ONCE

Example

```
:CAL:PMET:ZERO:AUTO ONCE;*WAI
```

Starts zeroing and delays the execution of further commands until zeroing is concluded.

Characteristics

*RST value: –

SCPI: device-specific

Mode

PSM

DISPlay Subsystem (Power Meter, K9)

The DISPlay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

- [DISPlay\[:WINDow<1|2>\]:PMETer:STATe](#)

DISPlay[:WINDow<1|2>]:PMETer:STATe

This command switches the bar graph view for power sensor measurement on and off. If the view is switched off, the value for power sensor measurement is displayed in the marker field.

Parameter

ON | OFF

Example

```
DISP:PMET:STAT OFF
```

Switches the bar graph view off.

Characteristics

*RST value: ON

SCPI: device-specific

Mode

PSM

FETCh Subsystem (Power Meter, K9)

The FETCh subsystem contains commands for reading out results of complex measurement tasks.

The following subsystem is included:

- ["FETCh:PMETer Subsystem"](#) on page 6.213

FETCh:PMETer Subsystem (Power Meter, K9)

The FETCh:PMETer subsystem contains commands to read measurement results of power sensor measurements without starting the measurement itself.

Commands of the FETCh:PMETer Subsystem

- [FETCh<1|2>:PMETer?](#)

FETCh<1|2>:PMETer?

This command reads the result of the power sensor measurement.

If no measurement has been performed, this command will lead to a query error. This command is a query and therefore has no *RST value.

Example

```
FETC : PMET?
```

Reads the result of the power sensor measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

PSM

READ Subsystem (Power Meter, K9)

The READ subsystem contains commands for starting complex measurement tasks, and for querying the results subsequently.

The following subsystem is included:

- ["READ:PMETer Subsystem"](#) on page 6.214

READ:PMETer Subsystem

This subsystem contains commands to start power sensor measurements and to read the results after the measurement is concluded.

Commands of the READ:PMETer Subsystem

- [READ<1|2>:PMETer?](#)

READ<1|2>:PMETer?

This command starts a power sensor measurement and reads the result after the measurement is concluded.

This command is a query and therefore has no *RST value.

Example

```
READ:PMET?
```

Starts a measurement and read the result.

Characteristics

*RST value: –

SCPI: device-specific

Mode

PSM

SENSE Subsystem (Power Meter, K9)

The SENSE subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.

The SENSE subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSE" is optional for this reason, which means that it is not necessary to include the SENSE node in command sequences.

The following subsystems are included:

- ["SENSE:PMETER Subsystem"](#) on page 6.215

SENSE:PMETER Subsystem (Power Meter, K9)

This subsystem controls the device settings for power sensor measurements.

Commands of the SENSE:PMETER Subsystem

- [\[SENSE<1|2>:\]PMETER\[:STATe\]](#)
- [\[SENSE<1|2>:\]PMETER:FREQuency](#)
- [\[SENSE<1|2>:\]PMETER:FREQuency:LINK](#)
- [\[SENSE<1|2>:\]PMETER:MTIME](#)

[\[SENSE<1|2>:\]PMETER\[:STATe\]](#)

This command switches the power sensor measurements on or off.

Parameter

ON | OFF

Example

```
PMET ON
```

Switches the power sensor measurements on.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

PSM

[\[SENSE<1|2>:\]PMETER:FREQuency](#)

This command sets the frequency of the power sensor. The limits f_{\min} and f_{\max} are defined by the power sensor.

Parameter

f_{\min} ... f_{\max}

Example

```
PMET:FREQ 1GHZ
```

Sets the frequency of the power sensor to 1 GHz.

Characteristics

*RST value: 50 MHz

SCPI: device-specific

Mode

PSM

[SENSe<1|2>:]PMETer:FREQuency:LINK

This command sets the frequency coupling of the power sensor.

Parameter

CENTER couples the frequency to the center frequency of the analyzer

MARKer1 couples the frequency to the position of marker 1

OFF switches the frequency coupling off

Example

```
PMET:FREQ:LINK CENT
```

Couples the frequency to the center frequency of the analyzer

Characteristics

*RST value: CENT

SCPI: device-specific

Mode

PSM

[SENSe<1|2>:]PMETer:MTIMe

This command sets the measurement duration of the power sensor.

Parameter

SHORT | NORMAl | LONG

Example

```
PMET:MTIM SHOR
```

Sets a short measurement duration for measurements of stationary high power signals.

Characteristics

*RST value: NORM

SCPI: device-specific

Mode

PSM

UNIT Subsystem (Power Meter, K9)

The UNIT subsystem sets the basic unit of the setting parameters.

The following subsystems are included:

- ["UNIT:PMETer Subsystem"](#) on page 6.217

UNIT:PMETer Subsystem (Power Meter, K9)

The UNIT:PMETer subsystem sets the basic unit for power sensor measurement.

Commands of the UNIT:PMETer Subsystem

- [UNIT<1|2>:PMETer:POWer](#)
- [UNIT<1|2>:PMETer:POWer:RATio](#)

UNIT<1|2>:PMETer:POWer

This command selects the unit for absolute power sensor measurement.

Parameter

DBM | WATT | W

Example

```
UNIT:PMET:POW DBM
```

Characteristics

*RST value: DBM

SCPI: conforming

Mode

PSM

UNIT<1|2>:PMETer:POWer:RATio

This command selects the unit for relative power sensor measurement.

Parameter

DB | PCT

Example

```
UNIT:PMET:POW DB
```

Characteristics

*RST value: DB

SCPI: conforming

Mode

PSM

Remote Commands of the WLAN TX Measurements Option (K91)

This chapter describes the remote commands for the WLAN TX Measurements option (K91). The abbreviation WLAN stands for the operating mode Wireless LAN. For further information on analyzer or basic settings commands, refer to the corresponding subsystem in section "Remote Control – Description of Basic Settings Commands".

This option is available from firmware version 1.20.

Subsystems of the WLAN TX Measurements option (K91)

- [ABORt Subsystem \(WLAN 802.11, K91\)](#)
- [CALCulate:LIMit Subsystem \(WLAN 802.11, K91\)](#)
- [CALCulate:MARKer Subsystem \(WLAN 802.11, K91\)](#)
- [CONFigure Subsystem \(WLAN 802.11, K91\)](#)
- [DISPlay Subsystem \(WLAN 802.11, K91\)](#)
- [FETCh:BURSt Subsystem \(WLAN 802.11, K91\)](#)
- [FORMat Subsystem \(WLAN 802.11, K91\)](#)
- [INITiate Subsystem \(WLAN 802.11, K91\)](#)
- [INPut Subsystem \(WLAN 802.11, K91\)](#)
- [INSTRument Subsystem \(WLAN 802.11, K91\)](#)
- [MMEMory Subsystem \(WLAN 802.11, K91\)](#)
- [SENSe Subsystem \(WLAN 802.11, K91\)](#)
- [STATus Subsystem \(WLAN 802.11, K91\)](#)
- [TRACe Subsystem \(WLAN 802.11, K91\)](#)
- [TRIGger Subsystem \(WLAN 802.11, K91\)](#)
- [UNIT Subsystem \(WLAN 802.11, K91\)](#)

ABORt Subsystem (WLAN 802.11, K91)

The ABORt subsystem contains the commands for aborting triggered actions.

Commands of the ABORt Subsystem

- [ABORt](#)

ABORt

For details refer to "[ABORt](#)" on page 6.5.

CALCulate:LIMit Subsystem (WLAN 802.11, K91)

The CALCulate:LIMit subsystem consists of the limit lines and the corresponding limit checks.

Commands of the CALCulate:LIMit Subsystem

- CALCulate<1|2>:LIMit<1...8>:FAIL?
- CALCulate<1|2>:LIMit<1>:ACPower:ACHannel?
- CALCulate<1|2>:LIMit<1>:ACPower:ACHannel:RESult?
- CALCulate<1|2>:LIMit<1>:ACPower:ALTernate?
- CALCulate<1|2>:LIMit<1>:ACPower:ALTernate:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:ALL
- CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:TFALI[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:TFALI[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:TFALI:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:TFALI:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:SYMBOLerror[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:SYMBOLerror[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:SYMBOLerror:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:SYMBOLerror:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERAge]:RESult?

- CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt[:AVERAge]
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt[:AVERAge]:RESult?
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt:MAXimum
- CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILOt:MAXimum:RESult?
- CALCulate<1|2>:LIMit<1>:SPECTrum:MASK:CHECK:X?
- CALCulate<1|2>:LIMit<1>:SPECTrum:MASK:CHECK:Y?

CALCulate<1|2>:LIMit<1...8>:FAIL?

For option WLAN TX Measurements, K91, the index for LIMit for specific limit lines is as follows:

| Index | Limit |
|--------|--------------------------------------|
| 1 to 2 | These indexes are not used |
| 3 | ETSI Spectrum Mask limit line |
| 4 | Spectrum Flatness (Upper) limit line |
| 5 | Spectrum Flatness (Lower) limit line |
| 6 | IEEE Spectrum Mask limit line |
| 7 | PVT Rising Edge max limit |
| 8 | PVT Rising Edge mean limit |
| 9 | PVT Falling Edge max limit |
| 10 | PVT Falling Edge mean limit |

For details refer to "CALCulate<1|2>:LIMit<1...8>:FAIL?" on page 6.20.

CALCulate<1|2>:LIMit<1>:ACPpower:ACHannel?

This command returns the ACP adjacent channel limit for IEEE 802.11j if defined.
This command is a query only and thus has no *RST value.

Parameter

numeric value in dB

Example

```
CALC:LIM:ACP:ACH?
```

Returns the IEEE 802.11j ACP adjacent channel limit.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:ACPowEr:ACHannel:RESult?

For details refer to "[CALCulate<1|2>:LIMit<1...8>:ACPowEr:ACHannel:RESult?](#)" on page 6.25.

CALCulate<1|2>:LIMit<1>:ACPowEr:ALTErnate?

This command returns the ACP alternate channel limit for IEEE 802.11j if defined.

Parameter

numeric value in dB

Example

```
CALC:LIM:ACP:ALT?
```

Returns the IEEE 802.11j ACP alternate channel limit.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:ACPowEr:ALTErnate:RESult?

For details refer to "[CALCulate<1|2>:LIMit<1...8>:ACPowEr:ALTErnate<1|2>:RESult?](#)" on page 6.29.

CALCulate<1|2>:LIMit<1>:BURSt:ALL

This command sets or returns all the limit values.

Parameter

The results are input or output as a list of values separated by ',' in the following (ASCII) format:

```
<average frequency error>, <max frequency error>,
<average symbol error>, <max symbol error>,
<average IQ offset>, <maximum IQ offset>,
<average EVM all bursts>, <max EVM all bursts>,
<average EVM data carriers >, <max EVM data carriers >
<average EVM pilots >, <max EVM pilots >
```

Note: The units for the EVM results are specified with the `UNITS:EVM` command.

Example

```
CALC:LIM:BURS:ALL?
```

All limit values are returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESUlt?

This command returns all the limit results.

This command is a query only and thus has no *RST value.

Parameter

For details on formats refer to "[CALCulate<1|2>:LIMit<1>:BURSt:ALL](#)" on page 6.222.

Example

```
CALC:LIM:BURS:ALL:RES?
```

All limit values are returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERAge]

This command sets the average rise time limit.

Parameter

numeric value in seconds

Example

```
CALC:LIM:BURS:TRIS 0.000001
```

The average rise time limit is set to 1 μ s

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERAge]:RESUlt?

This command returns the average rise time limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:TRIS:RES?
```

The average rise time limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum

This command sets the maximum rise time limit.

Parameter

numeric value in seconds

Example

```
CALC:LIM:BURS:TRIS:MAX 0.000001
```

Maximum rise time limit is set to 1 μ s

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum:RESult?

This command returns the maximum rise time limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:TRIS:MAX:RES?
```

Maximum rise time limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TFALI[:AVERage]

This command sets the average fall time limit.

Parameter

numeric value in seconds

Example

```
CALC:LIM:BURS:TFAL 0.000001
```

The average fall time limit is set to 1 μ s

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TFALI[:AVERage]:RESult?

This command returns the average fall time limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:TFALL:RES?
```

Average fall time limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TFALI:MAXimum

This command sets the maximum fall time limit.

Parameter

numeric value in seconds

Example

```
CALC:LIM:BURS:TFALL:MAX 0.000001
```

The maximum fall time limit set to 1 μ s

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:TFALI:MAXimum:RESult?

This command returns the maximum fall time limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:TRIS:MAX:RES?
```

Maximum fall time limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]

This command sets the average frequency error limit.

Parameter

numeric value in Hertz

Example

```
CALC:LIM:BURS:FERR 10000
```

The average frequency error limit is set to 10 kHz

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult?

This command returns the average frequency error limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:FERR:RES?
```

Average frequency error limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum

This command sets the maximum frequency error limit.

Parameter

numeric value in Hertz

Example

```
CALC:LIM:BURS:FERR:MAX?
```

Maximum frequency error limit is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult?

This command returns the maximum frequency error limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:FERR:MAX:RES?
```

Maximum frequency error limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERAge]

This command sets the average symbol error limit.

Parameter

numeric value in Hertz

Example

```
CALC:LIM:BURS:SYMB 10000
```

The average symbol error limit is set to 10kHz

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERAge]:RESult?

This command returns the average symbol error limit result.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:SYMB:RES?
```

Average symbol error limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum

This command sets the maximum symbol error limit.

Parameter

numeric value in Hertz

Example

```
CALC:LIM:BURS:SYMB:MAX?
```

Maximum symbol error limit is returned

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult?

This command returns the maximum symbol error limit result.
This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:SYMB:MAX:RES?
Maximum symbol error limit result is returned
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset[:AVERAge]

This command sets the average IQ Offset error limit.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:IQOF -10.0
Average IQ Offset error limit is set to -10.0 dB
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset[:AVERAge]:RESult?

This command returns the average IQ Offset error limit result.

Example

```
CALC:LIM:BURS:IQOF:RES?
Average IQ Offset error limit result is returned
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:IQOFFset:MAXimum

This command sets the maximum IQ Offset error limit.

Parameter

numeric value in dB

Example

CALC:LIM:BURS:IQOF:MAX 15.0
 Maximum IQ Offset error limit is set to –15.0 dB

Characteristics

*RST value: –
 SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:IQOFset:MAXimum:RESult?

This command returns the maximum IQ Offset error limit result.

Example

CALC:LIM:BURS:IQOF:MAX:RES:?
 Maximum IQ Offset error limit result is returned

Characteristics

*RST value: –
 SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERAge]

This command sets the average Error Vector Magnitude Limit for the IEEE 802.11b standard.

Parameter

numeric value in dB

Example

CALC:LIM:BURS:EVM -25.0
 Average EVM limit is set to –25 dB

Characteristics

*RST value: –
 SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERAge]:RESult?

This command returns the average Error Vector Magnitude Limit result (PASSED | FAILED) for the IEEE 802.11b standard.

This command is a query only and thus has no *RST value.

Example

CALC:LIM:BURS:EVM:RES?
 Average EVM limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum

This command sets the maximum Error Vector Magnitude Limit for the IEEE 802.11b standard.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:MAX?
Maximum EVM limit is returned
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude Limit result (PASSED | FAILED) for the IEEE 802.11b standard.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:MAX:RES?
Maximum EVM limit result is returned
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage]

This command sets the average Error Vector Magnitude Limit. This is a combined figure that represents the pilot, data and the free carrier.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:ALL -25.0
Average EVM for all carrier limit is set to -25.0 dB
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERAge]:RESult?

This command returns the average Error Vector Magnitude Limit result (PASSED | FAILED). This is a combined figure that represents the pilot, data and the free carrier.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:ALL:RES?
```

Average EVM for all carrier limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum

This command sets the maximum Error Vector Magnitude Limit. This is a combined figure that represents the pilot, data and the free carrier.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:ALL:MAX?
```

Maximum EVM for all carrier limit is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude Limit result (PASSED | FAILED). This is a combined figure that represents the pilot, data and the free carrier.? (K91)"

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:ALL:MAX:RES?
```

Maximum EVM for all carrier limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERAge]

This command sets the average Error Vector Magnitude limit summary for the data carrier.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:DATA -30.0
Average EVM for data carrier limit is set to -30.0 dB
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERAge]:RESult?

This command returns the average Error Vector Magnitude limit result summary (PASSED | FAILED) for the data carrier.? (K91)"

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:DATA:RES?
Average EVM for data carrier limit result is returned
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum

This command sets the maximum Error Vector Magnitude limit summary for the data carrier.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:DATA:MAX?
Maximum EVM for data burst limit is returned
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude limit result summary (PASSED | FAILED) for the data carrier.? (K91)"

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:DATA:MAX:RES?
```

Maximum EVM for data carrier limit result is returned Characteristics.

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]

This command sets the average Error Vector Magnitude limit summary for the pilot carriers.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:PIL -8.0
```

Average EVM for pilot carrier limit is set to –8.0 dB

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage]:RESult?

This command returns the average Error Vector Magnitude limit result summary (PASSED | FAILED) for the pilot carriers.? (K91)"

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:PIL:RES?
```

Average EVM for pilot carrier limit result is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum

This command sets the maximum Error Vector Magnitude limit summary for the pilot carriers.

Parameter

numeric value in dB

Example

```
CALC:LIM:BURS:EVM:PIL:MAX?
Maximum EVM for pilot carrier limit is returned
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum:RESult?

This command returns the maximum Error Vector Magnitude limit result summary (PASSED | FAILED) for the pilot carriers.? (K91)"

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:BURS:EVM:PIL:MAX:RES?
Maximum EVM for pilot carrier limit result is returned
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECK:X?

This command returns the X-value at the maximum overstepping of the spectrum mask limits.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:SPEC:MASK:CHEC:X?
Returns the frequency at the maximum overstepping.
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECK:Y?

This command returns the Y-value at the maximum overstepping of the spectrum mask limits.

This command is a query only and thus has no *RST value.

Example

```
CALC:LIM:SPEC:MASK:CHEC:Y?
Returns the power at the maximum overstepping.
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate:MARKer Subsystem (WLAN 802.11, K91)

The CALCulate:MARKer subsystem checks the marker functions in the instrument.

Commands of the CALCulate:MARKer Subsystem

- [CALCulate<1|2>:MARKer<1>:MAXimum](#)
- [CALCulate<1|2>:MARKer<1>:MINimum](#)
- [CALCulate<1|2>:MARKer<1>:TRACe](#)
- [CALCulate<1|2>:MARKer<1>:X](#)
- [CALCulate<1|2>:MARKer<1>:Y](#)
- [CALCulate<1|2>:MARKer<1>:SYMBOL](#)
- [CALCulate<1|2>:MARKer<1>:CARRIER](#)
- [CALCulate<1|2>:MARKer<1>:BSYMBOL](#)
- [CALCulate<1|2>:MARKer<1>:AOFF](#)
- [CALCulate<1|2>:MARKer<1>\[:STATE\]](#)

CALCulate<1|2>:MARKer<1>:MAXimum

For option WLAN TX Measurements, K91, this command is only available for the Spectrum Flatness result display. For details refer to "[CALCulate<1|2>:MARKer<1...4>:MAXimum\[:PEAK\]](#)" on page 6.45.

CALCulate<1|2>:MARKer<1>:MINimum

For option WLAN TX Measurements, K91, this command is only available for the Spectrum Flatness result display. For details refer to "[CALCulate<1|2>:MARKer<1...4>:MINimum\[:PEAK\]](#)" on page 6.47.

CALCulate<1|2>:MARKer<1>:TRACe

For option WLAN TX Measurements, K91, this command is only available for the following result displays:

- Constellation versus Carrier
- EVM versus Symbol
- Frequency error versus Preamble
- Phase error versus Preamble
- PVT Full Burst
- PVT Rising / Falling
- Spectrum Flatness
- Spectrum Mask, if Max Hold trace is displayed
- Spectrum ACP/ACPR, if Max Hold trace is displayed

For details refer to "[CALCulate<1|2>:MARKer<1...4>:TRACe](#)" on page 6.40.

CALCulate<1|2>:MARKer<1>:X

This command positions the selected marker to the indicated inphase (constellation Vs symbol), frequency (spectrum FFT, spectrum mask, spectrum APCR), time (magnitude capture buffer, auto level, PVT full burst, PVT rising / falling), power (CCDF), sub-carrier (constellation Vs carrier, EVM Vs carrier, spectrum flatness) or symbol (EVM Vs symbol) in the selected measurement window.

This command is query only for the following result displays:

- Constellation Vs Symbol
- Constellation Vs Carrier

Parameter

<numeric_value> in Hz, s, dB

Example

```
CALC:MARK:X 2ms
Positions marker 1 to time 2ms.
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:Y

This command positions the selected marker to the indicated quadrature (constellation Vs symbol), magnitude of I or Q (constellation Vs carrier), EVM (EVM Vs carrier) or abs (spectrum flatness) in the selected measurement window.

This command is query only for the following result displays:

- Auto level
- Constellation Vs Symbol
- Constellation Vs Carrier
- EVM Vs Symbol
- PVT Full
- PVT Rising / Falling
- Magnitude Capture Buffer
- Spectrum Mask
- Spectrum ACP/ACPR
- Spectrum FFT
- CCDF

Parameter

<numeric_value> in percent or dB

Example

```
CALC2:MARK:Y -2
Positions marker 1 in screen B to -2.
CALC:MARK:Y?
Outputs the measured value of marker 1 in screen A.
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:SYMBol

This command positions the selected marker to the indicated symbol (constellation vs symbol and constellation Vs carrier).

This command is query only for the following result displays:

- Constellation Vs Symbol
- Constellation Vs Carrier

Parameter

<numeric_value>

Example

```
CALC:MARK:SYMB 2
```

Positions marker 1 to symbol 2.

```
CALC:MARK:SYMB?
```

Outputs the symbol value of marker 1.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:CARRier

This command positions the selected marker to the indicated carrier (constellation vs symbol and constellation Vs carrier).

This command is query only for the following result displays:

- Constellation Vs Symbol
- Constellation Vs Carrier

Parameter

<numeric_value>

Example

```
CALC:MARK:CARR -7
```

Positions marker 1 to carrier –7.

```
CALC:MARK:CARR?
```

Outputs the carrier value of marker 1.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:BSYMBOL

This command positions the selected marker to the indicated symbol in the indicated burst (Constellation vs Symbol and EVM vs Symbol). The first numeric value is the burst number and the second numeric value is the symbol number.

This command only applies to 802.11b standard for the following result displays:

- Constellation Vs Symbol
- EVM Vs Symbol

This command is a query only and thus has no *RST value.

Parameter

<numeric_value>,<numeric_value>

Example

CALC:MARK1:BSYM 2,10

Positions marker 1 to symbol 10 of burst 2.

CALC:MARK1:BSYM?

Outputs the burst and symbol values of marker 1.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:AOFF

For details refer to "[CALCulate<1|2>:MARKer<1...4>:AOFF](#)" on page 6.40.

CALCulate<1|2>:MARKer<1>[:STATe]

For details refer to "[CALCulate<1|2>:MARKer<1...4>\[:STATe\]](#)" on page 6.40.

CALCulate:MARKer:FUNCTION Subsystem (WLAN 802.11, K91)

The measurement window is selected by CALCulate 1 (screen A) or 2 (screen B).

Commands of the CALCulate:MARKer:FUNCTION Subsystem

- [CALCulate<1|2>:MARKer<1>:FUNCTION:ZOOM](#)
- [CALCulate<1|2>:MARKer<1>:FUNCTION:POWER:RESult\[:CURRENT\]?](#)
- [CALCulate<1|2>:MARKer<1>:FUNCTION:POWER:RESult:MAXHold?](#)

CALCulate<1|2>:MARKer<1>:FUNCTION:ZOOM

This command sets the magnification factor for the zoom. It is only available for the following result displays:

- Constellation vs Carrier
- Constellation vs Symbol

- PVT
- Magnitude Capture Buffer

Parameter

<numeric_value>

Example

```
INIT:CONT OFF
```

Switches to single sweep mode

```
CALC:MARK:FUNC:ZOOM 3;*WAI
```

Activates zooming and waits for its end.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:FUNCTION:POWER:RESult[:CURRENT]?

This command queries the current result values of the adjacent channel power measurement. An ACPR (Adjacent channel power relative) measurement must have previously been run, for there to be summary data available.

Results are output separated by commas in the following order:

- Power of main channel
- Power of lower adjacent channel
- Power of upper adjacent channel
- Power of lower alternate adjacent channel 1
- Power of upper alternate adjacent channel 1
- Power of lower alternate adjacent channel 2
- Power of upper alternate adjacent channel 2

Adjacent channel power values are output in dB.

This command is a query only and thus has no *RST value.

Example

```
CALC:MARK:FUNC:POW:RES?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CALCulate<1|2>:MARKer<1>:FUNCTION:POWER:RESult:MAXHold?

This command queries the maximum result values of the adjacent channel power measurement. An ACPR (Adjacent channel power relative) measurement must have previously been run with more than one sweep, for there to be maximum summary data available.

For details on the output refer to

"[CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult\[:CURRent\]?](#)" on page 6.240.

This command is a query only and thus has no *RST value.

Example

```
CALC:MARK:FUNC:POW:RES:MAXH?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure Subsystem (WLAN 802.11, K91)

The CONFigure subsystem contains commands for configuring complex measurement tasks. The CONFigure subsystem is closely linked to the functions of the FETCH subsystem, where the measurement results are queried.

Commands of the CONFigure Subsystem

- CONFigure:POWer:EXPEcted:RF
- CONFigure:POWer:EXPEcted:IQ
- CONFigure:POWer:AUTO
- CONFigure:POWer:AUTO:SWEEp:TIME
- CONFigure:CHANnel
- CONFigure:STANdard
- CONFigure:BURSt:PVT:AVERAge
- CONFigure:BURSt:PVT:RPOWer
- CONFigure:BURSt:PVT:SELEct
- CONFigure:BURSt:PVT[:IMMEDIATE]
- CONFigure:BURSt:EVM:ECARrier[:IMMEDIATE]
- CONFigure:BURSt:EVM:ESYMBOL[:IMMEDIATE]
- CONFigure:BURSt:SPECTrum:MASK:SELEct
- CONFigure:BURSt:SPECTrum:MASK[:IMMEDIATE]
- CONFigure:BURSt:SPECTrum:FLATness[:IMMEDIATE]
- CONFigure:BURSt:SPECTrum:FFT[:IMMEDIATE]
- CONFigure:BURSt:SPECTrum:ACPR[:IMMEDIATE]
- CONFigure:BURSt:CONSt:CCARrier[:IMMEDIATE]
- CONFigure:BURSt:CONSt:CSYMBOL[:IMMEDIATE]
- CONFigure:BURSt:CONSt:CARRier:SELEct
- CONFigure:BURSt:STATistics:CCDF[:IMMEDIATE]
- CONFigure:BURSt:STATistics:BSTReam[:IMMEDIATE]
- CONFigure:BURSt:STATistics:SFIELD [:IMMEDIATE]
- CONFigure:BURSt:PREamble[:IMMEDIATE]
- CONFigure:BURSt:PREamble:SELEct

CONFigure:POWer:EXPEcted:RF

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer RF input. This value will be overwritten if Auto Level is turned on.

Parameter

<numeric_value> in dBm

Example

```
CONF:POW:EXP:RF 9
```

The WLAN 802.11 option assumes an input signal strength of 9 dBm

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:POWer:EXPeCted:IQ

This remote control command is used to specify the mean power level of the source signal as supplied to the Analyzer IQ inputs. This value will be overwritten if Auto Level is turned on.

Parameter

<numeric_value> in V

Example

```
CONF:POW:EXP:IQ 1
```

The WLAN 802.11 option assumes an input signal strength of 1 Volt

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:POWer:AUTO

This remote control command is used to switch on or off automatic power level detection. When switched on, power level detection is performed at the start of each measurement sweep.

Parameter

ONCE | ON | OFF

If this command is issued with the ONCE parameter then the auto level routine is performed immediately one time.

Example

```
CONF:POW:AUTO 1
```

The WLAN 802.11 option will automatically detect the input power level

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:POWer:AUTO:SWEep:TIME

This remote control command is used to specify the sweep time for the automatic power level detection.

Parameter

numeric value in seconds

Example

```
CONF:POW:AUTO:SWE:TIME 200MS
```

The WLAN 802.11 option will use a 200ms sweep time for the auto-level detection

Characteristics

*RST value: 100ms

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:CHANnel

This remote control command is used to specify the input channel for which measurements are to be performed. This command will automatically cause the internal measurement frequency to be re-calculated.

