Software Manual

WLAN 802.11A, B, G,J & N TX Tests Applications Firmware R&S® R&S FSQ-K90/K91/K91n

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ROHDE&SCHWARZ
Test and Measurement

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached 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, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies 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, if expressly permitted, also 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 any 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 product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

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 and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

					
ON/OFF supply voltage	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double (reinforced) insulation

Tags and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

indicates a hazardous situation which, if not avoided, will result in death or serious injury.

indicates a hazardous situation which, if not avoided, could result in death or serious injury.

indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

indicates the possibility of incorrect operation which can result in damage to the product.
In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency.
2. 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). An installation that is not carried out as described in the product documentation could result in personal injury or death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure 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.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. 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.
4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. 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.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. 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 licensed electrician.
13. 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 anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts 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 (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
7. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal

1. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
2. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Informaciones elementales de seguridad

Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad adjunto de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas 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 está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios.

Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Adver-tencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

					
Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.

ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.

ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.

AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, pueden causarse lesiones o incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, 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 bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. 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. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados, los llamados alérgenos (p. ej. el níquel). Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

6. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
7. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación

1. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
2. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Qualitätszertifikat
Certificate of quality
Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

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 Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde&Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

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 standards such as ISO 9001 and ISO 14001.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

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, entre autres, conformément aux normes ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de gestion de l'environnement certifié selon ISO 14001

ROHDE&SCHWARZ

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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

USA & Canada

Monday to Friday 8:00 AM – 8:00 PM	(except US public holidays) Eastern Standard Time (EST)
Tel. from USA From outside USA Fax	888-test-rsa (888-837-8772) (opt 2) +1 410 910 7800 (opt 2) +1 410 910 7801
E-mail	CustomerSupport@rohde-schwarz.com

East Asia

Monday to Friday 8:30 AM – 6:00 PM	(except Singaporean public holidays) Singapore Time (SGT)
Tel. Fax	+65 6 513 0488 +65 6 846 1090
E-mail	CustomerSupport@rohde-schwarz.com

Rest of the World

Monday to Friday 08:00 – 17:00	(except German public holidays) Central European Time (CET)
Tel. Fax	+49 89 4129 13774 +49 (0) 89 41 29 637 78
E-mail	CustomerSupport@rohde-schwarz.com

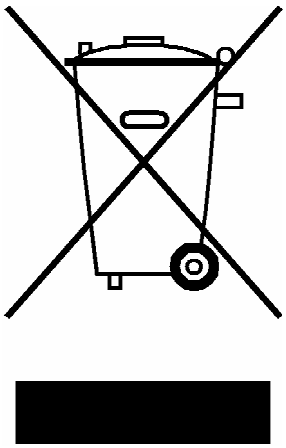
ROHDE&SCHWARZ

1171.0200.22-04.00

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).



Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.

ROHDE&SCHWARZ

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- Sales Locations
- Service Locations
- National Websites

Contents

1 General Information

The R&S FSQ-K90/K91/K91n application extends the functionality of the R&S FSQ spectrum analyzer to enable wireless LAN TX measurements in accordance with IEEE standards 802.11a (R&S FSQ-K90) and IEEE 802.11 a b,g, j & n (R&S FSQ-K91n).

This manual describes how to use R&S FSQ-K90/K91/K91n. It aids in the preparation, execution and evaluation of a measurement and provides many helpful hints and examples.

For quick instructions on using R&S FSQ-K90/K91/K91n, refer to the Quick Start Guide section below. It provides step-by-step descriptions of a typical measurement. The remainder of this section describes all basic information about how the R&S FSQ-K90/K91/K91n application works, without covering measurements in detail. A detailed description of all measurement modes, settings and results can be found in section 2. Section 4 covers remote control operation ofR&S FSQ-K90/K91/K91n.

This section covers the following topics:

Introduction to R&S FSQ-K90/K91/K91n & wireless LAN measurements

- Installation
- Starting the application
- Exiting the application
- Quick Start Guide – for quickly getting the application up-and-running
- Navigation
- Save/recall – saving & recalling user settings & measurement results
- Printing

Support

To send a request to Rohde & Schwarz it is necessary to create the support data via the Support softkey. The support data is stored under D:\USER\SUPPORT and comprises the following files:

- *.bin file option settings
- *.iqw file IQ-data
- *.txt file option and version list
- *.bmp screenshot

Note: All 4 files must be sent to Rohde & Schwarz.