Parameter

<numeric_value>

Example

```
CONF:CHAN 9
```

The WLAN 802.11 option will perform measurements at the frequency represented by channel 9.

Characteristics

*RST value: 0

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:STANdard

This remote control command specifies which Wireless LAN standard the option is configured to measure.

Parameter

- 0 IEEE 802.11a
- 1 IEEE 802.11b
- 2 IEEE 802.11j (10 MHz)
- 3 IEEE 802.11j (20 MHz)
- 4 IEEE 802.11g
- 5 IEEE 802.11 OFDM Turbo Mode

Example

```
CONF:STAN 0
```

The WLAN 802.11 option will perform measurements according to IEEE 802.11a.

Characteristics

*RST value: 0

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:PVT:AVERage

This remote control command configures the measurement type to set the burst power averaging length to the desired value. This command is only valid when the selected standard is IEEE 802.11b.

Parameter

<numeric_value>

Example

CONF: BURS: PVT: AVER 31

WLAN 802.11 option is configured to use burst power average length of 31.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:PVT:RPOWer

This remote control command configures the use of either mean or maximum burst power as a reference power for the 802.11b PVT measurement.

Parameter

MEAN | MAXimum

Example

CONF: BURS: PVT: RPOW MEAN

WLAN 802.11 option is configured to use mean burst power as a reference power

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:PVT:SELEct

This remote control configures how to interpret the power versus time measurement results.

| Parameter | Description | Wireless LAN standard |
|-----------|--|---|
| EDGE | configures the measurement to be rising and falling edge | all |
| FALL | configures the measurement to be falling edge only | IEEE 802.11b & g (CCK) |
| FULL | configures the measurement to be full burst | IEEE 802.11a, j & g (OFDM), IEEE 802.11 Turbo Mode |

RISE configures the measurement to IEEE 802.11b & g (CCK)
 be rising edge only

Example

CONF: BURS: PVT: SEL FULL
 WLAN 802.11 option will interpret the measurement results as full burst

Characteristics

*RST value: –
 SCPI: device-specific

Mode

WLAN 802.11

CONFigure: BURSt: PVT[:IMMediate]

This remote control command configures the measurement type to be Power Versus Time. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

CONF: BURS: PVT
 WLAN 802.11 option is configured to run a Power Versus Time measurement.

Characteristics

*RST value: –
 SCPI: device-specific

Mode

WLAN 802.11

CONFigure: BURSt: EVM: ECARrier[:IMMediate]

This remote control command configures the measurement type to be EVM Versus Carrier. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

CONF: BURS: EVM: ECAR
 WLAN 802.11 option is configured to run a EVM versus carrier measurement.

Characteristics

*RST value: –
 SCPI: device-specific

Mode

WLAN 802.11

CONFigure: BURSt: EVM: ESYMBOL[:IMMediate]

This remote control command configures the measurement type to be EVM Versus Symbol. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF: BURS: EVM: ESYM
```

WLAN 802.11 option is configured to run a EVM versus symbol measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure: BURSt: SPECtrum: MASK: SElect

This remote control configures the interpretation of the Spectrum MASK measurement results. This command is only available for IEEE 802.11a.

Parameter

IEEE | ETSI

Example

```
CONF: BURS: SPECT: MASK: SEL ETSI
```

WLAN 802.11 option is will interpret the measurement results using the ETSI standard

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure: BURSt: SPECtrum: MASK[: IMMEDIATE]

This remote control command configures the measurement type to be Spectrum mask. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command

Example

```
CONF: BURS: SPEC: MASK
```

WLAN 802.11 option is configured to run a Spectrum Mask measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure: BURSt: SPECtrum: FLATness[: IMMEDIATE]

This remote control command configures the measurement type to be Spectrum flatness. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF: BURS: SPEC: FLAT
```

WLAN 802.11 option is configured to run a Spectrum Flatness measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:SPECTrum:FFT[:IMMediate]

This remote control command configures the measurement type to be FFT (Fast Fourier Transform). After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF: BURS: SPEC: FFT
```

WLAN 802.11 option is configured to run a FFT measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:SPECTrum:ACPR[:IMMediate]

This remote control command configures the measurement type to be ACPR (adjacent channel power relative) After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF: BURS: SPEC: ACPR
```

WLAN 802.11 option is configured to run a ACPR measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:CONSt:CCARrier[:IMMediate]

This remote control command configures the measurement type to be Constellation versus Carrier. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF: BURS: CONS: CCAR
```

WLAN 802.11 option is configured to run a Constellation versus Carrier measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:CONSt:CSYMBOL[:IMMEDIATE]

This remote control command configures the measurement type to be Constellation versus Symbol. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command

Example

```
CONF: BURS: CONS: CSYM
```

WLAN 802.11 option is configured to run a Constellation versus Symbol measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:CONSt:CARRIER:SElect

This remote control command is only available when Constellation versus Symbol measurement is selected. When the Constellation versus Symbol measurement is initiated, it will calculate the results of the selected carrier.

Parameter

–26 to 26 | ALL | PILOTS

Example

```
CONF: BURS: CONS: CARR: SEL -26
```

Carrier –26 is selected.

```
CONF: BURS: CONS: CARR: SEL 10
```

Carrier 10 is selected.

```
CONF: BURS: CONS: CARR: SEL ALL
```

All carriers are selected.

```
CONF: BURS: CONS: CARR: SEL PIL
```

Pilots only.

Characteristics

*RST value: ALL

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:STATistics:CCDF[:IMMEDIATE]

This remote control command configures the measurement type to be CCDF (conditional cumulative distribution functions.). After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF: BURS: STAT: CCDF
```

WLAN 802.11 option is configured to run a CCDF measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:STATistics:BSTream[:IMMediate]

This remote control command configures the measurement type to be bit stream. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF:BURS:STAT:BSTR
```

WLAN 802.11 option is configured to run a bit stream measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:STATistics:SFIeld [:IMMediate]

This remote control command configures the measurement type to be signal field. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF:BURS:STAT:SFIeld
```

WLAN 802.11 option is configured to run a bit stream measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

CONFigure:BURSt:PREamble[:IMMediate]

This remote control command configures the measurement type to be Phase or Frequency vs Preamble. After this command has been executed, the specified measurement will only be started when the user issues the `INITiate` command.

Example

```
CONF:BURS:PRE
```

WLAN 802.11 option is configured to run a preamble measurement.

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

CONFigure:BURSt:PREamble:SElect

This remote control command configures the interpretation of the preamble measurement results.

Parameter

PHASe | FREQuency

Example

```
CONF: BURS: PRE: SEL PHAS
```

The measurement results are interpreted as Phase vs Preamble.

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

DISPlay Subsystem (WLAN 802.11, K91)

The DISPlay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display. In contrast to the basic device, the WLAN TX Measurements option supports the split screen modus.

Commands of the DISPlay Subsystem

- DISPlay:FORMat
- DISPlay[:WINDow<1|2>]:SElect
- DISPlay[:WINDow<1|2>]:SSElect
- DISPlay[:WINDow<1|2>]:TABLe
- DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:AUTO
- DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:PDIVision
- DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel
- DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet

DISPlay:FORMat

This command sets the visible screen display type to full or split screen.

Parameter

SPLit | SINGle

Example

```
DISP:FORM SINGLE
Sets the display to full screen.
```

Characteristics

*RST value: SPL
SCPI: device-specific

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:SElect

This command selects whether screen A or screen B is active.

Example

```
DISP:WIND1:SEL
Sets the screen A active.
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:SSElect

This is an alias for `DISPlay:WINDow[1|2]:SElect` command. `SSElect` means Screen `SElect`.

Example

```
DISP:WIND1:SSEL
Sets the screen A active.
```

Characteristics

*RST value: 1
SCPI: device-specific

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:TABLe

This command selects whether the results table is displayed.

Parameter

ON | OFF

Example

```
DISP:WIND1:TABL ON
Hides the results table
```

Characteristics

*RST value: ON
SCPI: device-specific

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:AUTO

This command switches on or off automatic scaling of the Y-axis for the specified trace display. Automatic scaling sets the Y-axis to automatically scale to best fit the measurement results. This command is only available for the following result displays:

- EVM vs Carrier
- EVM vs Symbol.
- Frequency error vs Preamble
- Phase error vs Preamble

The numeric suffix at `WINDow<1|2>` must be 2 as the relevant results are always displayed in screen B. The numeric suffix at `TRACe<1 to 4>` must be 1.

Parameter

ON | OFF

Example

```
DISP:WIND2:TRAC:Y:SCAL:AUTO ON
switches on automatic scaling of the Y-axis for the active trace
```

Characteristics

*RST value: ON

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:PDIVision

This command sets the size of each Y scale division for the specified trace display. Note that this command has no affect if automatic scaling of the Y-axis is enabled. This command is only available for the following result displays:

- EVM vs Carrier
- EVM vs Symbol.
- Frequency error vs Preamble
- Phase error vs Preamble

The numeric suffix at WINDow<1|2> must be 2 as the relevant results are always displayed in screen B. The numeric suffix at TRACe<1 to 4> must be 1.

Parameter

<numeric_value>

Example

```
DISP:WIND2:TRAC:Y:SCAL:DPIV 2
```

Sets the Y scale division to size to 2.

Characteristics

*RST value: 3

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel

This remote control command can be used to set the current internal instrument reference level used when performing measurements. The numeric suffix at WINDow<1|2> and TRACe<1 to 4> are irrelevant.

Parameter

numeric value in dB

Example

```
DISP:TRAC:Y:RLEV?
```

returns the current reference level in use

Characteristics

*RST value: –

Mode

WLAN 802.11

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet

For details refer to "[DISPlay\[:WINDow<1|2>\]:TRACe<1...4>:Y\[:SCALe\]:RLEVel:OFFSet](#)" on page 6.91.

FETCh:BURSt Subsystem (WLAN 802.11, K91)

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSE subsystems.

Commands of the DISPlay Subsystem

- FETCh:BURSt:ALL?
- FETCh:BURSt:COUnT?
- FETCh:BURSt:PREAmble?
- FETCh:BURSt:PAYLoad?
- FETCh:BURSt:RMS[:AVERAge?]
- FETCh:BURSt:RMS:MINimum?
- FETCh:BURSt:RMS:MAXimum?
- FETCh:BURSt:PEAK?
- FETCh:BURSt:CRESt[:AVERAge?]
- FETCh:BURSt:CRESt:MINimum?
- FETCh:BURSt:CRESt:MAXimum?
- FETCh:BURSt:TRISe:AVERAge?
- FETCh:BURSt:TRISe:MINimum?
- FETCh:BURSt:TRISe:MAXimum?
- FETCh:BURSt:TFALI:AVERAge?
- FETCh:BURSt:TFALI:MINimum?
- FETCh:BURSt:TFALI:MAXimum?
- FETCh:BURSt:FERRor:AVERAge?
- FETCh:BURSt:FERRor:MINimum?
- FETCh:BURSt:FERRor:MAXimum?
- FETCh:BURSt:SYMBolerror:AVERAge?
- FETCh:BURSt:SYMBolerror:MINimum?
- FETCh:BURSt:SYMBolerror:MAXimum?
- FETCh:BURSt:IQOffset:AVERAge?
- FETCh:BURSt:IQOffset:MINimum?
- FETCh:BURSt:IQOffset:MAXimum?
- FETCh:BURSt:GIMBalance:AVERAge?
- FETCh:BURSt:GIMBalance:MINimum?
- FETCh:BURSt:GIMBalance:MAXimum?
- FETCh:BURSt:QUADOffset:AVERAge?
- FETCh:BURSt:QUADOffset:MINimum?
- FETCh:BURSt:QUADOffset:MAXimum?
- FETCh:BURSt:EVM:[IEEE]:AVERAge?

- FETCh:BURSt:EVM:[IEEE]:MINimum?
- FETCh:BURSt:EVM:[IEEE]:MAXimum?
- FETCh:BURSt:EVM:DIRect:AVERage?
- FETCh:BURSt:EVM:DIRect:MINimum?
- FETCh:BURSt:EVM:DIRect:MAXimum?
- FETCh:BURSt:EVM:ALL:AVERage?
- FETCh:BURSt:EVM:ALL:MINimum?
- FETCh:BURSt:EVM:ALL:MAXimum?
- FETCh:BURSt:EVM:DATA:AVERage?
- FETCh:BURSt:EVM:DATA:MINimum?
- FETCh:BURSt:EVM:DATA:MAXimum?
- FETCh:BURSt:EVM:PILot:AVERage?
- FETCh:BURSt:EVM:PILot:MINimum?
- FETCh:BURSt:EVM:PILot:MAXimum?
- FETCh:SYMBol:COUNT?

Further information

- ASCII formats for returned values

ASCII formats for returned values

The results are output as a list of result strings separated by commas.

Returned values for IEEE 802.11a, j, g(OFDM) & Turbo Mode

<preamble power>,
 <payload power>,
 <min rms power>,<average rms power>,<max rms power>,<>,
 <peak power>,
 <min crest factor>,<average crest factor>,<max crest factor>,
 <min frequency error>,<average frequency error> , <max frequency error>,
 <min symbol error> , <average symbol error> , <max symbol error>,
 <min IQ offset> , <average IQ offset> , <maximum IQ offset>,
 <min gain imbalance> , <average gain imbalance> , <max gain imbalance>,
 <min quadrature offset> , <average quadrature offset> , <max quadrature offset>,
 <min EVM all bursts> , <average EVM all bursts> , <max EVM all bursts> ,
 <min EVM data carriers> , <average EVM data carriers > , <max EVM data carriers >
 <min EVM pilots> , <average EVM pilots > , <max EVM pilots >

Returned values for IEEE 802.11b & g (CCK)

<min rise time>,<average rise time>,<max rise time>,
 <min fall time>,<average fall time>,<max fall time>,
 <min rms power>,<average rms power>,<max rms power>,

<min peak power>,<average peak power>,<max peak power>,
 <min crest factor>,<average crest factor>,<max crest factor>,
 <min frequency error>,<average frequency error> ,<max frequency error>,
 <min chip clock error> , <average chip clock error> , <max chip clock error>,
 <min phase error> , <average phase error> , <max phase error> ,
 <min IQ offset> , <average IQ offset> , <maximum IQ offset> ,
 <min gain imbalance> , <average gain imbalance> , <max gain imbalance> ,
 <min quadrature offset> , <average quadrature offset> , <max quadrature offset> ,
 <min EVM IEEE> , <average EVM IEEE> , <max EVM IEEE> ,
 <min EVM Direct> , <average EVM Direct > , <max EVM Direct >

FETCh:BURSt:ALL?

This command returns all the results. The results are output as a list of result strings separated by commas in ASCII format. For details on the format refer to "[ASCII formats for returned values](#)" on page 6.256. The units for the EVM results are specified with the `UNITS : EVM` command.

Example

```
FETC : BURS : ALL?
```

All calculated results are returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:COUNT?

This command returns the number of analyzed bursts.

This command is a query only and thus has no *RST value.

Example

```
FETC : BURS : COUN?
```

The analyzed number of bursts are returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:PREAmble?

This command returns the measured power in the burst preamble.

This command is a query only and thus has no *RST value.

Example

FETC: BURS: PRE?

The burst preamble power is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:PAYLoad?

This command returns the measured power in the payload of the burst.

This command is a query only and thus has no *RST value.

Example

FETC: BURS: PAYL?

The burst payload power is returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:RMS[:AVERAge?] / FETCh:BURSt:RMS:MINimum? / FETCh:BURSt:RMS:MAXimum?

This command returns the average, minimum or maximum RMS burst power in dBm measured during the measurement.

This command is a query only and thus has no *RST value.

Example

FETC: BURS: RMS: MAX?

The maximum calculated RSM burst power from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:PEAK?

This command returns the Peak power in dBm measured during the measurement time.

Example

FETC: BURS: PEAK?

The calculated peak power from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:CRESt[:AVERAge?] / FETCh:BURSt:CRESt:MINimum? / FETCh:BURSt:CRESt:MAXimum?

This command returns the average, minimum or maximum determined CREST factor (= ratio of peak power to average power) in dB.

This command is a query only and thus has no *RST value.

Example

```
FETC:BURS:CRESt:MAX?
```

The maximum calculated crest factor from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:TRISe:AVERAge? / FETCh:BURSt:TRISe:MINimum? / FETCh:BURSt:TRISe:MAXimum?

This command returns the average, minimum or maximum burst rise time in seconds.

This command is a query only and thus has no *RST value.

Example

```
FETC:BURS:TRIS:MAX?
```

The maximum calculated rise time from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:TFALI:AVERAge? / FETCh:BURSt:TFALI:MINimum? / FETCh:BURSt:TFALI:MAXimum?

This command returns the average, minimum or maximum burst fall time in seconds.

This command is a query only and thus has no *RST value.

Example

```
FETC:BURS:TFAL:MAX?
```

The maximum calculated fall time from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:FERRor:AVERage? / FETCh:BURSt:FERRor:MINimum? / FETCh:BURSt:FERRor:MAXimum?

This command returns the measured average, minimum or maximum frequency errors in Hertz. This command is a query only and thus has no *RST value.

Example

FETC: BURS: FERR: MAX?

The maximum frequency error from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:SYMBolerror:AVERage? / FETCh:BURSt:SYMBolerror:MINimum? / FETCh:BURSt:SYMBolerror:MAXimum?

This command returns the percentage of symbols that were outside permissible de-modulation range within a burst.

Example

FETC: BURS: SYMB: MAX?

The maximum number of symbols that were out of range per burst.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:IQOFfset:AVERage? / FETCh:BURSt:IQOFfset:MINimum? / FETCh:BURSt:IQOFfset:MAXimum?

This command returns the measured average, minimum or maximum IQ Offset errors in dB. This command is a query only and thus has no *RST value.

Example

FETC: BURS: IQOF: MAX?

The maximum IQ Offset error from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:GIMBalance:AVERage? / FETCh:BURSt:GIMBalance:MINimum? / FETCh:BURSt:GIMBalance:MAXimum?

This command returns the measured average, minimum or maximum IQ Imbalance errors in dB.

This command is a query only and thus has no *RST value.

Example

```
FETC: BURS: GIMB: MAX?
```

The maximum IQ Imbalance error from the most recent measurement is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:QUADoffset:AVERage? / FETCh:BURSt:QUADoffset:MINimum? / FETCh:BURSt:QUADoffset:MAXimum?

This command returns the accuracy in terms of the phase error of symbols within a burst.

This command is a query only and thus has no *RST value.

Example

```
FETC: BURS: QUAD: MAX?
```

The maximum angle error recorded for a symbol during the measurement.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:EVM:[IEEE]:AVERage? / FETCh:BURSt:EVM:[IEEE]:MINimum? / FETCh:BURSt:EVM:[IEEE]:MAXimum?

This command returns the Error Vector Magnitude measurement results summary (average, minimum or maximum value) in dB for the IEEE 802.11b standard. This result is the value before filtering.

This command is a query only and thus has no *RST value.

Example

```
FETC: BURS: EVM: MAX?
```

The maximum EVM recorded before filtering.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:EVM:DIRect:AVERAge? / FETCh:BURSt:EVM:DIRect:MINimum? / FETCh:BURSt:EVM:DIRect:MAXimum?

This command returns the Error Vector Magnitude measurement results summary (average, minimum or maximum value) in dB for the IEEE 802.11b standard. This result is the value after filtering.

This command is a query only and thus has no *RST value.

Example

`FETC: BURS: EVM: DIR: MAX?`

The maximum EVM recorded after filtering.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:EVM:ALL:AVERAge? / FETCh:BURSt:EVM:ALL:MINimum? / FETCh:BURSt:EVM:ALL:MAXimum?

This command returns the Error Vector Magnitude measurement results summary (average, minimum or maximum value) in dB. This is a combined figure that represents the pilot, data and the free carrier.

This command is a query only and thus has no *RST value.

Example

`FETC: BURS: EVM: ALL: MAX?`

The maximum EVM recorded for all measurement carrier is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:EVM:DATA:AVERAge? / FETCh:BURSt:EVM:DATA:MINimum? / FETCh:BURSt:EVM:DATA:MAXimum?

This command returns the Error Vector Magnitude measurement results summary for the data carrier (average, minimum or maximum value) in dB.

This command is a query only and thus has no *RST value.

Example

`FETC: BURS: EVM: DATA: MAX?`

The maximum EVM recorded for the data carrier is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:BURSt:EVM:PILot:AVERAge? / FETCh:BURSt:EVM:PILot:MINimum? / FETCh:BURSt:EVM:PILot:MAXimum?

This command returns the Error Vector Magnitude measurement results summary for the EVM pilot carrier (average, minimum or maximum value) in dB.

This command is a query only and thus has no *RST value.

Example

```
FETC: BURS: EVM: PIL: MAX?
```

The maximum EVM recorded for the EVM pilot carrier is returned.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FETCh:SYMBol:COUNT?

This command returns the number of symbols for each analyzed burst as a comma separated list.

This command is a query only and thus has no *RST value.

Example

```
FETC: SYMB: COUN?
```

The analyzed number of symbols for each burst are returned

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

FORMat Subsystem (WLAN 802.11, K91)

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

Commands of the FORMat Subsystem

- [FORMat\[:DATA\]](#)

FORMat[:DATA]

For details refer to section "Remote Control – Description of Basic Settings Commands", section "FORMat Subsystem".

INITiate Subsystem (WLAN 802.11, K91)

The INITiate subsystem configures the instrument prior to a measurement being carried out. It is basically used to tell the instrument which measurement is to be performed and takes any necessary step to set up the instrument for the measurement.

Commands of the INITiate Subsystem

- [INITiate\[:IMMediate\]](#)
- [INITiate:CONTInuous](#)

INITiate[:IMMediate]

For details refer to "[INITiate<1|2>\[:IMMediate\]](#)" on page 6.98.

INITiate:CONTInuous

For details refer to "[INITiate<1|2>:CONTInuous](#)" on page 6.97.

INPut Subsystem (WLAN 802.11, K91)

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

Commands of the INPut Subsystem

- [INPut<1|2>:ATTenuation](#)

INPut:ATTenuation

For details refer to "[INPut<1|2>:ATTenuation](#)" on page 6.100.

INSTrument Subsystem (WLAN 802.11, K91)

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTrument Subsystem

- [INSTrument\[:SElect\]](#)
- [INSTrument:NSElect](#)

INSTrument[:SElect]

Parameter

WLAN (option WLAN 802.11, R&S FSL–K91)

For details refer to section "Remote Control – Description of Basic Settings Commands", section "INSTrument Subsystem".

INSTrument:NSElect

Parameter

6 (option WLAN 802.11, R&S FSL–K91)

For details refer to section "Remote Control – Description of Basic Settings Commands", section "INSTrument Subsystem".

MMEMory Subsystem (WLAN 802.11, K91)

The MMEMory (mass memory) subsystem provides commands to store and load IQ data.

Commands of the MMEMory Subsystem

- [MMEMory:LOAD:IQ:STATe](#)
- [MMEMory:STORe:IQ:STATe](#)

MMEMory:LOAD:IQ:STATe

This command loads the IQ data from the specified .iqw file.

Parameter

1,<file_name>

Example

```
MMEM:LOAD:IQ:STAT 'D:\USER\DATA.iqw'
```

Loads IQ data from the specified file.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

MMEMory:STORe:IQ:STATe

This command stores the IQ data to the specified .iqw file.

Parameter

1,<file_name>

Example

```
MMEM:STOR:IQ:STAT 'D:\USER\DATA.iqw'
```

Stores IQ data to the specified file.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

SENSe Subsystem (WLAN 802.11, K91)

The SENSe command is used to set and get the values of parameters in the remote instrument. The get variant of the SENSe command differs from set in that it takes no parameter values (unless otherwise stated) but is followed by the character '?' and will return the parameter's value in the same format as it is set.

Commands of the SENSe Subsystem

- [SENSe:]BURSt:COUnT
- [SENSe:]BURSt:COUnT:STATe
- [SENSe:]DEMod:CEStimation
- [SENSe:]DEMod:FiLTer:CATalog?
- [SENSe:]DEMod:FiLTer:MODulation
- [SENSe:]DEMod:FORMat:SIGSymbol
- [SENSe:]DEMod:FORMat[:BConTent]:AUTo
- [SENSe:]DEMod:FORMat:BTRate
- [SENSe:]DEMod:FORMat:BANalyze
- [SENSe:]DEMod:FORMat:BANalyze:BTYPe
- [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUal
- [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN
- [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MAX
- [SENSe:]DEMod:FORMat:BANalyze:DBYTeS:EQUal
- [SENSe:]DEMod:FORMat:BANalyze:DBYTeS:MIN
- [SENSe:]DEMod:FORMat:BANalyze:DBYTeS:MAX
- [SENSe:]DEMod:BANalyze:DURation:EQUal
- [SENSe:]DEMod:BANalyze:DURation:MIN
- [SENSe:]DEMod:BANalyze:DURation:MAX
- [SENSe:]FREQUency:CENTer
- [SENSe:]SWAPiq
- [SENSe:]SWEep:TIME
- [SENSe:]SWEep:COUnT
- [SENSe:]SWEep:EGATe
- [SENSe:]SWEep:EGATe:HOLDoff[:TIME]
- [SENSe:]SWEep:EGATe:HOLDoff:SAMPle
- [SENSe:]SWEep:EGATe:LENGth[:TIME]
- [SENSe:]SWEep:EGATe:LENGth:SAMPle
- [SENSe:]SWEep:EGATe:LINK
- [SENSe:]TRACking:LEVel
- [SENSe:]TRACking:PHASe

- [SENSe:]TRACking:TIME
- [SENSe:]POWer:ACHannel:MODE

Further information

- Analysis modulation format

Analysis modulation format

| Parameter | Standard | Description |
|-----------|---|--|
| BPSK3 | IEEE 802.11j (10 MHz) | BI Phase shift keying at 3 Mbps |
| BPSK45 | IEEE 802.11j (10 MHz) | BI Phase shift keying at 6 Mbps |
| BPSK6 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | BI Phase shift keying at 6 Mbps |
| BPSK9 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | BI Phase shift keying at 9 Mbps |
| BPSK | Alias for BI | Phase shift keying at higher data rate for selected standard |
| QPSK6 | IEEE 802.11j (10 MHz) | Quadrature phase shift keying at 6 Mbps |
| QPSK9 | IEEE 802.11j (10 MHz) | Quadrature phase shift keying at 9 Mbps |
| QPSK12 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | Quadrature phase shift keying at 12 Mbps |
| QPSK18 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | Quadrature phase shift keying at 18 Mbps |
| QPSK | Alias for Quadrature phase shift keying at higher data rate for selected standard | |
| QAM1612 | IEEE 802.11j (10 MHz) | Quadrature Amplitude Modulation at 12 Mbps |
| QAM1618 | IEEE 802.11j (10 MHz) | Quadrature Amplitude Modulation at 18 Mbps |
| QAM1624 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | Quadrature Amplitude Modulation at 24 Mbps |
| QAM1636 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | Quadrature Amplitude Modulation at 36 Mbps |
| QAM16 | Alias for Quadrature Amplitude Modulation at higher data rate for selected standard | |
| QAM6424 | IEEE 802.11j (10 MHz) | Quadrature Amplitude Modulation at 24 Mbps |
| QAM6427 | IEEE 802.11j (10 MHz) | Quadrature Amplitude Modulation at 27 Mbps |
| QAM6448 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | Quadrature Amplitude Modulation at 48 Mbps |
| QAM6454 | IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo | Quadrature Amplitude Modulation at 54 Mbps |

| Parameter | Standard | Description |
|-----------|---|--|
| QAM64 | Alias for Quadrature Amplitude Modulation at higher data rate for selected standard | |
| DBPSK | IEEE 802.11b & g (Single Carrier) | Differential BI Phase shift keying |
| DQPSK | IEEE 802.11b & g (Single Carrier) | Differential Quadrature phase shift keying |
| CCK55 | IEEE 802.11b & g (Single Carrier) | Complimentary Code Keying at 5.5 Mbps |
| CCK11 | IEEE 802.11b & g (Single Carrier) | Complimentary Code Keying at 11 Mbps |
| PBCC55 | IEEE 802.11b & g (Single Carrier) | PBCC at 5.5 Mbps |
| PBCC11 | IEEE 802.11b & g (Single Carrier) | PBCC at 11 Mbps |
| PBCC22 | IEEE 802.11g (Single Carrier) | PBCC at 11 Mbps |

[SENSe:]BURSt:COUNT

This command defines the number of bursts that will be analyzed by the measurement. This parameter is ignored if the setting for the [SENSe:]BURSt:COUNT:STATe parameter is off.

Parameter

<numeric_value>

Example

```
BURSt:COUNT 16
```

Sets the number of bursts to 16.

Characteristics

*RST value: 1

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]BURSt:COUNT:STATe

When this command is set to on, the burst count parameter will be used by the measurement, otherwise the burst count parameter will be ignored.

Parameter

ON | OFF

Example

```
BURSt:COUNT:STAT ON
```

Sets the burst count state to ON

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:CESTimation

This command defines whether channel estimation will be done in preamble and payload (if set to 1) or only in preamble (if set to 0). The effect of this is most noticeable for the EVM measurement results, where the results will be improved when this feature is enabled.

However, this functionality is not supported by the IEEE 802.11 standard and must be disabled if the results are to be strictly measured against the standard.

Parameter

ON | OFF

Example

```
DEMod:CEST ON
```

Specifies that the IQ measurement results will use channel estimation in preamble & payload.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FILTer:CATalog?

This command reads the names of all available filters. The file names are output without file extension. Syntax of output format: filter_1,filter_2, ... ,filter_n.

This command is a query only and thus has no *RST value.

Example

```
DEM:FILT:CAT?
```

Reads all filter names

Characteristics

*RST value: 0

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FILTer:MODulation

This command selects the TX and RX filters. The names of the filters correspond to the file names; a query of all available filters is possible by means of the `SENS:DEM:FILT:CAT?` command.

Parameter

<string>, <string>

DEF_TX: default transmit filter, DEF_RX: default receive filter

Example

```
DEM:FILT:MOD 'DEF_TX', 'DEF_RX'
```

DEF_TX is selected for the TX filter and DEF_RX for the RX filter

Characteristics

*RST value: AUTO,AUTO

SCPI: device-specific

ModeWLAN 802.11

[SENSE:]DEMod:FORMat:SIGSymbol

When this command is set to ON then the signal symbol field of the burst is analyzed to determine the details of the burst. When this field is set to ON only burst which match the supplied burst type and modulation are considered in results analysis. For IEEE 802.11b this command can only be queried as the decoding of the signal field is always performed for the IEEE 802.11b standard.

Parameter

ON | OFF

Example

DEM:FORM:SIGS ON

Specifies that the signal symbol field should be decoded.

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

[SENSE:]DEMod:FORMat[:BContent]:AUTO

When this command is set to ON then the signal symbol field of the burst is analyzed to determine the modulation scheme of the first burst. When this field is set to ON only bursts which match the modulation scheme are considered in results analysis.

Parameter

ON | OFF

Example

DEM:FORM:AUT ON

Specifies that the signal symbol field should be decoded.

Characteristics

*RST value: –

SCPI: device-specific

ModeWLAN 802.11

[SENSE:]DEMod:FORMat:BTRate

The remote control command is used to specify the bit rate for IEEE 802.11b signals. This command can be used as an alternative to [SENSE:]DEMod:FORMat:BANalyze. The bit rate can be set as follows:

Parameter

10 1 Mbit/s

20 2 Mbit/s

55 5.5 Mbit/s

110 11 Mbit/s

Example

DEM:FORM:BTR 20

The WLAN 802.11 option will demodulate 2 Mbit/s signals

Characteristics

*RST value: 10 (= 1mbit)

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze

The remote control command sets the analysis modulation format that will be assumed when the measurement is performed. If the [SENSe:]DEMod:FORMat:SIGSymbol parameter has been set to ON, this command can be used to measure only certain burst types within a measurement sequence.

Parameter

For details refer to "[Analysis modulation format](#)" on page 6.270.

Example

DEM:FORM:BAN 'QAM16'

The WLAN 802.11 option will only analyze bursts that are of the QAM16 modulation format

Characteristics

*RST value: QAM64'

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:BTYPe

This remote control command specifies the type of burst to be analyzed. Only bursts of the specified type take part in measurement analysis.

Parameter

| | |
|------------|--|
| DIRECT | IEEE 802.11a, IEEE 802.11j (10MHz), IEEE 802.11j (20MHz), IEEE 802.11g, 802.11 OFDM Turbo – Direct Link Burst |
| LONG-OFDM | IEEE 802.11g – Long DSSS OFDM |
| SHORT-OFDM | IEEE 802.11g – Short DSSS OFDM |
| LONG | IEEE 802.11b, IEEE 802.11g – Long PLCP Burst |
| SHORT | IEEE 802.11b, IEEE 802.11g – Short PLCP Burst |

Example

DEM:FORM:BAN:BTYPe 'DIRECT'

The WLAN 802.11 option will only analyze DIRECT bursts

Characteristics

*RST value: DIRECT'

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUal

When this command is activated then only bursts of equal length will take part in the measurement analysis. When this command is set to true the value specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN command specifies the number of symbols that a burst must have in order to take part in analysis.

Parameter

ON | OFF

Example

```
DEM:FORM:BAN:SYM:EQU ON
```

Only bursts of equal length will take part in analysis.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN

This command specifies the number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.

When the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUal command has been set to true then this command specifies the exact number of symbols required for a burst to take part in measurement analysis. When the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUal command is set to false this command specifies the minimum number of symbols required for a burst to take part in measurement analysis.

Parameter

<numeric_value>

Example

```
DEM:FORM:BAN:SYM:MIN 16
```

The WLAN 802.11 option will only analyze bursts which contain a symbol count of 16.

Characteristics

*RST value: 1

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MAX

This command specifies the maximum number of data symbols required for bursts to qualify for measurement analysis. Only bursts with the specified number of symbols will be used in the

measurement analysis. The number of data symbols is defined as the uncoded bits including service and tail bits.

This value will not have any immediate effect if the

[SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:EQUal command has been set to true as in this case no range of symbols is allowed and only bursts with exactly the number of symbols specified by the [SENSe:]DEMod:FORMat:BANalyze:SYMBOLs:MIN command shall take place in measurement analysis.

Parameter

<numeric_value>

Example

```
DEM:FORM:BAN:SYM:MAX 1300
```

The WLAN 802.11 option will only analyze bursts which contain a maximum symbol count of 1300.

Characteristics

*RST value: 64

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal

When this command is set to ON then only bursts of equal length will take part in the measurement analysis. When this command is set to true the value specified by the [SENSe:]DEMod:FORMat: BANalyze:DBYTes:MIN command specifies the number of data bytes that a burst must have in order to take part in measurement analysis.

Parameter

ON | OFF

Example

```
DEM:FORM:BAN:DBYTes:EQU ON
```

Only bursts of equal length will take part in the measurement analysis.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:MIN

This command specifies the number of data bytes required for bursts to qualify for measurement analysis. Only bursts with the specified number of data bytes will be used in the measurement analysis.

When the [SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal command has been set to true then this command specifies the exact number of data bytes required for a burst to take part in measurement analysis. When the [SENSe:]DEMod:BANalyze:DBYTes:EQUal command is set to false this command specifies the minimum number of data bytes required for a burst to take part in measurement analysis.

Parameter

<numeric_value>

Example

DEM:FORM:BAN:DBYtes:MIN 16

The R&S WLAN 802.11 option will only analyze bursts which contain 16 data bytes

Characteristics

*RST value: 1

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:FORMat:BANalyze:DBYtes:MAX

This command specifies the maximum number of data bytes required for bursts to qualify for measurement analysis. Only bursts with the specified number of data bytes will be used in the measurement analysis.

This value will not have any immediate effect if the

[SENSe:]DEMod:FORMat:BANalyze:DBYtes:EQUal command has been set to true as in this case no range of symbols is allowed and only bursts with exactly the number of data bytes specified by the [SENSe:]DEMod:FORMat:BANalyze:DBYtes:MIN command shall take part in measurement analysis.

Parameter

<numeric_value>

Example

DEM:FORM:BAN:DBYtes:MAX 1300

The WLAN 802.11 option will only analyze bursts which contain a maximum of 1300 data bytes.

Characteristics

*RST value: 64

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]DEMod:BANalyze:DURation:EQUal

When this command is set to ON then only bursts of equal length will take part in the PVT analysis. When this command is set to true the value specified by the [SENSe:]DEMod:BANalyze:DURation:MIN command specifies the duration that a burst must last in order to take part in measurement analysis.

Parameter

ON | OFF

Example

DEM:BAN:DUR:EQU ON

Only bursts of equal length will take part in the measurement analysis.

Characteristics

*RST value: OFF

SCPI: device-specific

ModeWLAN 802.11

[SENSe:]DEMod:BANalyze:DURation:MIN

This command specifies the duration in microseconds required for bursts to qualify for measurement analysis. Only bursts with the specified duration will be used in the measurement analysis. When the [SENSe:]DEMod:BANalyze:DURation:EQUal command has been set to true then this command specifies the exact duration required for a burst to take part in measurement analysis. When the [SENSe:]DEMod:BANalyze:DBYTes:EQUal command is set to false this command specifies the minimum duration required for a burst to take part in measurement analysis.

Parameter

<numeric_value>

Example

DEMod:BAN:DUR:MIN 45

The WLAN 802.11 option will only analyze bursts which last 48 microseconds.

Characteristics

*RST value: 1

SCPI: device-specific

ModeWLAN 802.11

[SENSe:]DEMod:BANalyze:DURation:MAX

This command specifies the maximum duration in microseconds required for bursts to qualify for measurement analysis. Only bursts with the specified duration will be used in the measurement analysis.

This value will not have any immediate effect if the

[SENSe:]DEMod:BANalyze:DURation:EQUal command has been set to true as in this case no range of durations is allowed and only bursts with exactly the duration specified by the [SENSe:]DEMod:BANalyze:DURation:MIN command shall take part in measurement analysis

Parameter

<numeric_value>

Example

DEMod:BAN:DUR:MAX 1300

The WLAN 802.11 option will only analyze bursts which have a maximum duration of 1300 microseconds.

Characteristics

*RST value: 5464

SCPI: device-specific

ModeWLAN 802.11

[SENSe:]FREQuency:CENTer

For details refer to "[SENSe<1|2>:]FREQuency:CENTer" on page 6.113.

[SENSe:]SWAPiq

This command defines whether or not the recorded IQ pairs should be swapped (I<-->Q) before being processed.

Parameter

ON | OFF

Example

```
SWAP ON
```

Specifies that IQ values should be swapped.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]SWEep:TIME

The RST value for option WLAN TX Measurements (K91) is 1 ms. For details refer to "[SENSe<1|2>:]SWEep:TIME" on page 6.134.

[SENSe:]SWEep:COUNT

The remote control command is used to specify the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Parameter

<numeric_value>

Example

```
SWEep:COUNT 64
```

Sets the number of sweeps to 64.

Characteristics

*RST value: 1

SCPI: conforming

Mode

WLAN 802.11

[SENSe:]SWEep:EGATe

For details refer to "[SENSe<1|2>:]SWEep:EGATe" on page 6.136.

[SENSe:]SWEep:EGATe:HOLDoff[:TIME]

This command defines the gate delay in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Parameter

<numeric_value>

Example

```
SWE:EGAT:HOLD 125us
```

The WLAN 802.11 option will enforce a delay of 125 μ s in the capture buffer

Characteristics

*RST value: 100 μ s

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle

This command defines the gate delay in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Parameter

<numeric_value>

Example

```
SWE:EGAT:HOLD:SAMP 2500
```

The WLAN 802.11 option will enforce a delay of 2500 samples in the capture buffer.

Characteristics

*RST value: 2000

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]SWEep:EGATe:LENGth[:TIME]

This command defines the gate time in the capture buffer in time units. The range of this value is dependent on the last run measurement.

Parameter

<numeric_value>

Example

```
SWE:EGAT:LENG 20ms
```

The WLAN 802.11 option will enforce a gate length of 20 milliseconds between sweeps.

Characteristics

*RST value: 400 μ s

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]SWEep:EGATe:LENGth:SAMPle

This command defines the gate time in the capture buffer as a number of samples. The range of this value is dependent on the last run measurement.

Parameter

<numeric_value>

Example

```
SWE:EGAT:LENG:SAMP 200000
```

The WLAN 802.11 option will enforce a gate length of 200000 samples in the Capture buffer.

Characteristics

*RST value: 8000

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]SWEep:EGATe:LINK

This command links together the movement of the gating lines and the capture buffer marker.

Parameter

ON | OFF

Example

```
SWE:EGAT:LINK ON
```

Links the gating lines as marker with the gating line delay and length are changed gate position.

Characteristics

*RST value: 0

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]TRACking:LEVEl

This command defines whether or not the measurement results should be compensated for level.

Parameter

ON | OFF

Example

```
TRAC:LEV ON
```

Specifies that the measurement results should be compensated for level.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]TRACking:PHASe

This command defines whether or not the measurement results should be compensated for phase.

Parameter

ON | OFF

Example

```
TRAC:PHAS ON
```

Specifies that the measurement results should be compensated for phase.

Characteristics

*RST value: ON

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]TRACking:TIME

This command defines whether or not the measurement results should be compensated for time.

Parameter

ON | OFF

Example

```
TRAC:TIME ON
```

Specifies that the measurement results should be compensated for time.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

WLAN 802.11

[SENSe:]POWer:ACHannel:MODE

This command sets the ACP measurement mode for the IEEE 802.11j standard to either absolute or relative.

Parameter

ABS Absolute measurement

REL Relative measurement

Example

```
POW:ACH:MODE ABS
```

Sets the ACP measurement to absolute mode

Characteristics

*RST value: REL

SCPI: device-specific

Mode

WLAN 802.11

STATus Subsystem (WLAN 802.11, K91)

The STATus subsystem contains the commands for the status reporting system (see chapter "Remote Control – Basics", section "Status Reporting System"). *RST does not influence the status registers.

Commands of the STATus Subsystem

- [STATus:QUEStionable:ACPLimit\[:EVENT\]?](#)
- [STATus:QUEStionable:ACPLimit:CONDition?](#)
- [STATus:QUEStionable:ACPLimit:ENABle](#)
- [STATus:QUEStionable:ACPLimit:PTRansition](#)
- [STATus:QUEStionable:ACPLimit:NTRansition](#)
- [STATus:QUEStionable:LIMit<1|2> \[:EVENT\]?](#)
- [STATus:QUEStionable:LIMit<1|2>:CONDition?](#)
- [STATus:QUEStionable:LIMit<1|2>:ENABle](#)
- [STATus:QUEStionable:LIMit<1|2>:PTRansition](#)
- [STATus:QUEStionable:LIMit<1|2>:NTRansition](#)
- [STATus:QUEStionable:POWer\[:EVENT\]?](#)
- [STATus:QUEStionable:POWer:CONDition?](#)
- [STATus:QUEStionable:POWer:ENABle](#)
- [STATus:QUEStionable:POWer:PTRansition](#)
- [STATus:QUEStionable:POWer:NTRansition](#)
- [STATus:QUEStionable:SYNC\[:EVENT\]?](#)
- [STATus:QUEStionable:SYNC:CONDition?](#)
- [STATus:QUEStionable:SYNC:ENABle](#)
- [STATus:QUEStionable:SYNC:PTRansition](#)
- [STATus:QUEStionable:SYNC:NTRansition](#)

STATus:QUEStionable:ACPLimit[:EVENT]?

For details refer to "[STATus:QUEStionable:ACPLimit\[:EVENT\]?](#)" on page 6.145.

STATus:QUEStionable:ACPLimit:CONDition?

For details refer to "[STATus:QUEStionable:ACPLimit:CONDition?](#)" on page 6.146.

STATus:QUEStionable:ACPLimit:ENABle

For details refer to "[STATus:QUEStionable:ACPLimit:ENABle](#)" on page 6.146.

STATus:QUESTionable:ACPLimit:PTRansition

For details refer to "[STATus:QUESTionable:LIMit<1|2>:PTRansition](#)" on page 6.142.

STATus:QUESTionable:ACPLimit:NTRansition

For details refer to "[STATus:QUESTionable:ACPLimit:NTRansition](#)" on page 6.147.

STATus:QUESTionable:LIMit<1|2> [:EVENT]?

For details refer to "[STATus:QUESTionable:LIMit<1|2> \[:EVENT\]?](#)" on page 6.141.

STATus:QUESTionable:LIMit<1|2>:CONDition?

For details refer to "[STATus:QUESTionable:LIMit<1|2>:CONDition?](#)" on page 6.141.

STATus:QUESTionable:LIMit<1|2>:ENABLE

For details refer to "[STATus:QUESTionable:LIMit<1|2>:ENABLE](#)" on page 6.141.

STATus:QUESTionable:LIMit<1|2>:PTRansition

For details refer to "[STATus:QUESTionable:LIMit<1|2>:PTRansition](#)" on page 6.142.

STATus:QUESTionable:LIMit<1|2>:NTRansition

For details refer to "[STATus:QUESTionable:LIMit<1|2>:NTRansition](#)" on page 6.142.

STATus:QUESTionable:POWER[:EVENT]?

For details refer to "[STATus:QUESTionable:POWER\[:EVENT\]?](#)" on page 6.142.

STATus:QUESTionable:POWER:CONDition?

For details refer to "[STATus:QUESTionable:POWER:CONDition?](#)" on page 6.143.

STATus:QUESTionable:POWER:ENABLE

For details refer to "[STATus:QUESTionable:POWER:ENABLE](#)" on page 6.143.

STATus:QUESTionable:POWER:PTRansition

For details refer to "[STATus:QUESTionable:POWER:PTRansition](#)" on page 6.143.

STATus:QUESTIONable:POWER:NTRansition

For details refer to "[STATus:QUESTIONable:POWER:NTRansition](#)" on page 6.143.

STATus:QUESTIONable:SYNC[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUESTIONable:SYNC register. Readout does not delete the contents of the EVENT section.

Example

```
STAT:QUES:SYNC?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

STATus:QUESTIONable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUESTIONable:SYNC register. Readout does not delete the contents of the CONDition section.

Example

```
STAT:QUES:SYNC:COND?
```

Characteristics

*RST value: –

SCPI: conforming

Mode

WLAN 802.11

STATus:QUESTIONable:SYNC:ENABLE

This command sets the bits of the ENABLE section of the STATus:QUESTIONable:SYNC register. The ENABLE register selectively enables the individual events of the associated EVENT section for the summary bit.

Parameter

0 to 65535

Example

```
STAT:QUES:SYNC:ENAB 65535
```

All events bits will be represented in the SYNC summary bit.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

STATus:QUESTionable:SYNC:PTRansition

This command determines what bits in the STATus:QUESTionable:SYNC Condition register will set the corresponding bit in the STATus:QUESTionable:SYNC Event register when that bit has a positive transition (0 to 1). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

```
STAT:QUES:SYNC:PTR 65535
```

All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

STATus:QUESTionable:SYNC:NTRansition

This command determines what bits in the STATus:QUESTionable:SYNC Condition will set the corresponding bit in the STATus:QUESTionable:SYNC Event register when that bit has a negative transition (1 to 0). The variable <number> is the sum of the decimal values of the bits that are to be enabled.

Parameter

0 to 65535

Example

```
STAT:QUES:SYNC:NTR 65535 -
```

All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

TRACe Subsystem (WLAN 802.11, K91)

The TRACe subsystem controls access to the instrument's internal trace memory.

Commands of the TRACe Subsystem

- TRACE[:DATA]
- TRACE:IQ:DATA:MEMory?
- TRACE:IQ:SRATe

Further information

- IQ Measurements
- Constellation vs Symbol
- Constellation vs Carrier
- Power vs Time – Full Burst and Rising /Falling Data
- Spectrum Flatness
- Spectrum FFT
- Statistics Bitstream data
- Statistics CCDF – Complementary cumulative distribution function
- Statistics Signal Field data
- EVM vs Carrier
- EVM vs Symbol
- Error vs Preamble
- Frequency Sweep Measurements
- Spectrum Mask
- Spectrum ACPR

IQ Measurements

There are a number of measurements that can be performed in IQ mode. No data will be returned for any of the following measurements, should it be requested, until such time as a measurement belonging to the IQ group has been previously run.

Running a frequency sweep measurement for example, Spectrum Mask, will not generate results for this measurement group.

Constellation vs Symbol

This measurement represents I and Q data. For IEEE 802.11a and j the data will be returned as a repeating array of interleaved I and Q data in groups of selected carriers, until all the data is exhausted. For IEEE 802.11b the data will be returned as a repeating array of interleaved I and Q data in symbol order until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

IEEE 802.11a & j only

- If "All Carriers" is selected, it will return 52 per of I and Q data per symbol.
- If "Pilots Only" is selected, it will return 4 per of I and Q per symbol in the following order: Carrier – 21, Carrier –7, Carrier 7, Carrier 21.
- If a single carrier is selected, it will return 1 per of I and Q data per symbol.

Constellation vs Carrier

This measurement represents I and Q data. Data will be returned as a repeating array of interleaved I and Q data in groups of 53 channels including the channel 0, until all the data is exhausted.

Each I and Q point will be returned in floating point format. TRACE1 is used for this measurement results.

Power vs Time – Full Burst and Rising /Falling Data

Both measurement results are once again simply slightly different views of the same results data.

All fully complete bursts within the capture time are analyzed into three master bursts. The three master bursts relate to the minimum, maximum and average values across all complete bursts. This data is returned in dBm values to the user on a per sample basis. Each sample will in some way relate to an analysis of each corresponding sample within each processed burst.

The type of PVT data returned will be determined by the TRACE number passed as an argument to the SCPI command, in addition to the graphic type that is selected.

If the graphic type selected is full burst, then the return data is as follows.

TRACE1 full burst, minimum burst data values.
TRACE2 full burst, mean burst data values.
TRACE3 full burst, maximum burst data values.

If the graphic type selected is EDGe, then the return data is as follows.

TRACE1 rising edge, minimum burst data values.
TRACE2 rising edge, mean burst data values.
TRACE3 rising edge, maximum burst data values.
TRACE4 falling edge, minimum burst data values.
TRACE5 falling edge, mean burst data values.
TRACE6 falling edge, maximum burst data values.

For IEEE 802.11b only

- if the graphic type selected is RISing or FALLing then only 3 traces are available (1 to 3) and represent the minimum, mean and maximum bursts data for the respective graph selection.
- The number of samples returned during full burst analysis will depend on the modulation type and will typically be 5000.
- The number of samples returned when the rising and falling graphic type is selected will be less than what is returned for full burst and will be approximately 400 samples.
- The samples will be returned in floating point format as a single sequence of comma delimited values.

Spectrum Flatness

There are four separate traces that are available with this measurement. Trace data for a particular trace will only be returnable by querying the appropriate trace

Spectrum flatness provides two basic graph types. These are an absolute power value graph (ABS) and a relative group delay graph, which are both plotted on a per carrier basis. All 52 carriers are drawn, in addition to the unused 0 carrier. Both the absolute power and group delay graph groups will allow all the data points to be returned as one trace and an average of all the channels as the other trace.

e.g. the return data will either be one single group of 53 carriers if the average trace is selected or a repeating group of 53 carriers if all the data is requested.

| | | |
|--------|-------------|-----------------------|
| TRACE1 | ABS | (all analyzed trains) |
| TRACE2 | Group Delay | (all analyzed trains) |
| TRACE3 | ABS | (average trace) |
| TRACE4 | Group Delay | (average trace) |

Absolute power results are returned in dB and group delay results are returned in ns.

Spectrum FFT

All FFT points will be returned if the data for this measurement is requested. This will be an exhaustive call, due to the fact that there are nearly always more FFT points than IQ samples. The number of FFT points is the number presented by a power of 2 that is higher than the total number of samples.

e.g. if there were 20000 samples, then 32768 FFT points would be returned.

Data will be returned in floating point format in dBm. TRACE1 is used for this measurement results.

Statistics Bitstream data

IEEE 802.11a & j only

Data will be returned in repeating groups of 52 data channels where each symbol value will be represented by an integer value within one byte. Channel 0 is unused and will therefore not have any data associated with it, with no return data being provided.

The number of repeating groups that are returned will be equal to the number of measured symbols.

Currently, 64QAM has the highest data rate and it contains symbol values up to 63, making the proposal of one byte sufficient in size to represent all symbol data values, regardless of the modulation type in use.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

IEEE 802.11b only

Data will be returned in burst order. Each burst will be represented as a series of bytes. For each burst the first 9 or 18 bytes represents the PLCP Preamble for Short and Long burst types respectively. The next 6 bytes represents the PLCP Header. The remaining bytes represent the PSDU.

Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for this measurement results.

Statistics CCDF – Complementary cumulative distribution function

Up to a maximum of 201 data points will be returned in addition to a data count value. The first value in the return data will represent the quantity of probability values that follow. Each of the potential 201 data points will be returned as probability value and will represent the total number of samples that are equal to or exceed the corresponding power level. Probability data will be returned up to the power level that contains at least one sample. It is highly unlikely that the full 201 data values will ever be returned.

Each probability value will be returned as a floating point number, with a value less than 1.

Statistics Signal Field data

IEEE 802.11a & j only

Data will be returned as an array of hexadecimal values, with each hexadecimal value representing the 24 bit long signal field for a single burst.

IEEE 802.11b only

Data will be returned as an array of hexadecimal values, with each hexadecimal value representing the 48 bit long signal field for a single burst

EVM vs Carrier

Two trace types are provided with this measurement. There is an average EVM value for each of the 53 channels or a repeating group of EVM values for each channel. The number of repeating groups will correspond to the number of fully analyzed trains.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

TRACE1 Average EVM values per channel

TRACE2 All EVM values per channel for each full train of the capture period

EVM vs Symbol

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum EVM value, as measured over the complete capture period.

The number of repeating groups that are returned will be equal to the number of measured symbols.

Each EVM value will be returned as a floating point number, expressed in units of dBm.

IEEE 802.11a & j only

TRACE1 Minimum EVM values

TRACE2 Mean EVM values

TRACE3 Maximum EVM values

IEEE 802.11b only

TRACE1 EVM IEEE values

TRACE2 EVM Direct values

Error vs Preamble

Three traces types are available with this measurement. The basic trace types show either the minimum, mean or maximum frequency or phase value as measured over the preamble part of the burst.

Frequency Sweep Measurements

No data will be returned for this type of measurement, should it be requested, until such time as a measurement has been previously run.

Running an IQ measurement will not generate results for this type of measurement.

Spectrum Mask

Result data will be returned as 625 trace points in floating point format. These trace points are obtained directly from the base system via the measurement API and the quantity is therefore a fixed value. Only an array of Y data will be returned. TRACE1 is used for this measurement results.

Spectrum ACPR

Result data will be returned as 625 trace points in floating point format. These trace points are obtained directly from the base system via the measurement API and the quantity is therefore a fixed value. Only an array of Y data will be returned. TRACE1 is used for this measurement results.

TRACE[:DATA]

This command returns all the measured data that relates to the currently selected measurement type. All results are returned in ASCII format. The returned data depends on the currently selected measurement type. `DISPlay:FORMat` is not supported with this command.

The following measurement types are available:

- "IQ Measurements" on page 6.288
- "Constellation vs Symbol" on page 6.288
- "Constellation vs Carrier" on page 6.289
- "Power vs Time – Full Burst and Rising /Falling Data" on page 6.289
- "Spectrum Flatness" on page 6.290
- "Spectrum FFT" on page 6.290
- "Statistics Bitstream data" on page 6.290
- "Statistics CCDF – Complementary cumulative distribution function" on page 6.291
- "Statistics Signal Field data" on page 6.291
- "EVM vs Carrier" on page 6.291
- "EVM vs Symbol" on page 6.291
- "Error vs Preamble" on page 6.291
- "Frequency Sweep Measurements" on page 6.292
- "Spectrum Mask" on page 6.292
- "Spectrum ACPR" on page 6.292

This command is a query only and thus has no *RST value.

Parameter

TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6

Example

```
TRAC? TRACE2
```

The measurement data for the selected graph is returned.

Characteristics

*RST value: –

SCPI: conforming

Mode

WLAN 802.11

TRACe:IQ:DATA:MEMory?

For details refer to "[TRACe<1|2>:IQ:DATA:MEMory?](#)" on page 6.157.

TRACe:IQ:SRATe

This command allows the sample rate for IQ measurements to be specified.

Example

```
TRACe:IQ:SRAT 20000
```

Specifies a sample rate of 20 MHz.

Characteristics

*RST value: –

SCPI: device-specific

Mode

WLAN 802.11

TRIGger Subsystem (WLAN 802.11, K91)

The trigger subsystem is used to synchronize device action(s) with events.

Commands of the TRIGger Subsystem

- TRIGger[:SEquence]:MODE
- TRIGger[:SEquence]:LEVel:POWer
- TRIGger[:SEquence]:LEVel:POWer:AUTO
- TRIGger[:SEquence]:HOLDoff

TRIGger[:SEquence]:MODE

This command configures how triggering is to be performed.