For detailed information refer to the Support softkey on page 118

Introduction to WLAN 802.11A, B, G, J & N TX Tests

The use of an R&S FSQ spectrum analyzer with its high sensitivity enables the accurate and reproducible TX measurement of a wireless LAN device under test (DUT) in accordance with the standards specified for the device:

- Modulation formats:
  - IEEE 802.1j (10 MHz)
    - BPSK (3 & 4.5 Mbps)
    - QPSK (6 & 9 Mbps)
    - 16QAM (12 & 18 Mbps)
    - 64QAM (24 & 27 Mbps)
  - IEEE 802.11a, j (20 MHz) & g (OFDM)
    - BPSK (6 & 9 Mbps)
    - QPSK (12 & 18 Mbps)
    - 16QAM (24 & 36 Mbps)
    - 64QAM (48 & 54 Mbps)
  - IEEE 802.11a, j (10 MHz) & g (OFDM)
    - BPSK (6 & 9 Mbps)
    - QPSK (12 & 18 Mbps)
    - 16QAM (24 & 36 Mbps)
    - 64QAM (48 & 54 Mbps)
  - IEEE 802.11b & g (single carrier mode)
    - DBPSK (1 Mbps)
    - DQPSK (2 Mbps)
    - CCK (5.5 & 11 Mbps)
    - PBCC (5.5, 11 & 22 Mbps)
  - IEEE 802.11 OFDM Turbo Mode
    - BPSK (12 & 18 Mbps)
    - QPSK (24, 36 Mbps)
    - 16QAM(48, 72 Mbps)
    - 64QAM(96, 108 Mbps)
  - IEEE 802.11n (OFDM)
    - BPSK (6.5, 7.2, 13.5 & 15 Mbps)
    - QPSK (13, 14.4, 19.5, 21.7, 27, 30, 40,5 & 45 Mbps)
    - 16QAM(26, 28.9, 39, 43.3, 54, 60, 81 & 90 Mbps)
    - 64QAM(52, 57.8, 58.5, 65, 72.2, 108, 121.5, 135, 120, 135 & 150 Mbps)
- Modulation measurements:
  - Constellation diagram
  - Constellation diagram for each OFDM carrier
  - I/Q offset and I/Q imbalance
  - Carrier and symbol frequency errors
  - Modulation error (EVM) for each 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 100 ms (depending on selected standard), multiple sweeps possible for large number of bursts
- Freq/Phase Err vs. Preamble

Installation

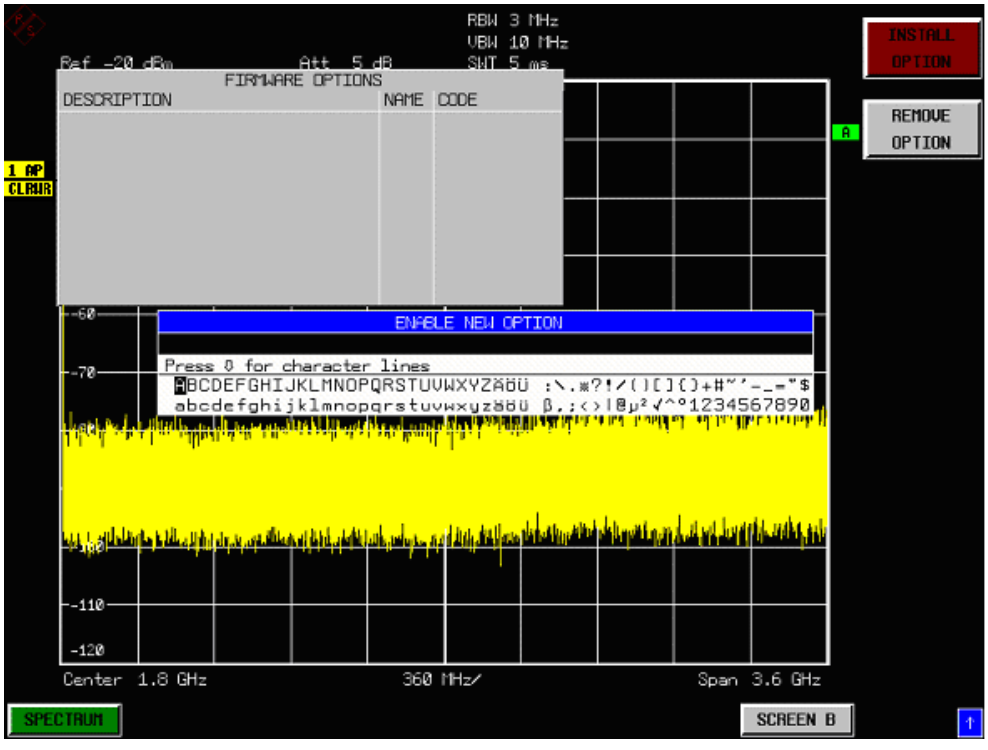
From the analyzer, select firmware update.

- Press the SETUP hardkey followed by NEXT, FIRMWARE UPDATE and finally the FIRMWARE UPDATE softkey. Follow the instructions displayed.

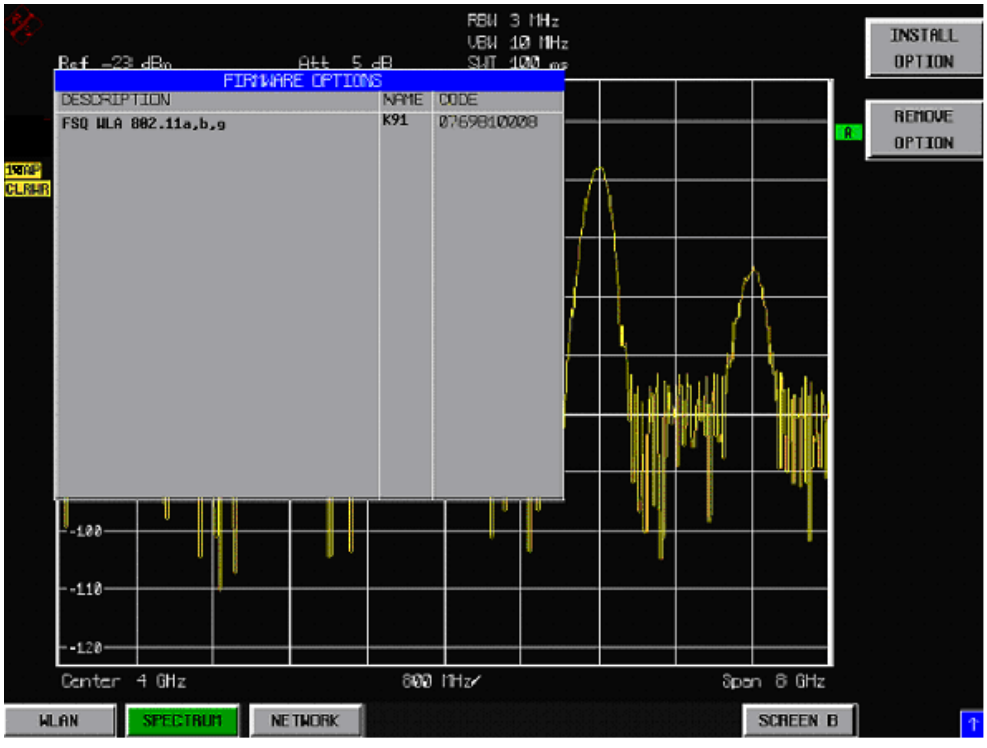
Once the installation has been completed, the analyzer will reboot.

Once the option has been installed, it needs to be activated:

- Start up the analyzer.
- Press the *SETUP* hardkey, followed by the *GENERAL SETUP* softkey and then the *OPTIONS* softkey. A list of the options currently activated is displayed.
- Press the *INSTALL OPTION* softkey. A dialog is displayed allowing the option key to be entered.



- Enter the option key supplied with the R&S FSQ-K90/K91/K91n software. If upgrading from R&S FSQ-K90 to R&S FSQ-K91 or R&S FSQ-K91n, the upgrade key needs to be entered in addition to the original R&S FSQ-K90 option key. An additional key is also required for IEEE 802.11n support
- When a valid option key has been supplied, a dialog will be displayed explaining that a reboot is required to complete this operation. Select OK in this dialog and the instrument will be rebooted.
- When the analyzer starts after the reboot, a new hotkey will be displayed at the bottom of the display labeled *WLAN.* In addition, an entry for the R&S FSQ-K90/K91/K91n option will be displayed in the *FIRMWARE OPTIONS* dialog.