Parameter

| | |
|-----------|---|
| IMMediate | automatically triggers the next measurement at the end of the previous measurement. This corresponds to the FREE RUN setting. |
| EXTernal | the next measurement is triggered by the signal at the external trigger input e.g. a Gated trigger |
| POWer | triggering of the measurement via signals which are the measurement channel. |

Example

```
TRIG:MODE IMM
```

AUTO triggering will occur for the next measurement at the specified video percentage value.

Characteristics

*RST value: IMMediate

SCPI: device-specific

Mode

WLAN 802.11

TRIGger[:SEquence]:LEVel:POWer

This command accepts the level of the input signal for which triggering will occur. The value is specified in dBm for RF input and Volts for base band inputs.

Parameter

<numeric_value>

Example

```
TRIG:LEV:POW 10 DBM
```

Set to 10 dBm for RF measurement.

```
TRIG:LEV:POW 1 V
```

Set to 1 Volt for base band measurement.

Characteristics

*RST value: 0 DBM

SCPI: device-specific

ModeWLAN 802.11

TRIGger[:SEquence]:LEVel:POWer:AUTO

This command specifies whether or not an automatic power trigger level calculation is performed before each main measurement. The setting of this command is ignored if the setting for the TRIGger[:SEquence]:MODE command is not POWER.

Parameter

ON | OFF

Example

TRIG:LEV:POW:AUTO On

Specifies that an automatic power trigger level calculation should be performed before the start of each main measurement.

Characteristics

*RST value: OFF

SCPI: device-specific

ModeWLAN 802.11

TRIGger[:SEquence]:HOLDoff

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set.

Parameter

<numeric_value>

Example

TRIG:HOLD 500us

The WLAN 802.11 option use a holdoff period of 500 μ s after the trigger condition has been met.

Characteristics*RST value: -10 μ s

SCPI: Conforming

ModeWLAN 802.11

UNIT Subsystem (WLAN 802.11, K91)

The unit subsystem specifies the units for specific result types.

Commands of the UNIT Subsystem

- UNIT:EVM
- UNIT:GIMBalance
- UNIT:PREamble

UNIT:EVM

This command specifies the units for EVM results.

Parameter

DB EVM results returned in dB
PCT EVM results returned in %

Example

```
UNIT:EVM PCT  
EVM results to be returned in %.
```

Characteristics

*RST value: DB
SCPI: device-specific

Mode

WLAN 802.11

UNIT:GIMBalance

This command specifies the units for Gain Imbalance results.

Parameter

DB Gain Imbalance results returned in dB
PCT Gain Imbalance results returned in %

Example

```
UNIT:GIMB PCT  
Gain Imbalance results to be returned in %.
```

Characteristics

*RST value: DB
SCPI: device-specific

Mode

WLAN 802.11

UNIT:PREamble

This command specifies the units for Preamble error results.

Parameter

HZ Preamble error results returned in Hz

PCT Preamble error results returned in %

Example

```
UNIT:PRE PCT
```

Preamble error results to be returned in %.

Characteristics

*RST value: DB

SCPI: device-specific

Mode

WLAN 802.11

Remote Control – Description of Basic Settings Commands

In this section all remote control commands for basic settings are described in detail. For details on analyzer commands refer to section "Remote Control – Description of Analyzer Commands".

Subsystems for basic settings

- Common Commands
- CALibration Subsystem
- DIAGnostic Subsystem
- DISPlay Subsystem
- FORMat Subsystem
- HCOPy Subsystem
- INSTRument Subsystem
- MMEMory Subsystem
- OUTPut Subsystem (Option Additional Interfaces, B5)
- SENSE Subsystem
- SOURce Subsystem
- STATus Subsystem
- SYSTem Subsystem

Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625–2) standard. A particular command has the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in chapter 4 "Remote Control – Basics".

Available Common Commands

- *CAL?
- *CLS
- *ESE
- *ESR?
- *IDN?
- *IST?
- *OPC
- *OPT?
- *PCB
- *PRE

- *PSC
- *RST
- *SRE
- *STB?
- *TRG
- *TST?
- *WAI

***CAL?**

CALIBRATION QUERY initiates a calibration of the instrument and subsequently queries the calibration status. Responses > 0 indicate errors.

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENT part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE**

EVENT STATUS ENABLE sets the event status enable register to the value indicated. The query form *ESE? returns the contents of the event status enable register in decimal form.

Parameter

0 to 255

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

Parameter

0 to 255

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.

Example: " Rohde&Schwarz, FSL3, 123456/789, 1.03"

| | |
|------------|---------------------------------|
| FSL3 | Device name |
| 123456/789 | Serial number of the instrument |
| 1.03 | Firmware version number |

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll (see chapter 4, "Remote Control – Basics").

Parameter

0 | 1

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register after all preceding commands have been executed. This bit can be used to initiate a service request (see chapter 4, "Remote Control – Basics").

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas.

Parameter

| Option string | Description |
|---------------|--------------------------|
| B4 | OCXO Reference Frequency |
| B5 | Additional Interfaces |
| B6 | TV Trigger |
| B7 | Narrow IF Filters |
| B8 | Gated Sweep |
| B10 | GPIB Interface |
| B22 | RF Preamplifier |
| B30 | DC Power Supply |
| B31 | NIMH Battery Pack |
| K7 | Analog Demodulation |
| K9 | Power Sensor Support |
| K91 | WLAN TX Measurements |

Example

B4, B5, B6, B7, B8, B10, B22, B30, B31, K7, K9

***PCB**

PASS CONTROL BACK indicates the controller address which the remote control is to be returned to after termination of the triggered action.

Parameter

0 to 30

***PRE**

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the indicated value. The query form `*PRE?` returns the contents of the parallel poll enable register in decimal form.

Parameter0 to 255

***PSC**

POWER ON STATUS CLEAR determines whether the contents of the ENABLE registers are preserved or reset during power-up.

The query form ***PSC?** reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

Parameter

- | | |
|---|---|
| 0 | Causes the contents of the status registers to be preserved. Thus a service request can be generated when switching on the instrument, if the status registers ESE and SRE are suitably configured. |
| 1 | Resets the registers. |
-

***RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the **PRESET** key. The default settings are described in chapter 2, section "Initializing the Configuration – PRESET Key".

***SRE**

SERVICE REQUEST ENABLE sets the service request enable register to the indicated value. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is generated. The query form ***SRE?** reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

Parameter0 to 255

***STB?**

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

***TRG**

TRIGGER initiates all actions in the currently active test screen expecting a trigger event. This command corresponds to **INITiate:IMMediate**. For details refer to chapter 5, "Remote Control – Description of Analyzer Commands", section "TRIGger Subsystem".

***TST?**

SELF TEST QUERY initiates the self test of the instrument and outputs an error code in decimal form.

Parameter0 = no error

***WAI**

WAIT-to-CONTINUE permits servicing of subsequent commands only after all preceding commands have been executed and all signals have settled (see chapter 4, "Remote Control – Basics", and command *OPC).

CALibration Subsystem

The commands of the CALibration subsystem determine the data for system error correction in the instrument.

Commands of the CALibration Subsystem

- CALibration[:ALL]?
- CALibration:ABORt
- CALibration:RESult?
- CALibration:STATe

CALibration[:ALL]?

This command initiates the acquisition of system error correction data. A "0" is returned if the acquisition was successful.

Note: *During the acquisition of correction data the instrument does not accept any remote control commands.*

In order to recognize when the acquisition of correction data is completed, the MAV bit in the status byte can be used. If the associated bit is set in the Service Request Enable Register, the instrument generates a service request after the acquisition of correction data has been completed.

Example

*CLS

Resets the status management.

*SRE 16

Enables MAV bit in the Service Request Enable Register.

*CAL?

Starts the correction data recording, and then a service request is generated.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

CALibration:ABORt

This command has no effect, but is implemented to provide compatibility with the FSP family. The collection of self alignment data can only be aborted via manual control. For details refer to chapter 3, "Instrument Functions – Basic Settings", section "Instrument Setup and Interface Configuration – SETUP Key" – "Alignment".

This command is an event and therefore has no *RST value and no query.

Example

CAL:ABOR

Characteristics

*RST value: –

SCPI: device-specific

Modeall

CALibration:RESult?

This command outputs the results of the correction data acquisition. The lines of the result table are output as string data separated by commas:

```
Total Calibration Status: PASSED,Date (dd/mm/yyyy): 12/07/2004,
Time: 16:24:54,Runtime: 00.06
```

Example

```
CAL:RES?
```

Characteristics

*RST value: –

SCPI: device-specific

Modeall

CALibration:STATe

This command determines whether the current calibration data are taken into account by the instrument (ON) or not (OFF).

Parameter

ON | OFF

Example

```
CAL:STAT OFF
```

Sets up the instrument to ignore the calibration data.

Characteristics

*RST value: –

SCPI: conforming

Modeall

DIAGnostic Subsystem

The DIAGnostic subsystem contains the commands which support instrument diagnostics for maintenance, service and repair. In accordance with the SCPI standard, all of these commands are device-specific.

Commands of the DIAGnostic Subsystem

- DIAGnostic<1|2>:SERVice:INPut[:SElect]
- DIAGnostic<1|2>:SERVice:INPut:PULSed[:STATe]
- DIAGnostic<1|2>:SERVice:INPut:PULSed:PRATe
- DIAGnostic<1|2>:SERVice:SFUNction
- DIAGnostic<1|2>:SERVice:NSOource (option Additional Interfaces, B5)
- DIAGnostic<1|2>:SERVice:STESt:RESult?
- DIAGnostic<1|2>:SERVice:BIOSinfo?
- DIAGnostic<1|2>:SERVice:HWINfo?

DIAGnostic<1|2>:SERVice:INPut[:SElect]

This command toggles between the RF input on the front panel and the internal 65.83 MHz reference signal. The level of the internal signal can be set by command `DIAG:SERV:CSOource`.

Parameter

CALibration | RF | TG

Example

```
DIAG:SERV:INP CAL
```

Characteristics

*RST value: RF

SCPI: device-specific

Mode

all

DIAGnostic<1|2>:SERVice:INPut:PULSed[:STATe]

This command has no effect (only the comb generator is available), but is implemented to provide compatibility with the FSP family.

Parameter

ON | OFF

Example

```
DIAG:SERV:INP:PULS ON
```

Characteristics

*RST value: ON

SCPI: conforming

Mode

all

DIAGnostic<1|2>:SERVice:INPut:PULSed:PRATe

This command sets the comb generator frequency. This command only takes effect, if the internal reference signal is selected for calibration (DIAGnostic:SERVice:INPut:SElect CALibration).

Parameter

COMB1 65.8333 MHz / 1
 COMB64 65.8333 MHz / 64
 COMB65 65.8333 MHz / 65

Example

DIAG:SERV:INP:PULS:PRAT COMB64

Sets the comb generator frequency to $\frac{1}{64}$ of 65.8333 MHz.

Characteristics

*RST value: COMB1

SCPI: conforming

Mode

all

DIAGnostic<1|2>:SERVice:SFUNction

This command activates a service function which can be selected by indicating the five parameters: function group number, board number, function number, parameter 1 and parameter 2 (see service manual). The contents of the parameter string are identical to the code to be entered in the edit dialog box of manual operation.

The entry of a service function is accepted only if the system password level 1 or level 2 has been entered previously (SYSTEM:SECurity).

The numeric suffix <1|2> is ignored with this command.

Parameter

<string>

Example

DIAG:SERV:SFUN 2.0.2.12.1

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

DIAGnostic<1|2>:SERVice:NSOource (option Additional Interfaces, B5)

This command switches the 28 V supply of the noise source at the rear panel on or off.

The numeric suffix <1|2> is ignored with this command.

Parameter

ON | OFF

Example

```
DIAG:SERV:NSO ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

all

DIAGnostic<1|2>:SERVICE:STEST:RESult?

This command reads the results of the self test out of the instrument. The lines of the result table are output as string data separated by commas:

```
"Total Selftest Status: PASSED", "Date (dd/mm/yyyy): 09/07/2004  
TIME: 16:24:54", "Runtime: 00:06", ...
```

The numeric suffix <1|2> is ignored with this command.

Example

```
DIAG:SERV:STES:RES?
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

DIAGnostic<1|2>:SERVICE:BIOSinfo?

This command reads the CPU board BIOS version and returns it as ASCII string.

The numeric suffix <1|2> is ignored with this command.

Example

```
DIAG:SERV:BIOS?
```

Returns the following strings:

```
V1.5: V1.5-26-3
```

```
V2.0: V2.0-17-2
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

DIAGnostic<1|2>:SERVICE:HWInfo?

This command queries the contents of the module info table. Table lines are output as string data and are separated by commas.

```
"<component 1>|<serial #>|<order #>|<model>|<HWC>|<rev>|<sub rev>",  
"<component 2>|<serial #>|<order #>|<model>|<HWC>|<rev>|<sub rev>",...
```

The individual columns of the table are separated from each other by |.

The numeric suffix <1|2> is ignored with this command.

Example

DIAG:SERV:HWIN?

Result (shortened)

RF_ATTEN_7|650551/007|1067.7684|02|00|20|04,
IF-FILTER|648158/037|1093.5540|03|01|07|05,
...

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

DISPlay Subsystem

The DISPlay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.

Commands of the DISPlay Subsystem

- [DISPlay:ANNotation:FREQuency](#)
- [DISPlay:FORMat](#)
- [DISPlay:LOGO](#)
- [DISPlay:PSAVe\[:STATe\]](#)
- [DISPlay:PSAVe:HOLDoff](#)
- [DISPlay\[:WINDow<1|2>\]:TEXT\[:DATA\]](#)
- [DISPlay\[:WINDow<1|2>\]:TEXT:STATe](#)
- [DISPlay\[:WINDow<1|2>\]:TIME](#)
- [DISPlay:CMAP<1...27>:DEFault<1|2>](#)
- [DISPlay:CMAP<1...27>:HSL](#)
- [DISPlay:CMAP<1...27>:PDEFined](#)

Further Information

- [CMAP suffix assignment](#)

CMAP suffix assignment

Each numeric suffix of CMAP is assigned one or several graphical elements which can be modified by varying the corresponding color setting. The following assignment applies:

| | |
|--------|---|
| CMAP1 | Background |
| CMAP2 | Grid |
| CMAP3 | Function field + status field + data entry text |
| CMAP4 | Function field LED on |
| CMAP5 | Function field LED warn |
| CMAP6 | Enhancement label text |
| CMAP7 | Status field background |
| CMAP8 | Trace 1 |
| CMAP9 | Trace 2 |
| CMAP10 | Trace 3 |
| CMAP11 | Marker |
| CMAP12 | Lines |
| CMAP13 | Measurement status + limit check pass |
| CMAP14 | Limit check fail |
| CMAP15 | Reserved |
| CMAP16 | Reserved |

| | |
|--------|---------------------------------|
| CMAP17 | Table selected field text |
| CMAP18 | Table selected field background |
| CMAP19 | Reserved |
| CMAP20 | Reserved |
| CMAP21 | Reserved |
| CMAP22 | Reserved |
| CMAP23 | Reserved |
| CMAP24 | Reserved |
| CMAP25 | Reserved |
| CMAP26 | Logo |
| CMAP27 | Trace 4 |

DISPlay:ANNotation:FREQuency

This command switches the X axis annotation on or off.
This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

DISP:ANN:FREQ OFF

Characteristics

*RST value: ON

SCPI: conforming

Mode

all

DISPlay:FORMat

This command has no effect but is implemented for reasons of compatibility with the FSP family.
It switches the measurement result display between FULL SCREEN and SPLIT SCREEN.

The coupling of settings between screen A and screen B can be selected with the command
INSTrument:COUPLe.

In full-screen display the active measurement window can be selected with
DISPlay:WINDow<1|2>:SELEct.

This command is available from firmware version 1.10.

Parameter

SINGle | SPLit

Example

DISP:FORM SPL

Switches the display to 2 measurement windows.

Characteristics

*RST value: SINGle

SCPI: device-specific

ModeA

DISPlay:LOGO

This command switches the company logo on the screen on or off.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

DISP:LOGO OFF

Characteristics

*RST value: ON

SCPI: device-specific

Modeall

DISPlay:PSAVe[:STATe]

This command switches on or off the power-save mode of the display. With the power-save mode activated the display including backlight is completely switched off after the elapse of the response time (see command `DISPlay:PSAVe:HOLDoff`).

Note: *This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.*

This command is available from firmware version 1.20.

Parameter

ON | OFF

Example

DISP:PSAVe ON

Switches on the power-save mode.

Characteristics

*RST value: OFF

SCPI: device-specific

Modeall

DISPlay:PSAVe:HOLDoff

This command sets the holdoff time for the power-save mode of the display. The available value range is 1 to 60 minutes, the resolution 1 minute. The entry is dimensionless.

This command is available from firmware version 1.20.

Parameter

1 to 60

Example

```
DISP:PSAV:HOLD 30
```

Characteristics

*RST value: 15

SCPI: device-specific

Mode

all

DISPlay[:WINDow<1|2>]:TEXT[:DATA]

This command defines a comment (max. 20 characters) which can be displayed on the screen.

This command is available from firmware version 1.10.

Parameter

<string>

Example

```
DISP:WIND:TEXT Noise Measurement
```

Defines the screen title.

Characteristics

*RST value: "" (empty)

SCPI: conforming

Mode

all

DISPlay[:WINDow<1|2>]:TEXT:STATe

This command switches on or off the display of the comment (screen title).

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
DISP:TEXT:STAT ON
```

Switches on the title.

Characteristics

*RST value: OFF

SCPI: conforming

Mode

all

DISPlay[:WINDow<1|2>]:TIME

This command switches on or off the screen display of date and time. The numeric suffix in WINDow<1| 2> is irrelevant.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
DISP:TIME ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

all

DISPlay:CMAP<1...27>:DEFault<1|2>

This command resets the screen colors of all display items to their default settings. Two default settings DEFault1 and DEFault2 are available. The numeric suffix of CMAP is irrelevant.

This command is an event and therefore has no query and no *RST value.

This command is available from firmware version 1.10.

Example

```
DISP:CMAP:DEF2
```

Selects default setting 2 for setting the colors.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

DISPlay:CMAP<1...27>:HSL

This command defines the color table of the instrument.

For the numeric suffix assignment of CMAP refer to "[CMAP suffix assignment](#)" on page 6.309.

The set values are not changed by *RST.

This command is available from firmware version 1.10.

Parameter

hue = TINT

sat = SATURATION

lum = BRIGHTNESS

The value range is 0 to 1 for all parameters.

Example

```
DISP:CMAP2:HSL 0.3,0.8,1.0
```

Changes the grid color.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

DISPlay:CMAP<1...27>:PDEFined

This command defines the color table of the instrument using predefined color values. Each numeric suffix of CMAP is assigned to one or several graphical elements which can be modified by varying the corresponding color setting.

For the numeric suffix assignment of CMAP refer to "[CMAP suffix assignment](#)" on page 6.309.

The values set are not changed by *RST.

This command is available from firmware version 1.10.

Parameter

BLACK | BLUE | BROWN | GREEN | CYAN | RED | MAGENTA | YELLOW | WHITE | DGRAY | LGRAY | LBLUE | LGREEN | LCYAN | LRED | LMAGENTA

Example

```
DISP:CMAP2:PDEF GRE
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

FORMat Subsystem

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

Commands of the FORMat Subsystem

- [FORMat\[:DATA\]](#)

FORMat[:DATA]

This command specifies the data format for the data transmitted from the instrument to the control PC. It is used for the transmission of trace data. The data format of trace data received by the instrument is automatically recognized, regardless of the format which is programmed. In the spectrum mode, the format setting REAL, 32 is used for the binary transmission of trace data (see also `TRACE:DATA?`).

Parameter

ASCii | REAL | UINT | MATLAB [,8 | 32]

ASCII data are transmitted in plain text, separated by commas. REAL data are transmitted as 32-bit IEEE 754 floating-point numbers in the "definite length block format". The format UINT is only used in operating mode vector signal analysis, for the symbol table.

Example

```
FORM REAL, 32
FORM ASC
FORM UINT, 8
```

Characteristics

*RST value: ASCII

SCPI: conforming

Mode

all

HCOPy Subsystem

The HCOPy subsystem controls the output of display information for documentation purposes on output devices or files. The instrument allows two independent printer configurations which can be set separately with the numeric suffix <1|2>.

Commands of the HCOPy Subsystem

- HCOPy:ABORt
- HCOPy:CMAP<1...27>:DEFault
- HCOPy:CMAP<1...27>:HSL
- HCOPy:CMAP<1...27>:PDEFined
- HCOPy:DESTination<1|2>
- HCOPy:DEVice:COLor
- HCOPy:DEVice:LANGUage<1|2>
- HCOPy[:IMMEDIATE<1|2>]
- HCOPy:ITEM:ALL
- HCOPy:ITEM:WINDow<1|2>:TRACe:STATe
- HCOPy:PAGE:ORientation<1|2>

HCOPy:ABORt

This command aborts a running hardcopy output.

This command is an event and therefore has no *RST value and no query.

Example

```
HCOP:ABOR
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

HCOPy:CMAP<1...27>:DEFault

This command resets the colors for a hardcopy to the selected default settings. DEFault1 (SCREEN COLORS, but background white), DEFault2 (OPTIMIZED COLOR SET) and DEFault3 (USER DEFINED). The numeric suffix in CMAP is not significant.

This command is an event and therefore has no query and no *RST value.

This command is available from firmware version 1.10.

Parameter

- 1 screen colors
- 2 optimized color set
- 3 user defined color set

Example

```
HCOP:CMAP:DEF2
```

Selects OPTIMIZED COLOR SET for the color settings of a hardcopy.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

HCOPy:CMAP<1...27>:HSL

This command defines the color table in user defined colors.

To each numeric suffix of CMAP is assigned one or several picture elements which can be modified by varying the corresponding color setting. For details on the CMAP assignment refer to "[CMAP suffix assignment](#)" on page 6.309.

The values set are not changed by *RST.

This command is available from firmware version 1.10.

Parameter

hue = tint

sat = saturation

lum = brightness

The value range is 0 to 1 for all parameters.

Example

```
HCOP:CMAP2:HSL 0.3,0.8,1.0
```

Changes the grid color

Characteristics

*RST value: –

SCPI: conforming

Mode

all

HCOPy:CMAP<1...27>:PDEFined

This command defines the color table in user defined colors using predefined color values. To each numeric suffix of CMAP is assigned one or several picture elements which can be modified by varying the corresponding color setting. For details on the CMAP assignment refer to "[CMAP suffix assignment](#)" on page 6.309.

The values set are not changed by *RST.

This command is available from firmware version 1.10.

Parameter

BLACK | BLUE | BROWN | GREEN | CYAN | RED | MAGENTA | YELLOW | WHITE | DGRAY | LGRAY | LBLUE | LGREEN | LCYAN | LRED | LMAGENTA

Example

```
HCOP:CMAP2:PDEF GRE
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

HCOPY:DESTination<1|2>

This command selects the printer output medium (Disk, Printer or Clipboard) associated with configuration 1 or 2.

This command is an event and therefore has no *RST value and no query.

Note: *The type of instrument is selected with SYSTem:COMMunicate:PRINter:SElect, which will automatically select a default output medium. Therefore the command HCOPY:DESTination should always be sent after setting the device type.*

Parameter

- 'MMEM' 'Directs the hardcopy to a file. Command MMEM:NAME <file_name> defines the file name. All formats can be selected for HCOPY:DEVIce:LANGUage.
- 'SYST:COMM:PRIN' 'Directs the hardcopy to the printer. The printer is selected with command SYSTem:COMMunicate:PRINter:SElect. 'GDI should be selected for 'HCOPY:DEVIce:LANGUage.
- 'SYST:COMM:CLIP' 'Directs the hardcopy to the clipboard. EWMF should be selected for HCOPY:DEVIce:LANGUage.

Example

```
SYST:COMM:PRIN:SEL2 LASER on LPT1
Selects the printer and output medium for device 2.
HCOPY:DEST2 SYST:COMM:PRIN
Selects the printer interface as device 2.
```

Characteristics

*RST value: –
SCPI: conforming

Mode

all

HCOPY:DEVIce:COLor

This command selects between color and monochrome hardcopy of the screen.
This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
HCOPY:DEV:COL ON
```

Characteristics

*RST value: OFF
SCPI: conforming

Mode

all

HCOPY:DEVIce:LANGUage<1|2>

This command determines the data format of the printout.

Parameter

| | |
|-----------|--|
| GDI | Graphics Device Interface: Default format for the output to a printer configured under Windows. Must be selected for the output to the printer interface (HCOPY:DEVIce 'SYST:COMM:PRIN'). Can be used for the output to a file (HCOPY:DEVIce 'SYST:COMM:MMEM'). The printer driver configured under Windows is used in this case and a printer-specific file format is thus generated. |
| WMF, EWMF | WINDOWS Metafile and Enhanced Metafile Format: Data formats for output files which can be integrated in corresponding programs for documentation purposes at a later time. WMF can only be used for output to a file (HCOPY:DEVIce 'SYST:COMM:MMEM') and EWMF also for the output to the clipboard (HCOPY:DEVIce 'SYST:COMM:CLIP'). |
| BMP | Bitmap: Data format for output to files only (HCOPY:DEVIce 'SYST:COMM:MMEM'). |

Example

```
HCOP:DEV:LANG WMF
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

HCOPY[:IMMEDIATE<1|2>]

This command starts a hardcopy output. The numeric suffix selects which printer configuration (1 or 2) is to be used for the hardcopy output. If there is no suffix, configuration 1 is automatically selected.

Parameter

| | |
|------------|--|
| HCOPY:IMM1 | 'Starts the hardcopy output to device 1 (default). |
| HCOPY:IMM2 | 'Starts the output to device 2. |

This command is an event and therefore has no *RST value and no query.

Example

```
HCOP
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

HCOPY:ITEM:ALL

This command selects the complete screen to be output.

The hardcopy output is always provided with comments, title, time and date. As an alternative to the whole screen, only traces (command `HCOPY:ITEM:WINDOW:TRACE:STATE ON`) or tables (command `HCOPY:ITEM:WINDOW:TABLE:STATE ON`) can be output.

Example

`HCOPY:ITEM:ALL`

Characteristics

*RST value: OFF

SCPI: conforming

Mode

all

HCOPY:ITEM:WINDOW<1|2>:TRACE:STATE

This command selects the output of the currently displayed trace.

The command `HCOPY:ITEM:WINDOW<1|2>:TRACE:STATE OFF` as well as command `HCOPY:ITEM:ALL` enables the output of the whole screen.

Parameter

ON | OFF

Example

`HCOPY:ITEM:WINDOW:TRACE:STATE ON`

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

all

HCOPY:PAGE:ORIENTATION<1|2>

The command selects the format of the output (portrait and landscape) (hardcopy unit 1 or 2).

Note: *The command is only available provided that the output device "printer" (`HCOPY:DEST 'SYST:COMM:PRIN'`) has been selected.*

Parameter

LANDscape | PORTrait

Example

`HCOPY:PAGE:ORIENTATION LAND`

Characteristics

*RST value: –

SCPI: conforming

Mode
all

INSTRument Subsystem

The INSTRument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

Commands of the INSTRument Subsystem

- INSTRument[:SElect]
- INSTRument:NSElect

INSTRument[:SElect]

This command switches between the measurement modes by means of text parameters.

Parameter

ADEMod analog demodulation (option Analog Demodulation, R&S FSL–K7,
 available from firmware version 1.10)

SANalyzer spectrum analyzer

Example

```
INST SAN
```

Switches the instrument to spectrum analyzer mode.

Characteristics

*RST value: SANalyzer

SCPI: conforming

Mode

all

INSTRument:NSElect

This command switches between the measurement modes by means of numbers.

Parameter

<numeric value>

1 spectrum analyzer

3 analog demodulation (option Analog Demodulation, R&S FSL–K7,
 available from firmware version 1.10)

Example

```
INST:NSEL 1
```

Switches the instrument to spectrum analyzer mode.

Characteristics

*RST value: 1

SCPI: conforming

Mode

all

MMEMory Subsystem

The MMEMory (mass memory) subsystem provides commands which allow for access to the storage media of the instrument and for storing and loading various instrument settings.

The various drives can be addressed via the "mass storage unit specifier" <msus> using the conventional DOS syntax. The internal hard disk is addressed by "C:". For details on drives refer to chapter 3, "Instrument Functions – Basic Settings", section "Saving and Recalling Data Sets – FILE Key".