RBW 3 MHz
VBW 10 MHz
SWT 100 ms
Ref -23 dBm
Att 5 dB
INSTALL OPTION
REMOVE OPTION
FIRMWARE OPTIONS
DESCRIPTION
NAME
CODE
FSQ WLA 802.11a,b,g
K91
0769810008
-100
-110
-120
Center 4 GHz
800 MHz/
Span 8 GHz
WLAN
SPECTRUM
NETWORK
SCREEN B

Starting the application

Power up the R&S FSQ spectrum analyzer. When R&S FSQ-K90/K91/K91n is correctly installed, a hotkey labeled *WLAN* will appear at the bottom of the screen. Press the *WLAN* hotkey to start R&S FSQ-K90/K91/K91n.

If the spectrum analyzer is powered down while R&S FSQ-K90/K91/K91n is active, the spectrum analyzer will start up in the R&S FSQ-K90/K91/K91n application when it is powered up again.

Exiting the application

To exit the R&S FSQ-K90/K91/K91n application, press the *SPECTRUM* hotkey at the bottom of the screen. This will cause the option to exit and the spectrum analyzer to be activated with the same settings as were set when the R&S FSQ-K90/K91/K91n option was activated.

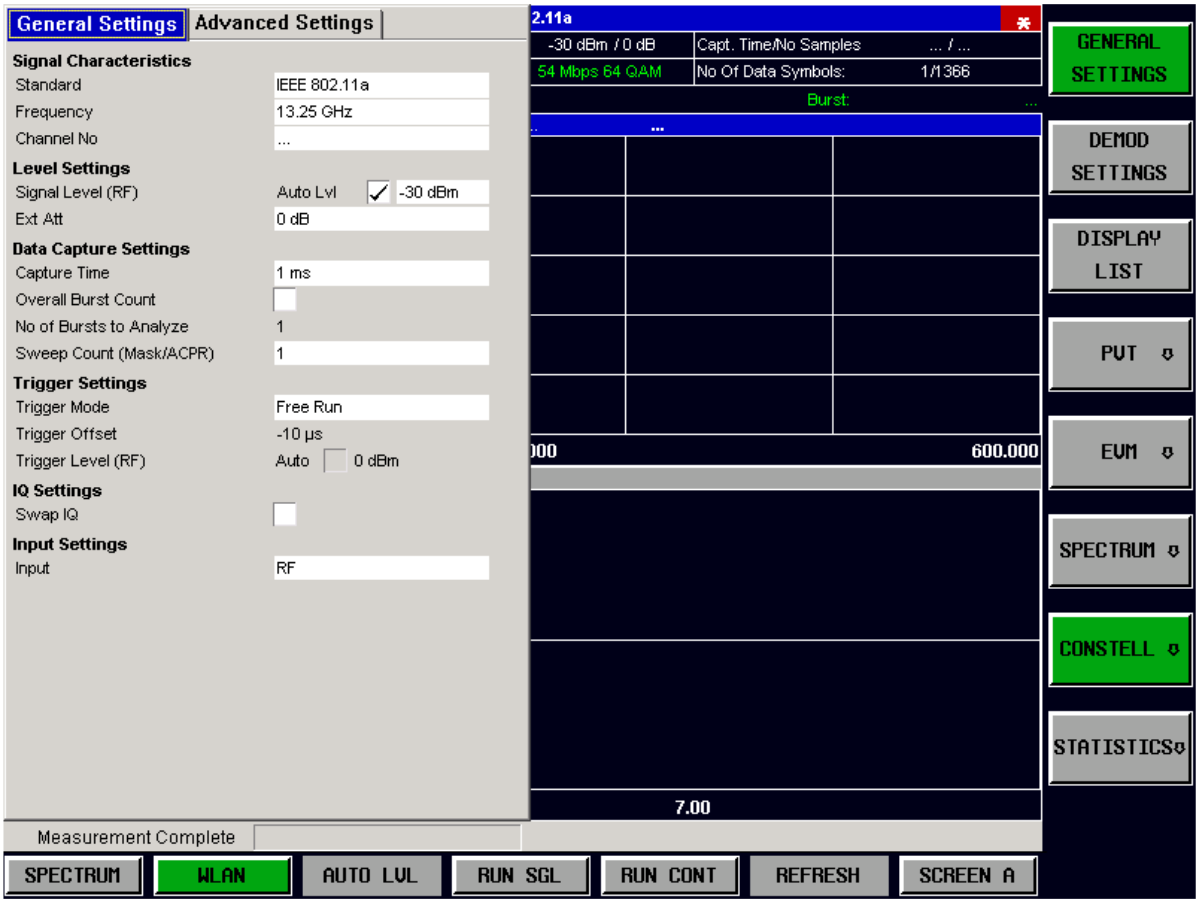
Quick Start Guide

This section helps the user to quickly become familiar with R&S FSQ-K90/K91/K91n by working step-by-step through an typical measurement. (Refer to section 2 for a detailed reference guide.)

This example will use a DUT based on IEEE 802.11a. The DUT will be connected to the analyzer using the RF input of the analyzer. The DUT will generate a signal modulated using 16QAM.

Setting up the measurement

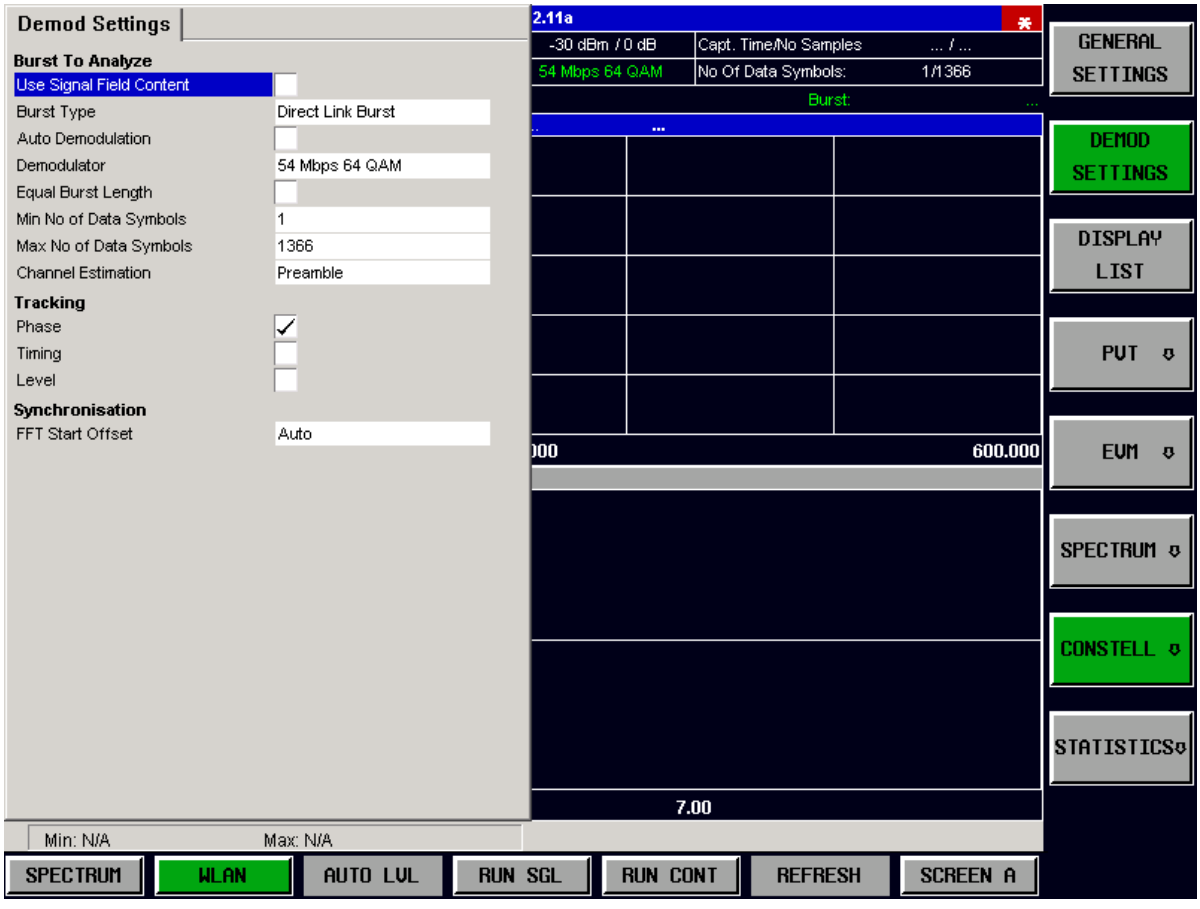
- Start the R&S FSQ-K90/K91/K91n application.
- Press the *GENERAL SETTINGS* softkey to open the General Settings view.