The file names <file_name> are indicated as string parameters with the commands being enclosed in quotation marks. They also comply with DOS conventions.

DOS file names consist of max. 8 ASCII characters and an extension of up to three characters separated from the file name by a dot "." Both, the dot and the extension are optional. The dot is not part of the file name. DOS file names do not distinguish between uppercase and lowercase notation. All letters and digits are permitted as well as the special characters "_", "^", "\$", "~", "!", "#", "%", "&", "-", "{", "}", "(", ")", "@", and "'". Reserved file names are CLOCK\$, CON, AUX, COM1 to COM4, LPT1 to LPT3, NUL and PRN.

The two characters "*" and "?" have the function of so-called "wildcards", i.e., they are variables for selection of several files. The question mark "?" replaces exactly one character, the asterisk means any of the remaining characters in the file name. "*. *" thus means all files in a directory.

Commands of the MMEMory Subsystem

- MMEMory:CATalog?
- MMEMory:CDIRectory
- MMEMory:COPY
- MMEMory:DATA
- MMEMory:DELeTe
- MMEMory:LOAD:STATe
- MMEMory:LOAD:AUTO
- MMEMory:MDIRectory
- MMEMory:MOVE
- MMEMory:MSIS
- MMEMory:NAME
- MMEMory:RDIRectory
- MMEMory:STORe<1|2>:STATe
- MMEMory:STORe<1|2>:TRACe
- MMEMory:CLEAr:STATe
- MMEMory:CLEAr:ALL
- MMEMory:SELEct[:ITEM]:HWSettings
- MMEMory:SELEct[:ITEM]:TRACe[:ACTive]
- MMEMory:SELEct[:ITEM]:LINes:ALL
- MMEMory:SELEct[:ITEM]:SCData (models 13 and 16)
- MMEMory:SELEct[:ITEM]:TRANSDucer:ALL
- MMEMory:SELEct[:ITEM]:ALL

- MMEMory:SElect[:ITEM]:NONE
- MMEMory:SElect[:ITEM]:DEFault

MMEMory:CATalog?

This command reads the indicated directory. According to DOS convention, wild card characters can be entered in order to query e.g. a list of all files of a certain type.

Parameter

<path> = DOS Path name

The path name should be in conformance with DOS conventions and may also include the drive name.

Example

```
MMEM:CAT:LONG? 'C:\R_S\Instr\user\DATA'
```

Queries the contents of directory C:\R_S\Instr\user directory

```
MMEM:CAT? 'C:\R_S\Instr\user\DATA\*.LOG'
```

Returns all files in C:\R_S\Instr\user with extension ".LOG"

```
MMEM:CAT? 'C:\R_S\Instr\user\SPOOL?.WMF'
```

Returns all files in C:\R_S\Instr\user whose names start with SPOOL, have 6 letters and the extension ".WMF".

Response value

List of file names in the form of strings separated by commas, i.e.

SPOOL1.WMF,SPOOL2.WMF,SPOOL3.WMF

Characteristics

*RST value: -

SCPI: conforming

Mode

all

MMEMory:CDIRectory

This command changes the current directory.

Parameter

<directory_name> = DOS path name

In addition to the path name, the indication of the directory may contain the drive name. The path name complies with the DOS conventions.

Example

```
MMEM:CDIR 'C:\R_S\Instr\user'
```

Returns the list of files in directory C:\R_S\Instr\user.

Characteristics

*RST value: -

SCPI: conforming

Mode

all

MMEMory:COPY

This command copies the files indicated in <file_source> to the destination directory indicated with <file_destination> or to the destination file indicated by <file_destination> when <file_source> is just a file.

This command is an event and therefore has no *RST value and no query.

Parameter

<file_source>, <file_destination> = <file_name> = DOS file name

The indication of the file name may include the path and the drive name. The file names and path information must be in accordance with the DOS conventions.

Example

```
MMEM:COPY 'C:\R_S\Instr\user\SETUP.CFG, E: '
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

MMEMory:DATA

This command writes the block data contained in <block> into the file characterized by <file_name>. The delimiter must be set to EOI to obtain error-free data transfer.

The associated query command reads the indicated file from the mass memory and transfers it to the remote control computer. It should be noted that the buffer memory of the control computer should be large enough to store the file. The setting of the delimiter is irrelevant in this case.

The command is useful for reading stored device settings or trace data from the instrument (MMEMory:DATA? <file_name>) or for transferring them to the instrument (MMEMory:DATA <file_name>, <block>)

Parameter

<file_name>[, <block>]

<file_name> selects the file to be transferred

<block> binary data block with the following structure:

- character '#'
- digit for the length of the length information
- indicated number of digits as length information (number of bytes) for the binary data themselves
- binary data with the indicated number of bytes

Example

MMEM:DATA 'TEST01.HCP', #217 This is the file means: #2: the next 2 characters are the length indication; 17: number of subsequent binary data bytes; This is the file: 17 bytes stored as binary data in the file TEST01.HCP.

```
MMEM:DATA? 'TEST01.HCP'
```

Transfers the file TEST01.HCP from the instrument to the control computer.

Characteristics

*RST value: –
SCPI: conforming

Mode

all

MMEMory:DELeTe

This command deletes the indicated files.

Parameter

<file_name> = DOS file name

The indication of the file name contains the path and, optionally, the drive name. Indication of the path complies with DOS conventions.

Example

```
MMEM:DEL 'TEST01.HCP'
```

The file TEST01.HCP is deleted.

Characteristics

*RST value: –
SCPI: conforming

Mode

all

MMEMory:LOAD:STATe

This command loads device settings from *.FSL.dfl files. The contents of the file are loaded and set as the new device state.

Parameter

1,<file_name>

with <file_name> = DOS file name without extension

The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Example

```
MMEM:LOAD:STAT 1, 'C:\R_S\Instr\user\TEST01'
```

Characteristics

*RST value: –
SCPI: conforming

Mode

all

MMEMory:LOAD:AUTO

This command defines which device setting is automatically loaded after the device is switched on. The contents of the file are read after switching on the device and used to define the new device state.

The data set defined as auto recall set can also be restored by an *RST command.

This command is an event and therefore has no *RST value and no query.

Parameter

1,<file_name>

with <file_name> = DOS file name without extension

The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Example

```
MMEM:LOAD:AUTO 1, 'C:\R_S\Instr\user\TEST'
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

MMEMory:MDIRECTory

This command creates a new directory. The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

This command is an event and therefore has no *RST value and no query.

Parameter

<directory_name> = DOS path name

Example

```
MMEM:MDIR 'C:\R_S\Instr\user'
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

MMEMory:MOVE

This command renames existing files, if <file_destination> contains no path indication. Otherwise the file is moved to the indicated path and stored under the file name specified there, if any.

This command is an event and therefore has no *RST value and no query.

Parameter

<file_source>,<file_destination> = <file_name> = DOS file name

The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Example

```
MMEM:MOVE 'C:\TEST01.CFG', 'SETUP.CFG'
```

Renames TEST01.CFG in SETUP.CFG in directory C:\.

```
MMEM:MOVE 'C:\TEST01.CFG', 'C:\R_S\Instr\user'
```

Moves TEST01.CFG from C:\ to C:\R_S\Instr\user.

```
MMEM:MOVE 'C:\TEST01.CFG', 'C:\R_S\Instr\user\SETUP.CFG'
```

Moves TEST01.CFG from C:\ to C:\R_S\Instr\user and renames the file in SETUP.CFG.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

MMEMory:MSIS

This command changes to the drive indicated. The drive may be the internal hard disk C:.

Parameter

<device> = A: | C: ... Z:

The path name complies with DOS conventions.

Example

```
MMEM:MSIS 'C: '
```

Characteristics

*RST value: "C:

SCPI: conforming

Mode

all

MMEMory:NAME

This command defines a destination file for the printout started with the command `HCOPY:IMMEDIATE`. In this case the printer output must be routed to destination *FILE* using the command `"HCOP:DEST MMEM "`.

This command is an event and therefore has no *RST value and no query.

Parameter

<file_name> = DOS file name

The file name includes indication of the path and may also include the drive name. The file name and path information comply with DOS conventions.

Example

```
HCOP:DEV:LANG BMP
```

Selection of data format.

```
HCOP:DEST MMEM
```

Selection of the output device.

```
MMEM:NAME 'PRINT1.BMP'
```

Selection of file name.

```
HCOP:IMM
```

Start of the printout.

Characteristics

*RST value: –

SCPI: conforming

Mode

all

MMEMory:RDIRectory

This command deletes the indicated directory. The directory name includes indication of the path and may also include the drive name. The path name complies with DOS conventions. This command is an event and therefore has no *RST value and no query.

Parameter

<directory_name> = DOS path name

Example

```
MMEM:RDIR 'C:\TEST'
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

MMEMory:STORe<1|2>:STATe

This command stores the current device settings in a *.FSL.dfl file. The numeric suffix in STORe<1|2> is irrelevant with this command.

A list of the extensions used is contained under MMEMory:LOAD:STATe.

This command is an event and therefore has no *RST value and no query.

Parameter

1,<file_name>

with <file_name> = DOS file name without extension

The file name includes indication of the path and may also include the drive name. The path name complies with DOS conventions.

Example

```
MMEM:STOR:STAT 1, 'TEST'
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

MMEMory:STORe<1|2>:TRACe

This command stores the selected trace (1 to 4) in a file with ASCII format. The file format is described in chapter 2, "Instrument Functions – Analyzer", section "Setting Traces – TRACE Key", **ASCII File Export** softkey.

The decimal separator (decimal point or comma) for floating-point numerals contained in the file is defined with the command FORMat:DEXPort:DSEPARATOR.

This command is an event and therefore has no *RST value and no query.

Parameter

1 to 4,<file_name>

with 1 to 4 = selected measurement curve trace 1 to 4 and <file_name> = DOS file name

The file name includes indication of the path and the drive name. Indication of the path complies with DOS conventions.

Example

```
MMEM:STOR:TRAC 3, 'TEST.ASC'
```

Stores trace 3 in the file TEST.ASC.

Characteristics

*RST value: –
SCPI: device-specific

Mode

all

MMEMory:CLEar:STATe

This command deletes the instrument setting selected by <file_name>. All associated files on the mass memory storage are cleared.

This command is an event and therefore has no *RST value and no query.

Parameter

1,<file_name>

with <file_name> = DOS file name without extension

The file name includes indication of the path and may also include the drive. The path name complies with DOS conventions.

Example

```
MMEM:CLE:STAT 1, 'TEST'
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

all

MMEMory:CLEar:ALL

This command deletes all device settings in the current directory. The current directory can be selected with `MMEM:CDIR`. The default directory is `C:\R_S\instr\user`.

This command is an event and therefore has no *RST value and no query.

Example

```
MMEM:CLE:ALL
```

Characteristics

*RST value: –
SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:HWSettings

This command includes the hardware settings in the list of data subsets of a device setting to be stored/loaded. The hardware settings include:

- current configuration of general device parameters (general setup)
- current setting of the measurement hardware including markers
- activated limit lines:

A data set may include 8 limit lines at maximum. This number includes the activated limit lines and, if available, the de-activated limit lines last used.

Therefore the combination of the non-activated restored limit lines depends on the sequence of use with the command `MMEM:LOAD`.

- user-defined color setting
- configuration for the hardcopy output
- tracking generator settings (models 13 and 16)
- correction data for source calibration (models 13 and 16)

Parameter

ON | OFF

Example

```
MMEM:SEL:HWS ON
```

Characteristics

*RST value: ON

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:TRACe[:ACTive]

This command adds the active traces to the list of data subsets of a save/recall device setting. Active traces are all traces whose state is not blank.

Parameter

ON | OFF

Example

```
MMEM:SEL:TRAC ON
```

Characteristics

*RST value: OFF, i.e. no traces will be stored

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:LINES:ALL

This command adds all limit lines (activated and de-activated) to the list of device settings to be stored/loaded.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
MMEM:SEL:LIN:ALL ON
```

Characteristics

*RST value: ON

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:SCData (models 13 and 16)

This command adds the tracking generator calibration data to the list of device settings to be stored/loaded.

This command is only available in conjunction with the tracking generator.**Parameter**

ON | OFF

Example

```
MMEM:SEL:SCD ON
```

Inserts the tracking generator correction data in the list of data subsets.

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:TRANsducer:ALL

This command includes all transducer factors and sets in the list of data subsets of a device setting to be stored/loaded.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
MMEM:SEL:TRAN:ALL ON
```

Characteristics

*RST value: ON

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:ALL

This command includes all data subsets in the list device settings to be stored/loaded.

This command is an event and therefore has no *RST value.

Example

```
MMEM:SEL:ALL
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:NONE

This command deletes all data subsets from the list of device settings to be stored/loaded.

This command is an event and therefore has no *RST value.

Example

```
MMEM:SEL:NONE
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

MMEMory:SElect[:ITEM]:DEfault

This command sets the default list of device settings to be stored/loaded. For details on hardware settings refer to the `MMEMory:SElect[:ITEM]:HWSettings` command.

Example

```
MMEM:SEL:DEfault
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

OUTPut Subsystem (Option Additional Interfaces, B5)

The OUTPut subsystem controls the output features of the instrument.

Commands of the OUTPut Subsystem

- [OUTPut<1|2>:IF\[:SOURce\]](#)

OUTPut<1|2>:IF[:SOURce]

This command switches the source of the IF output between the demodulated signal and the IF signal.

Note: *The AF output available at the frontpanel can only be used when the IF output source is set to video.*

Parameter

IF | VIDeo

Example

```
OUTP IF VID
```

Selects the video signal for the IF output connector.

Characteristics

*RST value: IF

SCPI: conforming

Mode

A

SENSe Subsystem

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings; they do not refer to the signal characteristics of the measurement signal.

The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.

The following subsystems are included:

- "SENSe:CORRection Subsystem (Models 13 and 16)" on page 6.335
- "SENSe:ROSCillator Subsystem" on page 6.335

SENSe:CORRection Subsystem (Models 13 and 16)

This subsystem controls calibration and normalization during operation with the tracking generator.

Commands of the SENSe:CORRection Subsystem

- [SENSe<1|2>:]CORRection:TRANsducer:SElect
- [SENSe<1|2>:]CORRection:TRANsducer:UNIT
- [SENSe<1|2>:]CORRection:TRANsducer:SCALing
- [SENSe<1|2>:]CORRection:TRANsducer:COMMeNT
- [SENSe<1|2>:]CORRection:TRANsducer:DATA
- [SENSe<1|2>:]CORRection:TRANsducer[::STATe]
- [SENSe<1|2>:]CORRection:TRANsducer:DELeTe
- [SENSe<1|2>:]CORRection:TRANsducer:VIEW
- [SENSe<1|2>:]CORRection:TRANsducer:ADJust:RLEVeL[::STATe]

[SENSe<1|2>:]CORRection:TRANsducer:SElect

This command selects the transducer factor designated by <name>. If <name> does not exist yet, a new transducer factor is created.

Note: *This command must be sent prior to the subsequent commands for modifying/activating transducer factors.*

This command is available from firmware version 1.10.

Parameter

<name> = Name of the transducer factor in string data form with a maximum of 8 characters.

Example

```
" :CORR:TRAN:SEL 'FACTOR1' "
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:TRANsducer:UNIT

This command defines the unit of the transducer factor selected.

Note: Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

This command is available from firmware version 1.10.

Parameter

<string> = DB | DBM | DBMV | DBUV | DBUV/M | DBUA DBUA/M | DBPW | DBPT

Example

```
:CORR:TRAN:UNIT DBUV'
```

Characteristics

*RST value: DB

SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:TRANsducer:SCALing

This command defines whether the frequency scaling of the transducer factor is linear or logarithmic.

Note: Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

This command is available from firmware version 1.10.

Parameter

LINear | LOGarithmic

Example

```
:CORR:TRAN:SCAL LOG
```

Characteristics

*RST value: LINear

SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:TRANsducer:COMMeNT

This command defines the comment for the selected transducer factor.

Note: Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

This command is available from firmware version 1.10.

Parameter

<string>

Example

```
":CORR:TRAN:COMM FACTOR FOR ANTENNA"
```

Characteristics

*RST value: (empty comment)

SCPI: device-specific

Mode A

[SENSe<1|2>:]CORRection:TRANsducer:DATA

This command defines the reference values of the transducer factor selected. These values are entered as a sequence of frequency/level pairs. The frequencies must be sent in ascending order.

Note: *Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent. The level values are sent as dimensionless numbers; the unit is specified by means of the command `SENS:CORR:TRAN:UNIT`.*

This command is available from firmware version 1.10.

Parameter

<freq>, <level>

Example

```
:CORR:TRAN:TRANsducer:DATA 1MHZ,-30,2MHZ,-40
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:TRANsducer[:STATe]

This command switches the selected transducer factor on or off.

Note: *Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.*

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
:CORR:TRAN ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode A**[SENSe<1|2>:]CORRection:TRANsducer:DELeTe**

This command deletes the selected transducer factor.

This command is an event and therefore has no *RST value.

Note: *Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.*

This command is available from firmware version 1.10.

Example

```
:CORR:TRAN:DEL
```

Characteristics

*RST value: –

SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:TRANsducer:VIEW

This command switches on the display of the active transducer factor or set.

Note: Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
CORR:TRAN:VIEW ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

[SENSe<1|2>:]CORRection:TRANsducer:ADJust:RLEVel[:STATe]

This command switches the automatic adjustment of the reference level to the selected transducer factor on or off.

Note: Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

This command is available from firmware version 1.10.

Parameter

ON | OFF

Example

```
CORR:TRAN:ADJ:RLEV ON
```

Characteristics

*RST value: OFF

SCPI: device-specific

Mode

A

SENSe:ROSCillator Subsystem

This subsystem controls the reference oscillator. The numeric suffix in SENSe is irrelevant for the commands of this subsystem.

Commands of the SENSe:ROSCillator Subsystem

- [\[SENSe<1|2>:\]ROSCillator:SOURce](#)

[SENSe<1|2>:]ROSCillator:SOURce

This command controls selection of the reference oscillator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Parameter

INTernal | EXTernal

Example

```
ROSC:SOUR EXT
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SOURce Subsystem

The SOURce subsystem controls the output signals of the instrument.

Commands of the SOURce Subsystem

- SOURce<1|2>:EXTernal<1|2>:ROSCillator[:SOURce]
- SOURce:TEMPerature:APRobe?

SOURce<1|2>:EXTernal<1|2>:ROSCillator[:SOURce]

This command switches between external and internal reference oscillator.

Parameter

INTernal | EXTernal

Example

```
SOUR:EXT:ROSC EXT
```

Switches to external reference oscillator

Characteristics

*RST value: INT

SCPI: device-specific

Mode

all

SOURce:TEMPerature:APRobe?

This command queries the sensor temperature.

Parameter

1 (CPU)

Example

```
SOUR:TEMP:APR? 1
```

Queries the temperature of the CPU sensor.

Characteristics

RST value: –

SCPI: device-specific

Mode

all

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (see chapter 4 "Remote Control – Basics", section "Status Reporting System"). *RST does not influence the status registers.

Commands of the STATus Subsystem

- STATus:OPERation[:EVENT]?
- STATus:OPERation:CONDition?
- STATus:OPERation:ENABLE
- STATus:OPERation:PTRansition
- STATus:OPERation:NTRansition
- STATus:PRESet
- STATus:QUEStionable[:EVENT]?
- STATus:QUEStionable:CONDition?
- STATus:QUEStionable:ENABLE
- STATus:OPERation:PTRansition
- STATus:QUEStionable:NTRansition
- STATus:QUEue[:NEXT?]

STATus:OPERation[:EVENT]?

This command queries the contents of the EVENT section of the STATus:OPERation register. The contents of the EVENT section are deleted after readout.

Example

```
STAT:OPER?
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:OPERation:CONDition?

This command queries the CONDition section of the STATus:OPERation register. Readout does not delete the contents of the CONDition section. The value returned reflects the current hardware status.

Example

```
STAT:OPER:COND?
```

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:OPERation:ENABle

This command sets the bits of the ENABle section of the STATus:OPERation register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit in the status byte.

Parameter

0 to 65535

Example

```
STAT:OPER:ENAB 65535
```

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:OPERation:PTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:OPER:PTR 65535
```

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:OPERation:NTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:OPER:NTR 65535
```

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:PRESet

This command resets the edge detectors and ENABLE parts of all registers to a defined value. All PTRansition parts are set to FFFFh, i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 in a CONDition bit is not detected. The ENABLE part of the STATus:OPERation and STATus:QUEStionable registers are set to 0, i.e. all events in these registers are not passed on.

Example

STAT:PRESet

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:QUEStionable[:EVENT]?

This command queries the contents of the EVENT section of the STATus:QUEStionable register. The contents of the EVENT section are deleted after the readout.

Example

STAT:QUES?

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:QUEStionable:CONDition?

This command queries the CONDition section of the STATus:QUEStionable register. Readout does not delete the contents of the CONDition section.

Example

STAT:QUES:COND?

Characteristics

*RST value: –

SCPI: conforming

Modeall

STATus:QUEStionable:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable register. The ENABle register selectively enables the individual events of the associated EVENT section for the summary bit in the status byte.

Parameter

0 to 65535

Example

```
STAT:QUES:ENAB 65535
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEStionable:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable register from 0 to 1 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:PTR 65535
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEStionable:NTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Parameter

0 to 65535

Example

```
STAT:QUES:NTR 65535
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

STATus:QUEue[:NEXT?]

This command queries the earliest error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned. This command is identical to the command `SYSTem:ERRor`.

Example

STAT:QUES?

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SYSTEM Subsystem

This subsystem contains a series of commands for general functions.

Commands of the SYSTEM Subsystem

- SYSTEM:COMMunicate:GPIB[:SELF]:ADDRess
- SYSTEM:COMMunicate:GPIB[:SELF]:RTERminator
- SYSTEM:COMMunicate:PRINter:ENUMerate[:NEXT?]
- SYSTEM:COMMunicate:PRINter:ENUMerate:FIRSt?
- SYSTEM:COMMunicate:PRINter:SElect <1|2>
- SYSTEM:DATE
- SYSTEM:DISPlay:FPANel
- SYSTEM:DISPlay:UPDate
- SYSTEM:ERRor[:NEXT]?
- SYSTEM:ERRor:LIST?
- SYSTEM:ERRor:CLEar:ALL
- SYSTEM:FIRMware:UPDate
- SYSTEM:FORMat:IDENT
- SYSTEM:PASSword[:CENable]
- SYSTEM:PASSword:RESet
- SYSTEM:PRESet
- SYSTEM:TIME
- SYSTEM:VERSion?

SYSTEM:COMMunicate:GPIB[:SELF]:ADDRess

This command changes the GPIB address of the unit.

Parameter

0 to 30

Example

```
SYST:COMM:GPIB:ADDR 18
```

Characteristics

*RST value: – (no influence on this parameter, factory default 20)

SCPI: conforming

Mode

all

SYSTEM:COMMunicate:GPIB[:SELF]:RTERminator

This command changes the GPIB receive terminator.

According to the standard the terminator in ASCII is <LF> and/or <EOI>. For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code (0AH)

used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by changing the receive terminator to EOI.

Output of binary data from the instrument to the control computer does not require such a terminator change.

Parameter

LFEOI | EOI

Example

```
SYST:COMM:GPIB:RTER EOI
```

Characteristics

*RST value: – (no influence on this parameter, factory default LFEOI)

SCPI: device-specific

Mode

all

SYSTEM:COMMunicate:PRINter:ENUMerate[:NEXT?]

This command queries the name of the next printer installed under Windows XP.

The command `SYSTEM:COMMunicate:PRINter:ENUMerate:FIRSt?` should be sent previously to return to the beginning of the printer list and query the name of the first printer.

The names of other printers can then be queried with `NEXT?`. After all available printer names have been output, an empty string enclosed by quotation marks (") is output for the next query. Further queries are answered by a Query Error.

Example

```
SYST:COMM:PRIN:ENUM:NEXT?
```

Characteristics

*RST value: NONE

SCPI: device-specific

Mode

all

SYSTEM:COMMunicate:PRINter:ENUMerate:FIRSt?

This command queries the name of the first printer (in the list of printers) available under Windows XP.

The names of other installed printers can be queried with command `SYSTEM:COMMunicate:PRINter:ENUMerate:NEXT?`.

If no printer is configured an empty string is output.

Example

```
SYST:COMM:PRIN:ENUM:FIRS?
```

Characteristics

*RST value: NONE

SCPI: device-specific

Mode

all

SYSTEM:COMMunicate:PRINter:SElect <1|2>

This command selects one of the printers configured under Windows XP including the associated output destination.

The specified printer name must be a string as returned by the commands
 SYSTem:COMMunicate :PRINter:ENUMerate:FIRSt? or
 SYSTem:COMMunicate :PRINter:ENUMerate:NEXT?

Note: *Command HCOpy:DESTination is used to select an output medium other than the default one.*

Parameter

<printer_name>

Example

SYST:COMM:PRIN:SEL LASER on LPT1

Characteristics

*RST value: NONE

SCPI: device-specific

Mode

all

SYSTEM:DATE

This command is used to enter the date for the internal calendar.

The sequence of entry is year, month, day.

Parameter

1980 to 2099, 1 to 12, 1 to 31

Example

SYST:DATE 2000, 6, 1

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SYSTEM:DISPlay:FPANel

This command activates or deactivates the display of the front panel keys on the screen.

With the display activated, the instrument can be operated on the screen using the mouse by pressing the corresponding buttons.

Parameter

ON | OFF

Example

SYST:DISP:FPAN ON

Characteristics

*RST value: OFF

SCPI: device-specific

Modeall

SYSTem:DISPlay:UPDate

In remote control mode, this command switches on or off the instrument display. When switched on, only the diagrams, traces and display fields are displayed and updated.

Note: *The best performance is obtained if the display output is switched off during remote control.*

Parameter

ON | OFF

Example

SYST:DISP:UPD ON

Characteristics

*RST value: OFF

SCPI: device-specific

Modeall

SYSTem:ERRor[:NEXT]?

This command queries the earliest error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned. This command is identical to the command `SYSTem:QUEue:NEXT?`.

This command is a query and therefore has no *RST value.

Example

STAT:ERR?

Characteristics

*RST value: –

SCPI: conforming

Modeall

SYSTem:ERRor:LIST?

This command reads all system messages and returns a list of comma separated strings. Each string corresponds to an entry in the table SYSTEM MESSAGES.

If the error list is empty, an empty string "" will be returned.

This command is a query and therefore has no *RST value.

Example

SYST:ERR:LIST?

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

SYSTEM:ERRor:CLEar:ALL

This command deletes all entries in the table SYSTEM MESSAGES.

This command is an event and therefore has no query and no *RST value.

Example

SYST:ERR:CLE:ALL?

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

SYSTEM:FIRMware:UPDate

This command starts a firmware update using the *.msi files in the selected directory. The default path is D:\FW_UPDATE. The path is changed via the `MMEMory:CDIRectory` command. To store the update files the `MMEM:DATA` command is used.

This command is an event and therefore has no query and no *RST value.

Example

SYST:FIRM:UPD D:\FW_UPDATE

Starts the firmware update from directory D:\FW_UPDATE.

Characteristics

*RST value: –

SCPI: device-specific

Mode

all

SYSTEM:FORMat:IDENt

This command adapts the return value of *IDN? to the FSP.

Parameter

LEGacy (FSP) | FSL

Example

SYST:FORM:IDEN FSP

Adapts the return value of *IDN? to the FSP.

Characteristics

RST value: FSL

SCPI: device-specific

Mode

all

SYSTem:PASSword[:CENable]

This command enables access to the service functions by means of the password.
This command is an event and therefore has no *RST value and no query.

Parameter

<password>

Example

```
SYST:PASS XXXX
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SYSTem:PASSword:RESet

This command resets the service password.
This command is an event and therefore has no *RST value and no query.

Example

```
SYST:PASS:RES
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SYSTem:PRESet

This command initiates an instrument reset.
The effect of this command corresponds to that of the **PRESET** key with manual control or to the *RST command. For details on preset settings refer to chapter 2 "Instrument Functions – Analyzer", section "Initializing the Configuration – PRESET Key".

Example

```
SYST:PRES
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SYSTem:TIME

This command sets the internal clock. The sequence of entry is hour, minute, second.

Parameter

0 to 23, 0 to 59, 0 to 59

Example

```
SYST:TIME 12,30,30
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

SYSTEM:VERSion?

This command queries the number of the SCPI version, which is relevant for the instrument.

This command is a query and therefore has no *RST value.

Example

```
SYST:VERS?
```

Characteristics

*RST value: –

SCPI: conforming

Mode

all

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7 Remote Control – Programming Examples

The following programming examples have a hierarchical structure, i.e. subsequent examples are based on previous ones. It is thus possible to compile very easily an operational program from the modules of the given examples. In this chapter, more complex programming examples are given. In the Quick Start Guide, chapter 6, basic steps in remote control programming are provided.

Service Request

The service request routine requires an extended initialization of the instrument in which the relevant bits of the transition and enable registers are set. In addition the service request event must be enabled in the VISA session.

Initiate Service Request

```

REM ---- Example of initialization of the SRQ in the case of errors -----
PUBLIC SUB SetupSRQ()
CALL InstrWrite(analyzer, "*CLS")           'Reset status reporting system
CALL InstrWrite(analyzer,"*SRE 168")       'Enable service request for
                                           'STAT:OPER,STAT:QUES and ESR
                                           'register
CALL InstrWrite(analyzer,"*ESE 60")        'Set event enable bit for
                                           'command, execution, device-
                                           'dependent and query error
CALL InstrWrite(analyzer,"STAT:OPER:ENAB 32767")
                                           'Set OPERation enable bit for
                                           'all events
CALL InstrWrite(analyzer,"STAT:OPER:PTR 32767")
                                           'Set appropriate OPERation
                                           'Ptransition bits
CALL InstrWrite(analyzer,"STAT:QUES:ENAB 32767")
                                           'Set questionable enable bits
                                           'for all events
CALL InstrWrite(analyzer,"STAT:QUES:PTR 32767")
                                           'Set appropriate questionable
                                           'Ptransition bits
CALL viEnableEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
                                           'Enable the event for service
                                           'request
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout,
VI_NULL, VI_NULL)
IF (status = VI_SUCCESS) THEN CALL Srq      'If SRQ is recognized =>
                                           'subroutine for evaluation
END SUB
REM *****

```

Waiting for the Arrival of a Service Request

There are basically two methods of waiting for the arrival of a service request:

1. Blocking (user inputs not possible):

This method is appropriate if the waiting time until the event to be signalled by an SRQ is short (shorter than the selected timeout), if no response to user inputs is required during the waiting time, and if – as the main criterion – the event is absolutely certain to occur.

Reason:

From the time the `viWaitOnEvent()` function is called until the occurrence of the expected event, it does not allow the program to respond to mouse clicks or key entries during the waiting time.

Moreover, it returns an error if the SRQ event does not occur within the predefined timeout period. The method is, therefore, in many cases not suitable for waiting for measurement results, especially when using triggered measurements.

The following function calls are required:

```
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout,
                       VI_NULL, VI_NULL)
                       'Wait for service request user
                       'inputs are not possible during
                       'the waiting time!

IF (status = VI_SUCCESS) THEN CALL Srq
                       'If SRQ is recognized =>
                       'subroutine for evaluation
```

2. Non-blocking (user inputs possible):

This method is recommended if the waiting time until the event to be signalled by an SRQ is long (longer than the selected timeout), and user inputs should be possible during the waiting time, or if the event is not certain to occur. This method is, therefore, the preferable choice for waiting for the end of measurements, i.e. the output of results, especially in the case of triggered measurements.

The method necessitates a waiting loop that checks the status of the SRQ line at regular intervals and returns control to the operating system during the time the expected event has not yet occurred. In this way, the system can respond to user inputs (mouse clicks, key entries) during the waiting time.

It is advisable to employ the `Hold()` auxiliary function, which returns control to the operating system for a selectable waiting time (see section "Waiting Without Blocking the Keyboard and Mouse"), so enabling user inputs during the waiting time.

```

result% = 0
For i = 1 To 10           'Abort after max. 10 loop
                        'iterations
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ,
                        VI_TMO_IMMEDIATE, VI_NULL,
                        VI_NULL)
                        'Check event queue

If (status = VI_SUCCESS) Then
    result% = 1
    CALL Srq           'If SRQ is recognized =>
                    'subroutine for evaluation

Else
    CALL Hold(20)     'Call hold function with
                    '20 ms 'waiting time. User inputs
                    'are possible.

Endif
Next i
If result% = 0 Then
    Debug.Print "Timeout Error; Program aborted"
                    'Output error message

    STOP             'Stop software
Endif

```

Waiting Without Blocking the Keyboard and Mouse

A frequent problem with remote control programs using Visual Basic is to insert waiting times without blocking the keyboard and the mouse.

If the program is to respond to user inputs also during a waiting time, control over the program events during this time must be returned to the operating system. In Visual Basic, this is done by calling the *DoEvents* function. This function causes keyboard- or mouse-triggered events to be executed by the associated elements. For example, it allows the operation of buttons and input fields while the user waits for an instrument setting to be completed.

The following programming example describes the *Hold()* function, which returns control to the operating system for the period of the waiting time selectable in milliseconds.

```

Rem *****
Rem The waiting function below expects the transfer of the desired
Rem waiting time in milliseconds. The keyboard and the mouse remain
Rem operative during the waiting period, thus allowing desired elements
Rem to be controlled
Rem *****

```

```

Public Sub Hold(delayTime As Single)
    Start = Timer                                'Save timer count on calling the
                                                'function
    Do While Timer < Start + delayTime / 1000 'Check timer count
        DoEvents                                'Return control to operating
                                                'system to enable control of
                                                'desired elements as long as
                                                'timer has not elapsed
    Loop
End Sub
Rem *****

```

The waiting procedure is activated simply by calling *Hold(<Waiting time in milliseconds>)*.

Service Request Routine

A service request is processed in the service request routine.

Note: the variables userN% and userM% must be pre-assigned usefully!

```

REM ----- Service request routine -----
Public SUB Srq()
ON ERROR GOTO noDevice                                'No user existing
CALL viReadSTB(analyzer, STB%)                       'Serial poll, read status byte
IF STB% > 0 THEN                                       'This instrument has bits set in
                                                        'the STB
    SRQFOUND% = 1
    IF (STB% AND 16) > 0 THEN CALL Outputqueue
    IF (STB% AND 4) > 0 THEN CALL ErrorQueueHandler
    IF (STB% AND 8) > 0 THEN CALL Questionablestatus
    IF (STB% AND 128) > 0 THEN CALL Operationstatus
    IF (STB% AND 32) > 0 THEN CALL Esrread
END IF
noDevice:
END SUB                                               'End of SRQ routine
Rem *****

```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

Reading Out the Output Buffer

```

REM ----- Subroutine for the individual STB bits -----
Public SUB Outputqueue()                                'Reading the output buffer
result$ = SPACE$(100)                                    'Make space for response
CALL InstrRead(analyzer, result$)
Debug.Print "Contents of Output Queue : "; result$
END SUB
REM *****

```

Reading Error Messages

```

REM ----- Subroutine for reading the error queue -----
Public SUB ErrorQueueHandler()
ERROR$ = SPACE$(100)                                    'Make space for error variable
CALL InstrWrite(analyzer, "SYSTEM:ERROR?")
CALL InstrRead(analyzer, ERROR$)
Debug.Print "Error Description : "; ERROR$
END SUB
REM *****

```

Evaluation of SCPI Status Registers

```

REM ----- Subroutine for evaluating Questionable Status Register -----
Public SUB Questionablestatus()
Ques$ = SPACE$(20)                                     'Preallocate blanks to text
                                                    'variable
CALL InstrWrite(analyzer, "STATus:QUEStionable:EVENT?")
CALL InstrRead(analyzer, Ques$)
Debug.Print "Questionable Status: "; Ques$
END SUB
REM *****

```

```

REM ----- Subroutine for evaluating Operation Status Register -----
Public SUB Operationstatus()
Oper$ = SPACE$(20)                                'Preallocate blanks to text
                                                'variable

CALL InstrWrite(analyzer, "STATUS:OPERation:EVENT?")
CALL InstrRead(analyzer, Oper$)
Debug.Print "Operation Status: "; Oper$
END SUB
REM *****

```

Evaluation of Event Status Register

```

REM ----- Subroutine for evaluating the Event Status Register -----
Public SUB Esrread()
Esr$ = SPACE$(20)                                'Preallocate blanks to text
                                                'variable

CALL InstrWrite(analyzer, "*ESR?")              'Read ESR
CALL InstrRead(analyzer, Esr$)

IF (VAL(Esr$) AND 1) > 0 THEN Debug.Print "Operation complete"
IF (VAL(Esr$) AND 2) > 0 THEN Debug.Print "Request Control"
IF (VAL(Esr$) AND 4) > 0 THEN Debug.Print "Query Error"
IF (VAL(Esr$) AND 8) > 0 THEN Debug.Print "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN
    Debug.Print "Execution Error; Program aborted"
                                                'Output error message
    STOP                                        'Stop software
    END IF
IF (VAL(Esr$) AND 32) > 0 THEN
    Debug.Print "Command Error; Program aborted"
                                                'Output error message
    STOP                                        'Stop software
    END IF
IF (VAL(Esr$) AND 64) > 0 THEN Debug.Print "User request"
IF (VAL(Esr$) AND 128) > 0 THEN Debug.Print "Power on"
END SUB
REM *****

```

Default Setting of the R&S FSL

The following settings are an example of how to modify the default setting of the R&S FSL.

It should be noted that only some settings are necessary depending on the example of application. In particular, the settings for resolution bandwidth, video bandwidth and sweep time are often not needed since these parameters are automatically calculated in the default setting on modifying the frequency range (span). The insertion loss is also automatically calculated depending on the reference level. The level detectors are coupled to the selected trace mode in the default setting.

The settings which are automatically calculated in the default setting are marked by (*) in the following programming example.

Setting the Status Register

```

REM *****
Public Sub SetupStatusReg()
'----- IEEE 488.2 status register -----
CALL InstrWrite(analyzer,"*CLS")           'Reset Status Registers
CALL InstrWrite(analyzer,"*SRE 168")       'Enable service request for
                                           'STAT:OPER-,STAT:QUES- and ESR
                                           'registers
CALL InstrWrite(analyzer,"*ESE 61")        'Set Event Enable bit for:
                                           'Operation Complete
                                           'Command-, Execution-, Device-
                                           'dependent and Query Error

'----- SCPI status register -----
CALL InstrWrite(analyzer,"STAT:OPER:ENAB 0")
                                           'Disable OPERATION Status Reg
CALL InstrWrite(analyzer,"STAT:QUES:ENAB 0")
                                           'Disable Questionable Status
                                           'Register

End Sub
REM *****

```

Default Setting for Measurements

```

REM *****
Public Sub SetupInstrument()
'----- R&S FSL default setting -----
CALL SetupStatusReg                       'Set status registers
CALL InstrWrite(analyzer,"*RST")          'Reset instrument
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                           'ON: display on
                                           'OFF: off(improved performance)
CALL InstrWrite(analyzer,"INIT:CONT OFF")
                                           'Single sweep

```

```

'----- Set frequency -----
CALL InstrWrite(analyzer,"FREQUENCY:CENTER 100MHz")
                                'Center frequency
CALL InstrWrite(analyzer,"FREQ:SPAN 1 MHz")
                                'Span

'----- Set level -----
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV -20dBm")
                                'Reference level
CALL InstrWrite(analyzer,"INP:ATT 10dB")  'Input attenuation (*)

'----- Scale y axis -----
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:SPAC LOG")
                                'Log level axis
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:SCAL 100dB")
                                'Level range
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:SCAL:MODE ABS")
                                'Absolute scaling
CALL InstrWrite(analyzer,"CALC:UNIT:POW DBM")
                                'Unit of y axis

'----- Trace and detector settings -----
CALL InstrWrite(analyzer,"DISP:WIND:TRAC1:MODE AVER")
                                'Trace1 average
CALL InstrWrite(analyzer,"AVER:TYPE VID") 'Average mode video;
                                '"LIN" for linear
CALL InstrWrite(analyzer,"SWE:COUN 10")  'Sweep count
CALL InstrWrite(analyzer,"DISP:WIND:TRAC2:STAT OFF")
                                'Trace2 blank
CALL InstrWrite(analyzer,"DISP:WIND:TRAC3:STAT OFF")
                                'Trace3 blank
CALL InstrWrite(analyzer,"CALC:MATH:STAT OFF")
                                'Trace mathematics off
CALL InstrWrite(analyzer,"DETECTOR1 RMS"  'Detector Trace1  (*)
CALL InstrWrite(analyzer,"DET2:AUTO ON")  'Detector Trace2  (*)
CALL InstrWrite(analyzer,"DET3:AUTO ON")  'Detector Trace3  (*)

'----- Bandwidth and sweep time -----
CALL InstrWrite(analyzer,"BAND:RES 100KHz")
                                'Resolution BW (*)
CALL InstrWrite(analyzer,"BAND:VID 1MHz")  'Video bandwidth  (*)
CALL InstrWrite(analyzer,"SWE:TIM 100ms")  'Sweep time          (*)

END SUB
REM *****

```


Using Marker and Delta Marker

Marker Search Functions, Limitation of Search Range

The example below is based on an AM-modulated signal at 100 MHz with the following characteristics:

- Carrier signal level: -30 dBm
- AF frequency: 100 kHz
- Modulation depth: 50 %

Marker 1 and delta marker 2 are set one after the other to the highest maxima of the measurement curve and then the frequency and level are read out. The default setting of the R&S FSL can be used for the following measurements (SetupInstrument).

```

REM *****
Public Sub MarkerSearch()
result$ = Space$(100)
CALL SetupInstrument           'Default setting
'----- Peak search without search limit -----
CALL InstrWrite(analyzer,"INIT:CONT OFF")
                                'Switch to single sweep
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                'Define peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                'Switch on Marker 1
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                'Assign Marker 1 to Trace 1
CALL InstrWrite(analyzer,"INIT;*WAI")
                                'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:MAX;X?;Y?")
                                'Marker to peak - read out
                                'frequency and level

CALL InstrRead(analyzer, result$)
Print "Marker 1: ";result$
CALL InstrWrite(analyzer,"CALC:DELT2:STAT ON;MAX;MAX:LEFT")
                                'Switch on delta marker 2
                                'Peak and then Next Peak Left
CALL InstrWrite(analyzer,"CALC:DELT:MODE ABS")
                                'Delta marker2 frequency output
                                'absolute
CALL InstrWrite(analyzer,"CALC:DELT2:X?;Y?")
                                'Delta marker 2 - read out
                                'frequency and level

CALL InstrRead(analyzer, result$)
Print "Delta 2: ";result$

```

```

'----- Peak search with search limit in x direction -----
CALL InstrWrite(analyzer,"CALC:MARK:X:SLIM:STAT ON;LEFT 0Hz;RIGHT
                    100.05MHz")
                    'Search limit on and set below
                    'LF on the right side

CALL InstrWrite(analyzer,"CALC:DELT3:STAT ON;MAX;MAX:RIGHT")
                    'Delta marker 3 on peak and then
                    'Next Peak Right

CALL InstrWrite(analyzer,"CALC:DELT3:X?;Y?")
                    'Delta marker 3; Read out
                    'frequency and level, both must
                    'have the value 0

CALL InstrRead(analyzer, result$)
Print "Delta 3: ";result$

'----- Peak search with search limit in y direction -----
CALL InstrWrite(analyzer,"CALC:THR:STAT ON")
CALL InstrWrite(analyzer,"CALC:THR -35DBM")
                    'Threshold on and set above LF

CALL InstrWrite(analyzer,"CALC:DELT3:STAT ON;MAX;MAX:NEXT")
                    'Delta marker 3 on
                    'Peak and then Next Peak
                    ' => is not found

CALL InstrWrite(analyzer,"CALC:DELT3:X:REL?;:CALC:DELT3:Y?")
CALL InstrRead(analyzer, result$)
                    'Delta marker 3; read out
                    'frequency and level, both must
                    'have the value 0

Print "Delta 3: ";result$

'---- Set center frequency and reference level by means of markers -----
CALL InstrWrite(analyzer,"CALC:MARK2:FUNC:CENT")
                    'Delta marker 2 -> Marker and
                    'center frequency = Marker 2

CALL InstrWrite(analyzer,"CALC:MARK2:FUNC:REF")
                    'Ref level = Marker 2

CALL InstrWrite(analyzer,"INIT;*WAI")
                    'Perform sweep with sync

END SUB

REM *****

```

Frequency Counting

The following example is based on a signal with a level of -30 dBm at 100 MHz. The default setting of the R&S FSL can also be used for this measurement (SetupInstrument). The objective of frequency counting is to determine the exact frequency of the signal at 100 MHz.

```

REM *****
Public Sub MarkerCount()
result$ = Space$(100)
CALL SetupInstrument           'Default setting
'----- Measure signal frequency with frequency counter -----
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep on
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                     'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                     'Marker 1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                     'Assign marker 1 to trace 1
CALL InstrWrite(analyzer,"CALC:MARK:X 100MHz")
                                     'Set marker 1 to 100 MHz
CALL InstrWrite(analyzer,"CALC:MARK:COUNT:RES 1HZ")
                                     'Frequency counter 1 Hz
CALL InstrWrite(analyzer,"CALC:MARK:COUNT ON")
                                     'Frequency counter on
CALL InstrWrite(analyzer,"INIT;*WAI")   'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:COUNT:FREQ?")
                                     'Query measured frequency
CALL InstrRead(analyzer, result$)       'and read it out
Print "Marker Count Freq: ";result$
END SUB
REM *****

```

Operation with Fixed Reference Point (Reference Fixed)

The following example is based on a signal with a level of -20 dBm at 100 MHz. The harmonics of the signal lie at 200 MHz, 300 MHz, etc. In the presence of high-quality signal sources these harmonics may be outside the dynamic range of the R&S FSL. In order to measure harmonic suppression, however, the level must be set to higher sensitivity for measuring the harmonics; the carrier has to be suppressed by a notch filter to avoid overloading the R&S FSL RF input.

In the following example, two measurements are therefore performed with different level settings, first with a high reference level at the carrier frequency and then with a low reference level at the frequency of the 3rd harmonic.

The default setting of the R&S FSL for measurements (SetupInstrument) is used as starting point and adaptations are then made for the measurement.

```

REM *****
Public Sub RefFixed()
result$ = Space$(100)
CALL SetupInstrument           'Default setting
'----- Measure the reference point -----
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                         'Peak Excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                         'Marker1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                         'Assign Marker 1 to Trace 1
CALL InstrWrite(analyzer,"INIT;*WAI")     'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:MAX")  'Set Marker1 to 100 MHz
CALL InstrWrite(analyzer,"CALC:DELT:FUNC:FIX ON")
                                         'Reference fixed
'-----Setting frequency, level and bandwidth for harmonic measurement -----
CALL InstrWrite(analyzer,"FREQ:CENT 400MHz;Span 1MHz")
                                         'Set freq. of 3rd harmonic
CALL InstrWrite(analyzer,"BAND:RES 1kHz")  'and appropriate RBW
CALL InstrWrite(analyzer,"SWEEP:TIME:AUTO ON")
                                         'Couple sweep time
CALL InstrWrite(analyzer,"INP:ATT:AUTO ON")
                                         'Optimize level
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV -50dBm")
CALL InstrWrite(analyzer,"INIT;*WAI")     'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:DELT:MODE REL")
                                         'Delta marker frequency relative
CALL InstrWrite(analyzer,"CALC:DELT:MAX;X?;Y?")
                                         'Read out delta marker
CALL InstrRead(analyzer, result$)         'Read out frequency and level
Print "Deltamarker 1: "; result$
END SUB
REM *****

```

Phase and Phase Noise Measurement

During phase noise measurement the noise power referred to 1 Hz is brought into proportion to the power of an adjacent carrier signal. The spacing often used between the measured frequency and the carrier frequency is 10 kHz.

For the noise measurement the measured absolute level is referred to a bandwidth of 1 Hz.

The following example is again based on a signal with a level of -30 dBm at 100 MHz. Two markers are used to determine the noise and the phase noise at an offset of 10 kHz from the carrier signal.

```

REM *****
Public Sub Noise()
result$ = Space$(100)
'----- R&S FSL default setting -----
CALL SetupStatusReg           'Configure status register
CALL InstrWrite(analyzer,"*RST") 'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
'----- Set frequency -----
CALL InstrWrite(analyzer,"FREQUENCY:CENTER 100MHz")
                                'Center frequency
CALL InstrWrite(analyzer,"FREQ:SPAN 100 kHz")
                                'Span
'----- Set level -----
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV -20dBm")
                                'Reference level
CALL InstrWrite(analyzer,"INIT;*WAI") 'Perform sweep with sync
'----- Set reference point -----
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                'Marker 1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                'Assign marker1 to tracel
CALL InstrWrite(analyzer,"CALC:MARK:MAX") 'Set marker1 to 100 MHz
CALL InstrWrite(analyzer,"CALC:DELT:FUNC:PNO ON")
                                'Define phase noise reference
                                'point
'----- Measure phase noise -----
CALL InstrWrite(analyzer,"CALC:DELT:X 10kHz")
                                'Set delta marker
CALL InstrWrite(analyzer,"CALC:DELT:FUNC:PNO:RES?")
                                'Read out result of phase noise
                                'meas

CALL InstrRead(analyzer, result$)
Print "Phase Noise [dBc/Hz]: "; result$
'----- Measure noise -----
CALL InstrWrite(analyzer,"CALC:MARK:X 99.96MHz")
                                'Set Marker 1
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NOIS:RES?")
                                'Read out result

CALL InstrRead(analyzer, result$)
Print "Noise [dBm/Hz]: "; result$
END SUB
REM *****

```

Shape Factor Measurement (using n dB down)

The n-dB-down function of the R&S FSL is used twice to determine the shape factor of a filter (ratio of bandwidths at 60 dB and 3 dB below the filter maximum).

The following example is again based on a signal with a level of -30 dBm at 100 MHz. The shape factor is determined for the 30 kHz resolution bandwidth. The default setting of the R&S FSL is used for measurements (SetupInstrument).

```

REM *****
Public Sub ShapeFactor()
result$ = Space$(100)
'----- R&S FSL default setting -----
CALL SetupInstrument           'Default setting
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
'----- Set frequency -----
CALL InstrWrite(analyzer,"FREQ:SPAN 1MHz")
                                'Span
CALL InstrWrite(analyzer,"BAND:RES 30kHz")
                                'Resolution bandwidth
CALL InstrWrite(analyzer,"INIT;*WAI")
                                'Perform sweep with sync
'----- Measure 60 dB value -----
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                'Marker1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                'Assign marker1 to trace1
CALL InstrWrite(analyzer,"CALC:MARK:MAX")
                                'Set marker1 to 100 MHz
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD 45dB")
                                'Read out bandwidth measured at
                                '45 dB
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD:RES?")
CALL InstrRead(analyzer,result$)
result60 = Val(result$)
'----- Measure 3 dB down value -----
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD 3dB")
                                'Read out bandwidth measured at
                                '3 dB
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:NDBD:RES?")
CALL InstrRead(analyzer,result$)
result3 = Val(result$)
'----- Read out shape factor-----
Print "Shapfaktor 60dB/3dB: ";result60/result3
END SUB
REM *****

```

Measuring the Third Order Intercept Point

The third order intercept point (TOI) is the (virtual) level of two adjacent useful signals at which the intermodulation products of third order have the same level as the useful signals.

The intermodulation product at f_{S2} is obtained by mixing the first harmonic of the useful signal P_{N2} with signal P_{N1} , the intermodulation product at f_{S1} by mixing the first harmonic of the useful signal P_{N1} with signal P_{N2} .

$$f_{S1} = 2 \times f_{n1} - f_{n2} \quad (1)$$

$$f_{S2} = 2 \times f_{n2} - f_{n1} \quad (2)$$

The following example is based on two adjacent signals with a level of -30 dBm at 100 MHz and 110 MHz. The intermodulation products lie at 90 MHz and 120 MHz according to the above formula. The frequency is set so that the examined mixture products are displayed in the diagram. Otherwise, the default setting of the R&S FSL is used for measurements (SetupInstrument).

```

REM *****
Public Sub TOI()
result$ = Space$(100)

'----- R&S FSL default setting -----
CALL SetupStatusReg           'Set status registers
CALL InstrWrite(analyzer,"*RST") 'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                'ON: display on
                                'OFF: off

'----- Set frequency -----
CALL InstrWrite(analyzer,"FREQ:START 85MHz;STOP 125 MHz")
                                'Span

'----- Set level -----
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV -20dBm")
                                'Reference level
CALL InstrWrite(analyzer,"INIT;*WAI") 'Perform sweep with sync

'----- TOI measurement -----
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:TOI ON")
                                'Switch on TOI measurement
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:TOI:RES?")
                                'and read out results

CALL InstrRead(analyzer,result$)

'----- Read out result -----
Print "TOI [dBm]: ";result$

END SUB

REM *****

```

Measuring the AM Modulation Depth

The example below is based on an AM-modulated signal at 100 MHz with the following characteristics:

- Carrier signal level: -30 dBm
- AF frequency: 100 kHz
- Modulation depth: 50 %

The default setting of the analyzer for measurements can be used for the measurements described below (SetupInstrument).

```

REM *****
Public Sub AMMod()
result$ = Space$(100)
CALL SetupInstrument           'Default setting
CALL InstrWrite(analyzer,"BAND:RES 30kHz") 'Set appropriate RBW
'----- Peak search -----
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"INIT;*WAI")     'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:PEXC 6DB")
                                           'Peak excursion
CALL InstrWrite(analyzer,"CALC:MARK:STAT ON")
                                           'Marker 1 on
CALL InstrWrite(analyzer,"CALC:MARK:TRAC 1")
                                           'Assign marker1 to trace1
'----- Measure modulation depth-----
CALL InstrWrite(analyzer,"CALC:MARK:MAX;FUNC:MDEP ON")
                                           'Marker to Peak;
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:MDEP:RES?")
                                           'Measure mod. depth
CALL InstrRead(analyzer, result$)         'Read out result
'----- Read out result -----
Print "AM Mod Depth [%]: ";result$
END SUB
REM *****

```


Limit Lines and Limit Test

The example below shows the definition and use of a new limit line 5 for trace 1 with the following characteristics:

- Upper limit line
- Absolute x axis in the frequency range
- 5 reference values:
 - 120 MHz / -70 dB, 126 MHz/-40 dB, 127 MHz/-40 dB, 128 MHz/-10 dB,
 - 129 MHz/-40 dB, 130 MHz/-40 dB, 136 MHz / -70 dB
- Relative y axis with unit dB
- Absolute threshold at -75 dBm
- No margin

The signal of the integrated calibration source (128 MHz, -30 dBm) is used to check the limit test.

REM *****

Public Sub LimitLine()

result\$ = Space\$(100)

'----- **R&S FSL default setting** -----

CALL SetupInstrument 'Default setting

CALL InstrWrite(analyzer, "FREQUENCY:CENTER 128MHz;Span 10MHz")
'Span

CALL InstrWrite(analyzer, "Diag:Serv:Inp Cal;CSO -30dBm")
'Cal signal on

'----- **Definition of limit lines** -----

CALL InstrWrite(analyzer, "CALC:LIM5:NAME 'TEST1'")
'Define name

CALL InstrWrite(analyzer, "CALC:LIM5:COMM 'Upper limit'")
'Define comment

CALL InstrWrite(analyzer, "CALC:LIM5:TRAC 1")
'Assign trace

CALL InstrWrite(analyzer, "CALC:LIM5:CONT:DOM FREQ")
'Define x axis range

CALL InstrWrite(analyzer, "CALC:LIM5:CONT:MODE ABS")
'Define x axis scaling

CALL InstrWrite(analyzer, "CALC:LIM5:UNIT DB")
'Define y axis unit

CALL InstrWrite(analyzer, "CALC:LIM5:UPP:MODE REL")
'Define y axis scaling

'----- **Definition of data points and threshold** -----

xlimit\$ = "CALC:LIM5:CONT 120MHZ,126MHZ,127MHZ,128MHZ,129MHZ,130MHZ,136MHZ"

CALL InstrWrite(analyzer, xlimit\$) 'Set values for x axis

CALL InstrWrite(analyzer, "CALC:LIM5:UPP -70,-40,-40,-20,-40,-40,-70")
'Set values for y axis

CALL InstrWrite(analyzer, "CALC:LIM5:UPP:THR -75DBM")
'Set y threshold (only
'possible for relative
'y axis)

```

'----- Definition of margin or x /y offset-----
'A margin or an x /y offset can be defined here.

'----- Activate and evaluate the limit line -----
CALL InstrWrite(analyzer,"CALC:LIM5:UPP:STAT ON")
                                'Activate line 5
CALL InstrWrite(analyzer,"CALC:LIM5:STAT ON")
                                'Activate limit check
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:LIM5:FAIL?")
                                'Query result of limit check
CALL InstrRead(analyzer, result$)         'Result: 1 (= FAIL)

'----- Read out result -----
Print "Limit Result Line 5: ";result$

'----- Evaluate limit line by means of status register -----
CALL InstrWrite(analyzer,"*CLS")          'Reset status register

'----- Measure -----
CALL InstrWrite(analyzer,"INIT;*OPC")     'Perform sweep with sync
CALL viEnableEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout,
VI_NULL, VI_NULL)
IF (status = VI_SUCCESS) THEN CALL Srq     'If SRQ is recognized =>
                                          'subroutine for evaluation

'----- Read out result -----
IF (status% = 1) THEN
    CALL InstrWrite(analyzer,"STAT:QUES:LIM1:COND?")
                                          'Read out STAT:QUES:LIMit
                                          'register

    CALL InstrRead(analyzer, result$)

    IF ((Val(result$) And 16) <> 0) THEN
        Print "Limit5 failed"
    ELSE
        Print "Limit5 passed"
    END IF
END IF
END SUB
REM *****

```

Measuring the Channel and Adjacent Channel Power

In the following example, the channel and adjacent channel power is first measured on a signal with a level of 0 dBm at 800 MHz to IS95. Then the channel and adjacent channel power is measured on a GSM signal at 935.2 MHz with fast ACP measurement (FAST ACP).

In addition, the limit test is activated.

```

REM *****
Public Sub ACP()
result$ = Space$(100)
'----- R&S FSL default setting -----
CALL SetupStatusReg           'Set status register
CALL InstrWrite(analyzer,"*RST")      'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                     'ON: display on
                                     'OFF: off
'----- Set frequency -----
CALL InstrWrite(analyzer,"FREQ:CENT 800MHz")
                                     'Set frequency
'----- Set level -----
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV 10dBm")
                                     'Reference level
'----- Example 1: Configure CP/ACP for CDMA -----
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:SEL ACP")
                                     'ACP measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:PRES F8CDMA")
                                     'Select CDMA800 FWD
CALL InstrWrite(analyzer,"SENS:POW:ACH:ACP 2")
                                     'Select 2 adjacent channels
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES ACP")
                                     'Optimize settings
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES:RLEV")
                                     'Optimize reference level
CALL InstrWrite(analyzer,"SENS:POW:ACH:MODE ABS")
                                     'Absolute measurement
CALL InstrWrite(analyzer,"SENS:POW:HSP ON")
                                     'Fast ACP measurement
'----- Perform measurement and query results -----
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:RES? ACP")      'Query result
                                     CALL InstrRead(analyzer, result$)

```

```

'----- Read out result -----
Print "Result (CP, ACP low, ACP up, Alt low, Alt up): "
Print result$

'----- Example 2: Configure CP/ACP manually for GSM -----
result$ = Space$(100)
CALL InstrWrite(analyzer,"FREQ:CENT 935.2MHz")
                                'Set frequency
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:SEL ACP")
                                'ACP measurement on
CALL InstrWrite(analyzer,"SENS:POW:ACH:ACP 1")
'1 adjacent channel
CALL InstrWrite(analyzer,"SENS:POW:ACH:BAND 200KHZ")
'Channel bandw. 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:ACH:BAND:ACH 200KHZ")
                                'Adjacent channel band-
                                'width 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:ACH:SPAC 200KHZ")
                                'Channel spacing 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES ACP")
                                'Optimize settings
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES:RLEV")
                                'Optimize reference level
CALL InstrWrite(analyzer,"SENS:POW:ACH:MODE ABS")
                                'Absolute measurement

'----- Start measurement and query result -----
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:RES? ACP")
                                'Query result

CALL InstrRead(analyzer, result$)

'----- Read out result -----
Print "Result (CP, ACP low, ACP up): "
Print result$

'----- Active limit check -----
result$ = Space$(100)
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH 30DB, 30DB")
                                'Set relative limit
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:ABS -35DBM,-35DBM")
                                'Set absolute limit
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:STAT ON")
                                'Rel. limit check on
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:ABS:STAT ON")
                                'Abs. limit check on
CALL InstrWrite(analyzer,"CALC:LIM:ACP ON")
                                'Limit check on

```

```

'----- Start measurement and query result -----
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:LIM:ACP:ACH:RES?")
                                           'Query result of limit check

CALL InstrRead(analyzer, result$)

'----- Read out result -----
Print "Result Limit Check: ";result$

END SUB
REM *****

```

Occupied Bandwidth Measurement

In the following example, the bandwidth is to be found in which 95% of the power of a GSM signal is contained. Signal frequency is 935.2 MHz; channel bandwidth is 200 kHz.

```

REM *****
Public Sub OBW()
result$ = Space$(100)

'----- R&S FSL default setting -----
CALL SetupStatusReg                      'Set status register
CALL InstrWrite(analyzer,"*RST")          'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                           'ON: display on
                                           'OFF: off

'----- Configure R&S FSL for OBW for GSM -----
CALL InstrWrite(analyzer,"FREQ:CENT 935.2MHz")
                                           'Set frequency
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:SEL OBW")
                                           'OBW measurement on
CALL InstrWrite(analyzer,"SENS:POW:ACH:BAND 200KHZ")
                                           'Channel bandw. 200 kHz
CALL InstrWrite(analyzer,"SENS:POW:BWID 95PCT")
                                           'Percentage of power
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES OBW")
                                           'Set frequency and optimize
                                           reference level
CALL InstrWrite(analyzer,"SENS:POW:ACH:PRES:RLEV")
CALL InstrWrite(analyzer,"SENS:POW:NCOR OFF")
                                           'Noise correction
                                           'OFF: switch off
                                           'ON: switch on

```

```

'----- Perform measurement and query results -----
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:POW:RES? OBW")
                                           'Query result

CALL InstrRead(analyzer, result$)
Print result$
END SUB
REM *****

```

Time Domain Power Measurement

In the following example, the mean carrier power of a signal with 300 kHz bandwidth at 100 MHz is to be determined. In addition, the peak power, the rms value and the standard deviation are measured. To do this, the time-domain-power measurement functions are used.

```

REM *****
Public Sub TimeDomainPower()
result$ = Space$(100)
'----- R&S FSL default setting -----
CALL SetupStatusReg      'Set status register
CALL InstrWrite(analyzer,"*RST")      'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                           'ON: display on
                                           'OFF: off

'----- Configure R&S FSL for time domain power measurement -----
CALL InstrWrite(analyzer,"FREQ:CENT 100MHz;SPAN 0Hz")
                                           'Set frequency

CALL InstrWrite(analyzer,"BAND:RES 300kHz")
                                           'Resolution bandwidth

CALL InstrWrite(analyzer,"SWE:TIME 200US") 'Sweep time
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:PPE ON")
                                           'Peak measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:MEAN ON")
                                           'Mean measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:RMS ON")
                                           'RMS measurement on
CALL InstrWrite(analyzer,"CALC:MARK:FUNC:SUMM:SDEV ON")
                                           'Standard deviation on

```

```

'----- Perform measurement and query results -----
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
                                           'Query results:
query$ = " CALC:MARK:FUNC:SUMM:PPE:RES?;"  'Peak measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:MEAN:RES?;"
                                           'Mean measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:RMS:RES?;"
                                           'RMS measurement
query$ = query$ + ":CALC:MARK:FUNC:SUMM:SDEV:RES?"
                                           'Standard deviation

CALL InstrWrite(analyzer, query$)
CALL InstrRead(analyzer, result$)
Print result$
END SUB
REM *****

```

Fast Power Measurement on Power Ramps

A frequent task in mobile radio tests is measurement of a DUT at various power control levels at the highest possible speed. The R&S FSL offers two test functions for this task, which can be used depending on the signal characteristics.

In the following, the two methods are presented by means of two examples.

Power Measurement with Multi-Summary Marker

The multi-summary marker function is suitable for measuring the power of a sequence of pulses with the following characteristics:

- The pulses occur at identical time intervals, which is typical of GSM transmission in slots, for example.
- The level of the first signal is reliably above threshold.
- The subsequent pulses may have any levels.

The function uses the first pulse as a trigger signal. The power of the subsequent pulses is determined exclusively via the timing pattern selected for the pulse sequence. The function is, therefore, suitable for adjustments where the DUT output power varies considerably and is not reliably above the trigger threshold.

The measurement accuracy is determined by the ratio of pulse duration to total measurement time; this should not be below 1:50.

The function always uses TRACE 1.

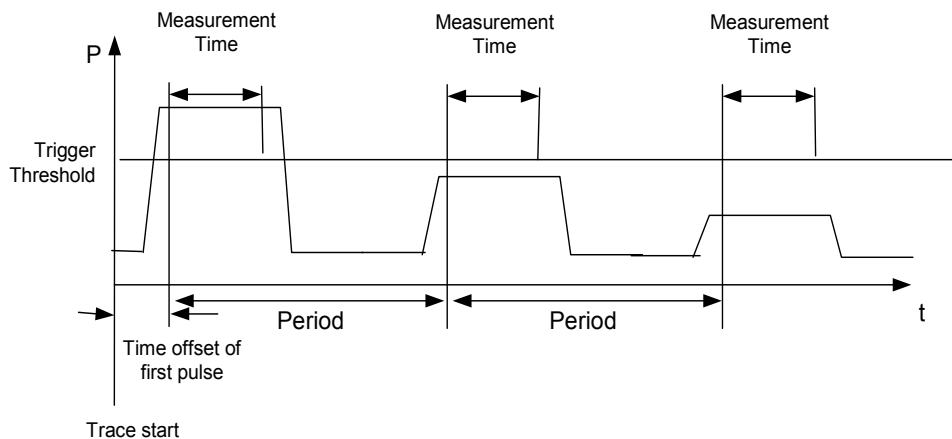


Fig. 7-1 Block diagram illustrating signal processing in analyzer

In the example below, a GSM puls sequence of 8 pulses is measured with an offset of 50 μ s of the first pulse, 450 μ s measurement time/pulse and 576.9 μ s pulse period.

```

REM *****
Public Sub MultiSumMarker()
result$ = Space$(200)
'----- R&S FSL default setting-----
CALL SetupStatusReg           'Configure status register
CALL InstrWrite(analyzer,"*RST") 'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep mode
CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
                                'ON: switch display on
                                'OFF: switch display off
'----- Configure R&S FSL for power measurement in time domain -----
CALL InstrWrite(analyzer,"FREQ:CENT 935.2MHz;SPAN 0Hz")
                                'Frequency setting
CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV 10dBm")
                                'Set reference level to 10 dB
CALL InstrWrite(analyzer,"INP:ATT 30 dB") 'Set input attenuation to 30 dB
CALL InstrWrite(analyzer,"BAND:RES 1MHz;VID 3MHz")
                                'Bandwidth setting
CALL InstrWrite(analyzer,"DET RMS") 'Select RMS detector
CALL InstrWrite(analyzer,"TRIG:SOUR VID") 'Trigger source: video
CALL InstrWrite(analyzer,"TRIG:LEV:VID 50 PCT")
                                'Trigger threshold: 50%
CALL InstrWrite(analyzer,"SWE:TIME 50ms") 'Sweep time  $\geq$  1 frame
    
```



```

'----- Perform measurement and query results -----
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
                                           'Query results:

cmd$ = "CALC:MARK:FUNC:MSUM? "
cmd$ = cmd$ + "50US,"                      'Offset of first pulse
cmd$ = cmd$ + "450US,"                    'Measurement time
cmd$ = cmd$ + "576.9US,"                  'Pulse period
cmd$ = cmd$ + "8"                          'Number of bursts
CALL InstrWrite(analyzer,cmd$)
CALL InstrRead(analyzer, result$)         'Read results
Print result$

END SUB

REM *****

```

Multi-Burst Power Measurement

The multi-burst power measurement function is suitable for measuring the power of a sequence of pulses with the following characteristics:

- The pulses occur at variable time intervals.
- The levels of all pulses of the sequence are reliably above the trigger threshold, or an external trigger signal is used.

The function requires one trigger event per pulse. This means that if the video trigger or the IF power trigger is used, the levels of all pulses must be above the trigger threshold.

The function is, therefore, particularly suitable for re-measuring DUTs already adjusted and whose output power is within the specified range. The measurement is optimized for minimum overhead relative to the actual measurement time.

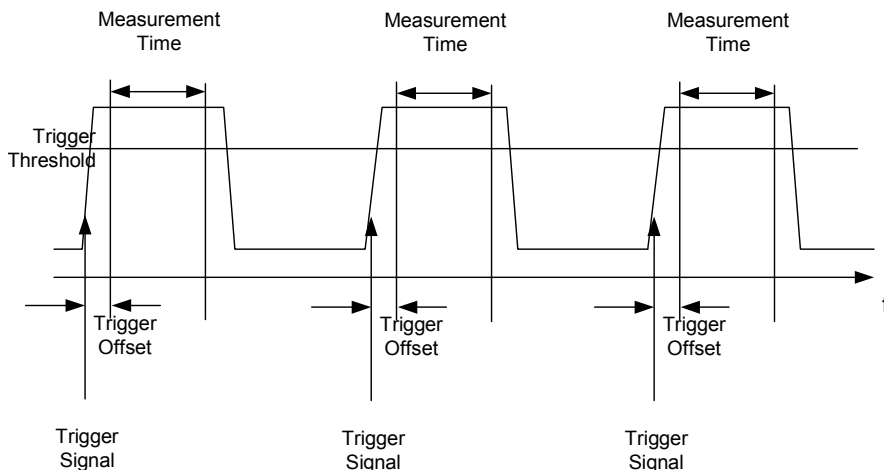


Fig. 7-2 Block diagram illustrating signal processing in analyzer

Either the root-mean-square power or the peak power is measured, depending on whether the RMS detector or the PEAK detector is selected. The function always uses TRACE 1.

The following parameters are to be set for this measurement:

- Analyzer frequency
- Resolution bandwidth
- Measurement time per single pulse
- Trigger source
- Trigger threshold
- Trigger offset
- Type of power measurement (PEAK, MEAN)
- Number of pulses to be measured

During the measurement, each pulse is mapped into a pixel of the screen, i.e. any change of the trace can be detected only at the left-hand edge of the screen. Maximum measurement speed is as usual achieved with the display switched off.

In the example below, a GSM pulse sequence of 8 pulses is measured with 5 μ s trigger offset, 434 μ s measurement time/pulse, video trigger with 50% trigger threshold, and peak detection:

```

REM *****
Public Sub MultiBurstPower()
result$ = Space$(200)
'----- R&S FSL default setting -----
CALL SetupStatusReg           'Configure status register
CALL InstrWrite(analyzer,"*RST") 'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep mode
CALL InstrWrite(analyzer,"SYST:DISP:UPD OFF")
                                'OFF: display off
'----- Perform measurement and query results -----
cmd$ = "MPOW? "
cmd$ = cmd$ + "935.2 MHZ,"      'Center frequency
cmd$ = cmd$ + "1MHZ,"          'Resolution bandwidth
cmd$ = cmd$ + "434US,"         'Measurement time
cmd$ = cmd$ + "VID,"           'Trigger source
cmd$ = cmd$ + "50PCT,"         'Trigger threshold
cmd$ = cmd$ + "1US,"           'Trigger offset, must be > 125 ns
cmd$ = cmd$ + "PEAK,"          'Peak detector
cmd$ = cmd$ + "8"              'Number of bursts
CALL InstrWrite(analyzer, cmd$)
CALL InstrRead(analyzer, result$) 'Read results
Print result$
END SUB
REM *****

```

Fast Level Measurement Using Frequency Lists

A typical task for the R&S FSL is power measurement at a number of frequency points, e.g. at multiples of the fundamental (harmonics measurement), or at frequencies defined by a mobile radio standard (e.g. spectrum due to transients at ± 200 kHz, ± 400 kHz, etc about the carrier frequency of a GSM signal). In many cases, different level and/or bandwidth settings are required for the different frequency points to match the channel spacing and meet the requirements of dynamic range.

Especially for this application, the R&S FSL offers a number of remote-control functions (commands available in SENSE:LIST subsystem) that allow level measurement based on a frequency list with different instrument settings assigned to different frequencies. Not only the frequency list can be programmed, but also the measurement types (PEAK, RMS, AVG) to be performed simultaneously can be selected.

The example below describes a harmonics measurement on a dual-band amplifier. The harmonics level in general decreases as the frequency increases. To boost measurement sensitivity, therefore, the reference level is lowered by 10 dB from the third harmonic.

The following settings are used:

Reference level: 10.00 dBm up to first harmonic, 0 dBm from 2nd harmonic
 RF attenuation: 20 dB
 Electronic attenuation: 0 dB (OFF)
 Filter type: NORMal
 RBW: 1 MHz
 VBW: 3 MHz
 Measurement time: 300 μ s
 Trigger delay: 100 μ s
 Trigger: video, 45 %

| Frequency | Type |
|------------|-----------------------|
| 935.2 MHz | GSM 900 fundamental |
| 1805.2 MHz | GSM 1800 fundamental |
| 1870.4 MHz | GSM 900 2nd harmonic |
| 2805.6 MHz | GSM 900 3rd harmonic |
| 3610.4 MHz | GSM 1800 2nd harmonic |
| 3740.8 MHz | GSM 900 4th harmonic |
| 5815.6 MHz | GSM 1800 3rd Harmonic |

The frequencies are selected in ascending order to minimize system-inherent waiting times resulting from frequency changes.

At each frequency point the peak power and the rms power are measured. The peak power and the rms power values are stored alternately in the results memory.

REM *****

Public Sub FrequencyList()

result\$ = Space\$(500)

'----- R&S FSL default setting -----

```
CALL SetupStatusReg           'Configure status register
CALL InstrWrite(analyzer,"*RST") 'Reset instrument
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep mode
CALL InstrWrite(analyzer,"SYST:DISP:UPD OFF") 'Display off
```

```
'-----Configure R&S FSL for power measurement based on frequency list -
CALL InstrWrite(analyzer, "TRIG:LEV:IFP -20dBm")
                                     'Set IF power trigger level
CALL InstrWrite(analyzer, "LIST:POWer:SET ON,ON,OFF,IFP,POS,100us,0")
'----- Perform measurement and query results -----
cmd$ = "LIST:POWer?"
cmd$ = cmd$ + "935.2MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "1805.2MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "1870.4MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "2805.6MHZ,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "3610.4MHZ,10dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "3740.8MHZ,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0,"
cmd$ = cmd$ + "5815.6MHZ,0dBm,20dB,OFF,NORM,1MHz,3MHz,300us,0"
CALL InstrWrite(analyzer, cmd$)
CALL InstrRead(analyzer, result$)
Print result$
END SUB
REM *****
```

Level Correction of Transducers (Definition of Transducer Factors)

In more complex test systems, the frequency response of the test setup must be taken into account in all power measurements to avoid any measurement errors being introduced from sources other than the DUT.

The R&S FSL offers the possibility of defining a frequency-dependent attenuation correction factor (transducer factor).

In the example below, a factor with the following characteristics is defined:

| | |
|-----------|----------------------------|
| Name: | Transtest |
| Unit: | dB |
| Scaling: | lin |
| Comment: | simulated cable correction |
| Frequency | Level |
| 10 MHz | 0 dB |
| 100 MHz | 3 dB |
| 1 GHz | 7 dB |
| 3 GHz | 10 dB |

The factor is defined and can be activated as required.

```

REM *****
Public Sub TransducerFactor()
'----- Define transducer factor -----
CALL InstrWrite(analyzer,"CORR:TRAN:SEL 'TRANSTEST'")
                                'Define "Transtest"
                                'transducer factor
CALL InstrWrite(analyzer,"CORR:TRAN:UNIT 'DB'")
                                'Unit 'dB'
CALL InstrWrite(analyzer,"CORR:TRAN:SCAL LIN")
                                'Linear frequency axis
CALL InstrWrite(analyzer,"CORR:TRAN:COMM 'Simulated cable correction'")
cmd$ = "CORR:TRAN:DATA "
                                'Enter frequency and level
cmd$ = cmd$ + "10MHz, 0,"
                                'values. Level values without
cmd$ = cmd$ + "100MHz, 3,"
                                'unit!
cmd$ = cmd$ + "1GHz, 7,"
cmd$ = cmd$ + "3GHz, 10"
CALL InstrWrite(analyzer,cmd$)
                                'Enter frequency and level values
'----- Activate transducer -----
CALL InstrWrite(analyzer,"CORR:TRAN:STAT ON")
                                'Activate transducer factor
END SUB
REM *****

```

Reading Trace Data

In the following example, the trace data recorded together at the default setting is read out and displayed on the screen in the form of a list. Reading is performed consecutively in the binary format and in the ASCII format, at span > 0 and also at span = 0.

In the binary format the message header is evaluated with the length information and used to calculate the x axis values.

In the ASCII format only the list of level values is output.

The binary data is read out in 3 steps:

1. Reading the number of digits of the length information
2. Reading the length information
3. Reading trace data

This procedure is necessary with programming languages that support only structures with similar data types (arrays) (such as Visual Basic) since the data types of header and data differ in binary data.

REM *****

Public Sub ReadTrace()

```
'----- Define variables -----
Dim traceData(1250) As Single      'Buffer for floating point
                                   'binary data
Dim digits As Byte                 'Number of digits of
                                   'length information
Dim traceBytes As Integer          'Length of trace data in bytes
Dim traceValues As Integer         'Number of values in buffer
Dim retCount As Integer            'Return count from read
asciiResult$ = Space$(25000)      'Buffer for ASCII trace data
result$ = Space$(100)              'Buffer for simple results
startFreq$ = Space$(100)          'Buffer for start frequency
span$ = Space$(100)                'Buffer for span

'----- R&S FSL default setting -----
CALL SetupInstrument                'Default setting
CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep
CALL InstrWrite(analyzer,"INIT;*WAI")  'Perform sweep with sync

'----- Define span for read out -----
CALL InstrWrite(analyzer,"FREQ:START?") 'Read out start frequency
CALL InstrRead(analyzer,startFreq$)
startFreq = Val(startFreq$)
CALL InstrWrite(analyzer,"FREQ:SPAN?")  'Read out span
CALL InstrRead(analyzer,span$)
span = Val(span$)

'----- Read out in binary format -----
CALL InstrWrite(analyzer, "FORMAT REAL,32")
                                   'Select binary format
CALL InstrWrite(analyzer, "TRAC1? TRACE1")
                                   'Read out trace 1
CALL viRead(analyzer, result$, 2, retCount)
                                   'Read out and store
digits = Val(Mid$(result$, 2, 1))    'number of digits of
                                   'length information
result$ = Space$(100)                'Initialize buffer again
CALL viRead(analyzer, result$, digits, retCount)
                                   'Read out
traceBytes = Val(Left$(result$, digits)) 'and store length information
CALL viRead(analyzer, traceData(0), traceBytes, retCount)
                                   'Read trace data into buffer
CALL viRead(analyzer, result$, 1, retCount)
                                   'Read the terminator <NL>
```

R&S FSL Measuring the Magnitude and Phase of a Signal (I/Q Data Acquisition)

```
'----- Read out binary data as pairs of frequency/level values -----
traceValues = traceBytes/4           'Single precision = 4 bytes
stepsize = span/traceValues         'Calculate frequency step width
For i = 0 To traceValues - 1
  Print "Value["; i; "] = "; startFreq+stepsize*i; ", "; traceData(i)
Next i

'----- Time domain default setting -----
CALL InstrWrite(analyzer,"FREQ:SPAN 0Hz") Switchover to time domain
CALL InstrWrite(analyzer,"INIT;*WAI")     'Perform sweep with sync

'----- Read out in ASCII format -----
CALL InstrWrite(analyzer,"FORMAT ASCII")  'Select ASCII format
CALL InstrWrite(analyzer,"TRAC1? TRACE1") 'Read out Trace 1
CALL InstrRead(analyzer, asciiResult$)
Print "Contents of Trace1: ",asciiResult$ 'Output
END SUB
REM *****
```

Measuring the Magnitude and Phase of a Signal (I/Q Data Acquisition)

Due to the R&S FSL's internal architecture, it is capable of measuring and outputting the magnitude and phase of a signal in addition to its power values. This opens up a variety of possibilities for more in-depth analysis (FFT, demodulation, etc).

I/Q data is stored in memory areas each containing 128 k words. Hardware triggering controls the memory.

The following example shows the steps necessary to collect data at a predefined sampling rate and read it from the I/Q memory.

Data is output in the form of voltage values referred to the analyzer input. Data can be read in binary or ASCII format.

In binary format, the length information carried in the message header is evaluated and used for calculating the x axis values.

In ASCII format, only a list of voltage values is output.

Binary data is read in three steps:

1. The number of digits carrying the length information is read.
2. The length information itself is read.
3. The trace data is read.

This procedure is necessary with programming languages like Visual Basic which support only structures of identical data types (arrays), whereas the binary data format uses different data types in the header and the data section.

Note: *The arrays for measured data are dimensioned in such a way that they can accommodate the I/Q data of the R&S FSL (2 * 128 k * 4 byte).*

Measuring the Magnitude and Phase of a Signal (I/Q Data Acquisition) R&S FSL

REM *****

Public Sub ReadIQData()

```
'----- Create variables -----
Dim IData(131072) As Single           'Buffer for floating-point
                                      'I data (= 128*1024 bytes)
Dim QData(131072) As Single           'Buffer for floating-point
                                      'Q data (= 128*1024 bytes)
                                      'Note:
                                      'Visual Basic cannot read in
                                      'data volumes larger than
                                      '128k words!
Dim digits As Byte                    'No. of digits as length
Dim IQBytes As Long                   'Length of trace data in bytes
Dim IQValues As Long                  'No. of meas. values in buffer
Dim retCount As Integer               'Return count from read
asciiResult$ = Space$(6553600)        'Buffer for ASCII I/Q data
                                      '(= 25*2*1024 bytes)
result$ = Space$(100)                 'Buffer for simple results
'----- Default setting -----
CALL SetupInstrument                  'Default setting
CALL InstrWrite(analyzer,"TRAC:IQ:STAT ON")
                                      'Activate I/Q data
                                      'acquisition mode; must be
                                      'done before TRAC:IQ:SET !
                                      'Select number of test points
                                      '(= 128 * 1024 - 512) at
                                      'RBW 10 MHz, 'sample rate 32 MHz,
                                      'trigger free run, pos. trigger
                                      'edge and 0 s trigger delay.
CALL InstrWrite(analyzer,"TRAC:IQ:SET NORM,10MHz,32MHz,IMM,POS,0,130560")
'----- Read-out in binary format-----
CALL InstrWrite(analyzer, "FORMAT REAL,32")
                                      'Set binary format
CALL InstrWrite(analyzer, "TRAC:IQ:DATA?")
                                      'Measure + read out I/Q data
CALL viRead(analyzer, result$, 2, retCount)
                                      'Read and store length for
digits = Val(Mid$(result$, 2, 1))     'number of digits
result$ = Space$(100)                 'Re-initialize buffer
CALL viRead(analyzer, result$, digits, retCount)
                                      'Read and store length
IQBytes = Val(Left$(result$, digits))
IQBytes = IQBytes / 2                  'Divide no. per buffer in half
CALL viRead(analyzer, IData(0), IQBytes, retCount)
                                      'Read I data in buffer
CALL viRead(analyzer, QData(0), IQBytes, retCount)
                                      'Read Q data in buffer
```



```

CALL viRead(analyzer, result$, 1, retCount)
                                     'Read in end character <NL>
'----- Output of binary data as frequency/level pair -----
IQValues = IQBytes/4                 'Single Precision = 4 Bytes
For i = 0 To IQValues - 1
  Print "I-Value["; i; "] = "; IData(i)
  Print "Q-Value["; i; "] = "; QData(i)
Next i
'----- Read-out in ASCII format -----
CALL InstrWrite(analyzer, "FORMAT ASCII") 'Set ASCII format
CALL InstrWrite(analyzer, "TRAC:IQ:DATA?")
                                     'Re-measure and read out
                                     'I/Q data

CALL InstrRead(analyzer, asciiResult$)
CALL InstrWrite(analyzer, "TRAC:IQ:STAT OFF")
                                     'Stop I/Q data aquisition
                                     'mode if no further
                                     'measurements are to be
                                     'done

END SUB
REM *****

```

Averaging I/Q Data

The R&S FSL has averaging capability also for I/Q measurements, i.e. I/Q data can be averaged over several test runs. This is subject to the following conditions:

1. An external trigger signal must be available for data measurement, and the trigger signal must be phase-locked to the signal measured.
2. The same reference-frequency signal must be used for the DUT and the R&S FSL.
3. The sampling rate must be 32 MHz, since only with this sampling frequency will the measurement be performed phase-synchronous with the trigger signal.

If all of the above conditions are fulfilled, no phase shift will occur between consecutive test runs. Phase shift may falsify the measured average so that in extreme cases a value of 0 is obtained.

The default setting of the instrument for data measurement without averaging has to be changed as follows:

```

REM *****
'----- R&S FSL default setting -----
CALL SetupInstrument           'Default setting
CALL InstrWrite(analyzer,"TRAC:IQ:STAT ON")
                                'Activate I/Q data acquisition
                                'mode; this must be
                                'done before TRAC:IQ:SET!
'Select max. number of test points (= 128 * 1024 - 512) at 10 MHz RBW,
                                '32 MHz sampling rate, external
                                'trigger, pos. trigger edge and
                                '0 s trigger delay.
CALL InstrWrite(analyzer,"TRAC:IQ:SET NORM,10MHz,32MHz,EXT,POS,0,130560")
CALL InstrWrite(analyzer,"TRAC:IQ:AVER ON")  'Switch on I/Q averaging
CALL InstrWrite(analyzer,"TRAC:IQ:AVER:COUN 10")      'Set 10 test runs
'----- Read data in binary format -----
...
REM *****

```

Storing and Loading Device Settings

Storing Instrument Settings

In the following example, the settings/measurement data to be stored are determined; only the hardware settings are stored. The selection commands for the other settings are indicated with the status OFF for the sake of completeness.

```

REM *****
Public Sub StoreSettings()
'This subroutine selects the settings to be stored and creates
'the data set "TEST1" in directory C:\R_S\Instr\user. It uses
'the default setting and resets the instrument after storage
'of the setting.
'----- R&S FSL default setting -----
CALL SetupInstrument
CALL InstrWrite(analyzer,"INIT:CONT OFF")  'Single sweep
CALL InstrWrite(analyzer,"INIT;*WAI")      'Perform sweep with sync
'----- Select items to be stored -----
CALL InstrWrite(analyzer,"MMEM:SEL:HWS ON")
                                'Save hardware settings
CALL InstrWrite(analyzer,"MMEM:SEL:TRAC OFF")
                                'No storing of traces
CALL InstrWrite(analyzer,"MMEM:SEL:LIN:ALL OFF")
                                'Save only active limit lines

```

```

'----- Define comment -----
CALL InstrWrite(analyzer,"MMEM:COMM 'Test Setup'")
'----- Store selected items -----
CALL InstrWrite(analyzer,"MMEM:STOR:STAT 1,'C:\R_S\Instr\user\TEST1'")
'----- Reset instrument -----
CALL InstrWrite(analyzer,"*RST")
END SUB
REM *****

```

Loading Device Settings

In the following example, data set TEST1 stored under C:\R_S\Instr\user is reloaded into the instrument:

```

REM *****
Public Sub LoadSettings()
'This subroutine loads data set "TEST1" in directory C:\R_S\Instr\user.
'----- Default setting of status register -----
CALL SetupStatusReg           'Configure status register
'----- Load data set -----
CALL InstrWrite(analyzer,"MMEM:LOAD:STAT 1,'C:\R_S\Instr\user\TEST1'")
'----Start measurement using the data set loaded -----
CALL InstrWrite(analyzer,"DISP:TRAC1:MODE WRITE")
                                'Set trace to Clr/Write
CALL InstrWrite(analyzer,"INIT;*WAI")    'Start the sweep
END SUB
REM *****

```

Reading and Writing Files

Reading a File from the Instrument

In the following example, the TEST1.FSL.DFL file stored under C:\R_S\Instr\user is read from the instrument and stored in the controller.

```

REM *****
Public Sub ReadFile()
'----- Generate variables -----
Dim digits As Byte           'Number of digits of
                             'length information
Dim fileBytes As Long       'Length of file with trace data
                             'in bytes
result$ = Space$(100)       'Buffer for simple results
'----- Default setting of status register -----
CALL SetupStatusReg         'Configure status register
'----- Read out file -----
CALL InstrWrite(analyzer, "MMEM:DATA? 'C:\R_S\Instr\user\TEST1.FSL.DFL'")
                             'Select file
CALL ilrd(analyzer, result$, 2) 'Read and store number of
digits = Val(Mid$(result$, 2, 1)) 'digits of length information
CALL ilrd(analyzer, result$, digits) 'Read and store length
fileBytes = Val(Left$(result$, digits)) 'information
FileBuffer$ = Space$(fileBytes) 'Buffer for file
CALL ilrd(analyzer, FileBuffer, fileBytes) 'Read file into buffer
CALL ilrd(analyzer, result$, 1) 'Read terminator <NL>
'----- Store file to controller -----
Open "TEST1.FSL.DFL" For Output As #1
Print #1, FileBuffer;      ' ; to avoid linefeed at
                             ' end of file

Close #1
END SUB
REM *****

```

Creating a File on the Instrument

In the following example, the TEST1.FSL.DFL file available on the controller is stored in the instrument under C:\R_S\Instr\user\DUPLICAT.FSL.DFL.

```

REM *****
Public Sub WriteFile()
'----- Generate variables -----
FileBuffer$ = Space$(100000)           'Buffer for file
Dim digits As Long                     'Number of digits of
                                       'length information
Dim fileBytes As Long                  'Length of file in bytes
fileSize$ = Space$(100)                'Length of file as a string
result$ = Space$(100)                 'Buffer for simple results
'----- Default setting of status register -----
CALL SetupStatusReg                   'Configure status register
'----- Prepare the definite length block data -----
fileBytes = FileLen("H:\work\vb\test1.set")
                                       'Determine length of file
fileSize$ = Str$(fileBytes)
digits = Len(fileSize$) - 1           'Determine number of digits of
fileSize$ = Right$(fileSize$, digits) 'length information
FileBuffer$ = "#" + Right$(Str$(digits), 1) + fileSize$
                                       'Store length information in
                                       'file buffer
'----- Read file from controller -----
Open "H:\work\vb\TEST1.FSL.DFL" For Binary As #1
FileBuffer$ = FileBuffer$ + Left$(Input(fileBytes, #1), fileBytes)
Close #1
'----- Write file -----
CALL InstrWrite(analyzer, "SYST:COMM:GPIB:RTER EOI") 'Set receive
                                                    'terminator on the
                                                    'instrument
CALL InstrWrite(analyzer, "MMEM:DATA 'file \DUPLICAT.FSL.DFL'," +
  FileBuffer$) 'Select file
END SUB
REM *****

```

Configuring and Starting a Printout

The following example shows the configuration of the output format and output device for printing out the measurement screen.

Proceed in the following order:

1. Set the measurement required for the printout
2. Query available output devices
3. Select an output device
4. Select the output interface
5. Configure the output format
6. Start printout with synchronization to the end

It is assumed that the setting required is a signal with a power of -20 dBm at 100 MHz and that the printer required is the No. 6 of the printers available. The data is first output on the selected printer, then to a file.

REM *****

Public Sub HCopy()

DIM Devices(100) as string 'Buffer for printer name

FOR i = 0 TO 49

 Devices\$(i) = Space\$(50) 'Preallocate buffer for
 'printer name

NEXT i

'----- **R&S FSL default setting** -----

CALL SetupStatusReg 'Configure status register

CALL InstrWrite(analyzer,"*RST") 'Reset instrument

CALL InstrWrite(analyzer,"INIT:CONT OFF") 'Single sweep

CALL InstrWrite(analyzer,"SYST:DISP:UPD ON")
 'Display on

'----- **Configure measurement** -----

CALL InstrWrite(analyzer,"FREQ:CENT 100MHz;SPAN 10MHz")
 'Set frequency

CALL InstrWrite(analyzer,"DISP:WIND:TRAC:Y:RLEV -10dBm")
 'Reference level

CALL InstrWrite(analyzer,"INIT;*WAI") 'Perform measurement

```

'----- Query regarding available output devices -----
CALL InstrWrite(analyzer,"SYST:COMM:PRIN:ENUM:FIRST?")
                                'Read out first output
CALL InstrRead(analyzer,Devices$(0))    'device and indicate
Debug.Print "Printer 0: "+Devices$(0)    'name
For i = 1 to 99
    CALL InstrWrite(analyzer,"SYST:COMM:PRIN:ENUM:NEXT?")
                                'Read out the next
    CALL InstrRead(analyzer,Devices$(i))  'printer name
    IF Left$(Devices$(i),2) = "" THEN GOTO SelectDevice
                                'Abort at end of list
    Debug.Print "Printer"+Str$(i)+" : " Devices$(i)
                                'Indicate printer name
NEXT i
SelectDevice:
'----- Select device, printer language and output interface -----
CALL InstrWrite(analyzer,"SYST:COMM:PRIN:SEL "+ Devices(6))
                                'Select printer #6
CALL InstrWrite(analyzer,"HCOP:DEST 'SYST:COMM:PRIN'")
                                'Configuration:
                                '"Output to printer interface"
CALL InstrWrite(analyzer,"HCOP:DEV:LANG GDI")
                                'Output language 'GDI'
'----- Select orientation (portrait/landscape) and color/BW -----
CALL InstrWrite(analyzer,"HCOP:PAGE:ORI PORTRait")
                                'Portrait
CALL InstrWrite(analyzer,"HCOP:DEV:COL OFF")
                                'Black and white
'----- Configure and start print out -----
CALL InstrWrite(analyzer,"HCOP:ITEM:ALL")
                                'Select complete screen
'CALL InstrWrite(analyzer,"HCOP:ITEM:WIND:TRAC:STAT ON")
                                'alternative: only traces
CALL InstrWrite(analyzer,"*CLS")      'Reset status registers
CALL InstrWrite(analyzer,"HCOP:IMMediate;*OPC")
                                'Start print out
CALL viEnableEvent(vi, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                            'Wait for service request
IF (status = VI_SUCCESS) THEN CALL Srq  'If SRQ is recognized =>
                                'Subroutine for evaluation

```

```
'---- Print out into file in WMF format (BMP format) -----
CALL InstrWrite(analyzer,"HCOP:DEST 'MMEM'")
                                'Configuration: "Print to file"
CALL InstrWrite(analyzer,"HCOP:DEV:LANG WMF")
                                'File format WMF
'CALL InstrWrite(analyzer,"HCOP:DEV:LANG BMP")
                                'File format BMP
CALL InstrWrite(analyzer,"MMEM:NAME 'C:\R_S\Instr\user\PRINT1.WMF'")
                                'Determine file name
CALL InstrWrite(analyzer,"*CLS")
                                'Reset status registers
CALL InstrWrite(analyzer,"HCOP:IMMEDIATE;*OPC")
                                'Start print out
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)
                                'Wait for service request
IF (status = VI_SUCCESS) THEN CALL Srq
                                'If SRQ is recognized =>
                                'Subroutine for evaluation

END SUB
REM *****
```


Programming Examples of the WLAN TX Measurements Option (K91)

The following section provides some examples of commonly performed operations when using the WLAN TX Measurements option (K91). For more general remote control examples refer to the programming examples chapter in the instrument user manual.

This option is available from firmware version 1.20.

Synchronization Entry of Option

The following example shows how to synchronize entering the WLAN TX Measurements option.

```
analyzer = 20                                'Instrument address
CALL InstrWrite(analyzer, "INST:SEL WLAN;*OPC?")
                                                'waits for 1 from *OPC?
```

Selecting Measurements

Measurements are selected using the command `CONFigure:BURSt:<Meas Type>` where `<Meas Type>` is as follows:

| <Meas Type> | Measurement Type |
|---------------------------|----------------------------------|
| PVT | Power vs Time (PVT) |
| PVT:SElect:EDGE | PVT rising and falling edge |
| PVT:SElect:FULL | PVT full burst (802.11a only) |
| PVT:SElect:RISE | PVT rising burst (802.11b only) |
| PVT:SElect:FALL | PVT falling burst (802.11b only) |
| EVM:ECARrier | EVM vs Carrier |
| EVM:ESYMBOL | EVM vs Symbol |
| SPECTrum:MASK | Spectrum Mask |
| SPECTrum:MASK:SElect:IEEE | Spectrum Mask IEEE |
| SPECTrum:MASK:SElect:ETSI | Spectrum Mask ETSI |
| SPECTrum:FLATness | Spectrum Flatness |
| SPECTrum:FFT | Spectrum FFT |
| SPECTrum:ACPR | Spectrum ACPR |
| CONStellation:CCARrier | Constellation vs Carrier |
| CONStellation:CSYMBOL | Constellation vs Symbol |

| <Meas Type> | Measurement Type |
|--------------------|------------------|
| STATistics:CCDF | CCDF |
| STATistics:BSTReam | Bit Steam |
| STATistics:SField | Signal Field |

The following example shows how to select a Spectrum Mask ETSI measurement:

```
REM select Spectrum Mask Select ETSI
CALL InstrWrite(analyzer, "SPECTrum:MASK:SElect:ETSI")
```

Running Synchronized Measurements

The following examples show how measurements can be synchronized. Synchronization is necessary to ensure that the measurement has completed before the measurement results and markers are requested.

PUBLIC SUB SweepSync ()

```
REM The command INITiate[:IMMEDIATE] starts a single sweep if the
REM command INIT:CONT OFF was previously sent. It should be ensured that
REM the next command is only then executed when the entire sweep is
REM complete.
CALL InstrWrite(analyzer, "INIT:CONT OFF")
REM ----- First possibility: Use of *WAI -----
CALL InstrWrite(analyzer, "INIT:IMM;*WAI")
REM ----- Second possibility: Use of *OPC? -----
OpcOk$ = SPACE$(2) 'Space for *OPC?          'Provide response
CALL InstrWrite(analyzer, "INIT:IMM;*OPC?")
REM ----- Here the controller can service other instrument-----
CALL InstrRead(analyzer, OpcOk$)           'Wait for "1" from *OPC?
REM ----- Third possibility: Use of *OPC -----
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM the GPIB configuration
REM (e.g. Windows Start menu: Settings -> Control Panel -> GPIB)!
CALL InstrWrite(analyzer, "*SRE 32")      'Permit service request for ESR
CALL InstrWrite(analyzer, "*ESE 1")      'Set event-enable bit for
                                          'operation-complete bit
CALL InstrWrite(analyzer, "INIT:IMM;*OPC") 'Start sweep and
'synchronize with OPC
status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                                'Wait for service request
```

```
REM ----- Fourth possibility: Use of INIT:IMM -----
REM In order to be able to use the service request function in
REM conjugation with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM the GPIB configuration
REM (e.g. Windows Start menu: Settings -> Control Panel -> GPIB)!
CALL InstrWrite(analyzer, "*SRE 128")      'Permit service request for ESR
CALL InstrWrite(analyzer, "*ESE 0")        'Set event-enable bit for
                                           'operation-complete bit
CALL InstrWrite(analyzer, "STATus:OPERation:ENABLE 16")
                                           'Enable bit 4 of status operation
                                           'register'
CALL InstrWrite(analyzer, "STAT:OPERation:NTRansition 16")
                                           'Set Negative transition to 1
CALL InstrWrite(analyzer, "STATus:OPERation:PTRansition 0")
                                           'Set Positive transition to 0
CALL InstrWrite(analyzer, "INIT:IMM")      'Start sweep and synchronize with
                                           'OPC

status = viWaitOnEvent(vi, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
VI_NULL)                                'Wait for service request

REM Continue main program here.

END SUB

REM *****
```


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- Storing and Packing.....8.1**
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8 Maintenance

The following chapter contains information on the maintenance of the R&S FSL.

Follow the instructions in the service manual and the safety instructions when exchanging modules or ordering spares. The order no. for spare parts is included in the service manual. The service manual includes further information particularly on troubleshooting, repair, exchange of modules (including battery exchange, adjustment of the OCXO oscillator) and alignment.

The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of this manual.

Mechanical and Electrical Maintenance

The R&S FSL does not require any special maintenance. Remove any contamination on the instrument by means of a soft cloth. Make sure that the air vent is not obstructed.

Storing and Packing

The R&S FSL can be stored at a temperature of -5°C to $+60^{\circ}\text{C}$. When stored for an extended period of time the instrument should be protected against dust.

Repack the instrument as it was originally packed when transporting or shipping. The two protective foam plastic parts prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

List of Power Cables Available

Table 8–1 List of power cables available

| Stock No. | Earthed–contact connector | Preferably used in |
|------------------------------------|--|-----------------------------|
| DS 006.7013.00 | BS1363: 1967' complying with IEC 83: 1975 standard B2 | Great Britain |
| DS 006.7020.00 | Type 12 complying with SEV–regulation 1011.1059, standard sheet S 24 507 | Switzerland |
| DS 006.7036.00 | Type 498/13 complying with US–regulation UL 498, or with IEC 83 | USA/Canada |
| DS 006.7107.00 | Type SAA3 10 A, 250 V, complying with AS C112–1964 Ap. | Australia |
| DS 0025.2365.00 DS 0099.1456.00 | DIN 49 441, 10 A, 250 V, angular DIN 49 441, 10 A, 250 V, straight | Europe (except Switzerland) |

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9 Error Messages

Error messages are entered in the error/event queue of the status reporting system in the remote control mode and can be queried with the command `SYSTem:ERRor?`. The answer format of R&S FSL to the command is as follows:

```
<error code>, "<error text with queue query>;
<remote control command concerned>"
```

The indication of the remote control command with prefixed semicolon is optional.

Example:

The command `"TEST:COMMAND"` generates the following answer to the query `SYSTem:ERRor?` :

```
-113,"Undefined header;TEST:COMMAND"
```

The subsequent list contains the description of error texts displayed on the instrument.

Distinction is made between error messages defined by SCPI, which are marked by negative error codes, and the device-specific error messages for which positive error codes are used.

The right-hand column in the following tables contains the error text in bold which is entered in the error/event queue and can be read out by means of query `SYSTem:ERRor?`. A short explanation of the error cause is given below. The left-hand column contains the associated error code.

SCPI-Specific Error Messages

No Error

| Error code | Error text in the case of queue poll Error explanation |
|------------|---|
| 0 | No error This message is displayed if the error queue does not contain any entries. |

Command Error – Faulty command; sets bit 5 in the ESR register.

| Error code | Error text in the case of queue poll Error explanation |
|------------|--|
| -100 | Command Error The command is faulty or invalid. |
| -101 | Invalid Character The command contains an invalid sign. Example: A header contains an ampersand, " SENSe& ". |

| Error code | Error text in the case of queue poll Error explanation |
|------------|--|
| -102 | Syntax error The command is invalid. Example: The command contains block data the instrument does not accept. |
| -103 | Invalid separator The command contains an invalid sign instead of a separator. Example: A semicolon is missing after the command. |
| -104 | Data type error The command contains an invalid value indication. Example: ON is indicated instead of a numeric value for frequency setting. |
| -105 | GET not allowed A Group Execute Trigger (GET) is within a command line. |
| -108 | Parameter not allowed The command contains too many parameters. Example: Command SENSe:FREQuency:CENTer permits only one frequency indication. |
| -109 | Missing parameter The command contains too few parameters. Example: The command SENSe:FREQuency:CENTer requires a frequency indication. |
| -110 | Command header error The header of the command is faulty. |
| -111 | Header separator error The header contains an invalid separator. Example: the header is not followed by a "White Space", " *ESE255 " |
| -112 | Program mnemonic too long The header contains more than 12 characters. |
| -113 | Undefined header The header is not defined for the instrument. Example: *XYZ is undefined for every instrument. |
| -114 | Header suffix out of range The header contains an invalid numeric suffix. Example: SENSe3 does not exist in the instrument. |
| -120 | Numeric data error The command contains a faulty numeric parameter. |
| -121 | Invalid character in number A number contains an invalid character. Example: An "A" in a decimal number or a "9" in an octal number. |
| -123 | Exponent too large The absolute value of the exponent is greater than 32000. |
| -124 | Too many digits The number includes too many digits. |
| -128 | Numeric data not allowed The command includes a number which is not allowed at this position. Example: The command INPut:COUPLing requires indication of a text parameter. |
| -130 | Suffix error The command contains a faulty suffix. |

| Error code | Error text in the case of queue poll Error explanation |
|------------|--|
| -131 | Invalid suffix The suffix is invalid for this instrument. Example: nHz is not defined. |
| -134 | Suffix too long The suffix contains more than 12 characters. |
| -138 | Suffix not allowed A suffix is not allowed for this command or at this position of the command. Example: The command *RCL does not permit a suffix to be indicated. |
| -140 | Character data error The command contains a faulty text parameter |
| -141 | Invalid character data The text parameter either contains an invalid character or it is invalid for this command. Example: Write error with parameter indication;INPut:COUPLing XC. |
| -144 | Character data too long The text parameter contains more than 12 characters. |
| -148 | Character data not allowed The text parameter is not allowed for this command or at this position of the command. Example: The command *RCL requires a number to be indicated. |
| -150 | String data error The command contains a faulty string. |
| -151 | Invalid string data The command contains a faulty string. Example: An END message has been received prior to the terminating apostrophe. |
| -158 | String data not allowed The command contains an allowed string at an invalid position. Example: A text parameter is set in quotation marks, INPut:COUPLing "DC" |
| -160 | Block data error The command contains faulty block data. |
| -161 | Invalid block data The command contains faulty block data. Example: An END message was received prior to reception of the expected number of data. |
| -168 | Block data not allowed The command contains allowed block data at an invalid position. Example: The command *RCL requires a number to be indicated. |
| -170 | Expression error The command contains an invalid mathematical expression. |
| -171 | Invalid expression The command contains an invalid mathematical expression. Example: The expression contains mismatching parentheses. |
| -178 | Expression data not allowed The command contains a mathematical expression at an invalid position. |

Execution Error – Error on execution of a command; sets bit 4 in the ESR register

| Error code | Error text in the case of queue poll Error explanation |
|------------|---|
| -200 | Execution error Error on execution of the command. |
| -201 | Invalid while in local The command is not executable while the device is in local due to a hard local control. Example: The device receives a command which would change the rotary knob state, but the device is in local so the command can not be executed. |
| -202 | Settings lost due to rtl A setting associated with hard local control was lost when the device changed to LOCS from REMS or to LWLS from RWLS. |
| -210 | Trigger error Error on triggering the device. |
| -211 | Trigger ignored The trigger (GET, *TRG or trigger signal) was ignored because of device timing considerations. Example: The device was not ready to respond. |
| -212 | Arm ignored An arming signal was ignored by the device. |
| -213 | Init ignored Measurement initialization was ignored as another measurement was already in progress. |
| -214 | Trigger deadlock The trigger source for the initiation of measurement is set to GET and subsequent measurement is received. The measurement cannot be started until a GET is received, but the GET would cause an interrupted-error) |
| -215 | Arm deadlock The trigger source for the initiation of measurement is set to GET and subsequent measurement is received. The measurement cannot be started until a GET is received, but the GET would cause an interrupted-error. |
| -220 | Parameter error The command contains a faulty or invalid parameter. |
| -221 | Settings conflict There is a conflict between setting of parameter value and instrument state. |
| -222 | Data out of range The parameter value lies out of the allowed range of the instrument. |
| -223 | Too much data The command contains too many data. Example: The instrument does not have sufficient storage space. |
| -224 | Illegal parameter value The parameter value is invalid. Example: The text parameter is invalid , <code>TRIGger : SWEEp : SOURce TASTe</code> |
| -230 | Data corrupt or stale The data are incomplete or invalid. Example: The instrument has aborted a measurement. |
| -231 | Data questionable The measurement accuracy is suspect. |

| Error code | Error text in the case of queue poll Error explanation |
|-------------------|--|
| -240 | Hardware error The command cannot be executed due to problems with the instrument hardware. |
| -241 | Hardware missing Hardware is missing. Example: An option is not fitted. |
| -250 | Mass storage error A mass storage error occurred. |
| -251 | Missing mass storage The mass storage is missing. Example: An option is not installed. |
| -252 | Missing media The media is missing. Example: There is no floppy in the floppy disk drive. |
| -253 | Corrupt media The media is corrupt. Example: The floppy is bad or has the wrong format. |
| -254 | Media full The media is full. Example: There is no room on the floppy. |
| -255 | Directory full The media directory is full. |
| -256 | File name not found The file name cannot be found on the media. |
| -257 | File name error The file name is wrong. Example: An attempt is made to copy to a duplicate file name. |
| -258 | Media protected The media is protected. Example: The write-protect tab on the floppy is present. |
| -260 | Expression error The expression contains an error. |

Device Specific Error; sets bit 3 in the ESR register

| Error code | Error text in the case of queue poll Error explanation |
|-------------------|--|
| -300 | Device-specific error R&S FSL-specific error not defined in greater detail. |
| -310 | System error This error message suggests an error within the instrument. Please inform the R&S Service. |
| -313 | Calibration memory lost Loss of the non-volatile data stored using the *CAL? command. This error occurs when the correction data recording has failed. |

| Error code | Error test in the case of queue poll Error explanation |
|------------|--|
| -330 | Self-test failed The self test could not be executed. |
| -350 | Queue overflow This error code is entered in the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been accepted. The queue can accept 5 entries. |

Query Error – Error in data request; sets bit 2 in the ESR register

| Error code | Error text in the case of queue poll Error explanation |
|------------|---|
| -400 | Query error General error occurring when data are requested by a query. |
| -410 | Query INTERRUPTED The query has been interrupted. Example: After a query, the instrument receives new data before the response has been sent completely. |
| -420 | Query UNTERMINATED The query is incomplete. Example: The instrument is addressed as a talker and receives incomplete data. |
| -430 | Query DEADLOCKED The query cannot be processed. Example: The input and output buffers are full, the instrument cannot continue operation. |
| -440 | Query UNTERMINATED after indefinite response A query is in the same command line after a query which requests an indefinite response. |

Device-Specific Messages

| Error code | Error text in the case of queue poll Error explanation |
|------------|---|
| 1052 | Frontend LO is Unlocked This message is displayed when the phase regulation of the local oscillator fails in the RF front-end. |
| 1060 | Trigger-Block Gate Delay Error- gate length < Gate Delay This message is displayed when the gate signal length is not sufficient for the pull-in delay with a predefined gate delay. |
| 1064 | Tracking LO is Unlocked This message is displayed when the phase regulation of the local oscillator fails on the tracking generator module. |

| Error code | Error text in the case of queue poll Error explanation |
|------------|---|
| 2028 | Hardcopy not possible during measurement sequence This message is displayed when a printout is started during scan sequences that cannot be interrupted. Such sequences are for example: <ul style="list-style-type: none"> • Recording the system error correction data (alignment) • Instrument self test In such cases synchronization to the end of the scan sequence should be performed prior to starting the printout. |
| 2033 | Printer Not Available This message is displayed when the selected printer is not included in the list of available output devices. A possible cause is that the required printer driver is missing or incorrectly installed. |
| 2034 | CPU Temperature is too high This message is displayed when the temperature of the processor exceeds 70 °C. |

WLAN TX Measurements Option Messages (K91)

The list of possible warning & error messages are shown below.

This option is available from firmware version 1.20.

| Status Bar Message | Description |
|--|--|
| Gate length too small – must be greater than 1 | This message is only displayed for the FFT measurement. This message indicates that there are no samples contained within the gating lines. Increase the Gate length and then press the <i>REFRESH</i> hotkey to remove this error. |
| No valid analyzed bursts within gating lines | This message is only displayed for the PVT measurement. This message indicates that there are no complete & valid bursts contained within the gating lines. Increase the Gate length and then press the <i>REFRESH</i> hotkey to remove this error. |
| No bursts found | <p>This message is displayed if no valid burst was detected in the input data. To correct this problem check the following:</p> <p>The connections between the DUT and analyzer are correct</p> <p>The input signal is of a sufficient level</p> <p>The capture time is long enough to capture at least one complete burst. If running with a Free Run trigger then the capture time must be greater than the burst length (ideally at least twice the burst length) to ensure that a complete burst is recorded.</p> <p>Check that the demod settings are correct</p> |
| No bursts of desired type to analyze | This message is displayed if bursts are found, but none of desired type to analyse. Check that the setting for Burst Type is correct. |
| No signal found | This message is displayed when an automatic level detection measurement is executed and the measured signal level is lower the permitted minimum value. |
| No power trigger for Spectrum Mask ETSI | This message is displayed when the Spectrum Mask ETSI measurement is selected whilst the trigger is set to power. No action is required as the trigger is automatically set to Free Run in this case. |
| Signal overload detected | This message is displayed when the OVLD enhancement label is displayed and indicates that the input mixer is overloaded. If this message is displayed then try increasing the setting for the Signal Level parameter (or settings Auto Level). If this does not clear the problem then an external attenuation may need to be applied. |

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