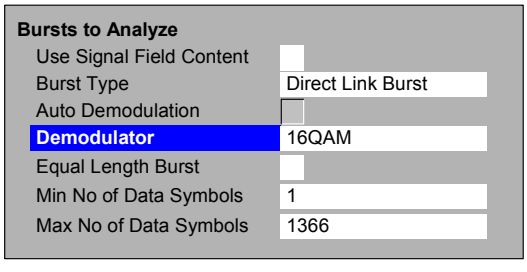
- Select the *Frequency* field (or use the FREQ key without opening the *GENERAL SETTINGS dialog box*) and enter the desired frequency to measure. Note that the *Channel No* field updates when a valid frequency is entered.
- Switch off the *Auto Level* field. In this example, the level detection measurement will be executed manually.

All other settings in this view are sufficient for this example.

- Press the *DEMOD SETTINGS* softkey to open the Demod Settings view



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



Close the Demod Settings by pressing the *WLAN* hotkey.

Performing Level Detection

➢ Connect the DUT to the RF input of the spectrum analyzer (see Fig. 1).

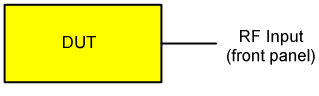


Fig. 1 Preparation for level detection

➢ Start the level detection measurement by pressing the *AUTO LVL* hotkey.

➢ 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 bar will display "*Measurement Complete*", the signal level field for the selected input will be updated to show the detected signal level and the magnitude capture buffer (screen A) will be updated to show the zero span trace obtained during the measurement sequence.

Performing the Main Measurement

After level detection has been successfully completed, the main measurement can be started. The setup for the main measurement is the same as that for the level detection measurement.

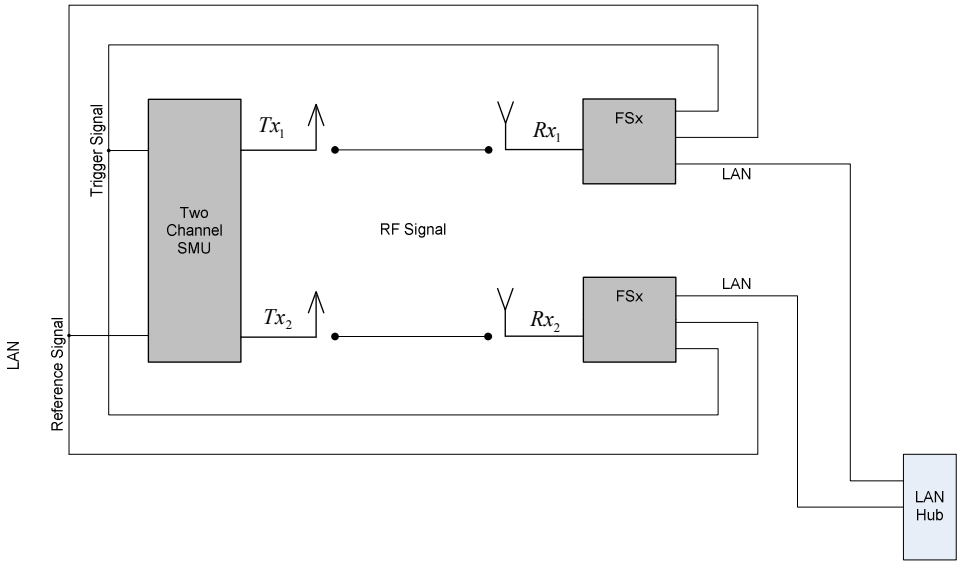
- Start the measurement by pressing the *RUN SGL* hotkey.
- During the measurement, the text "*Running...*" is displayed in the status bar at the bottom of the screen.

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

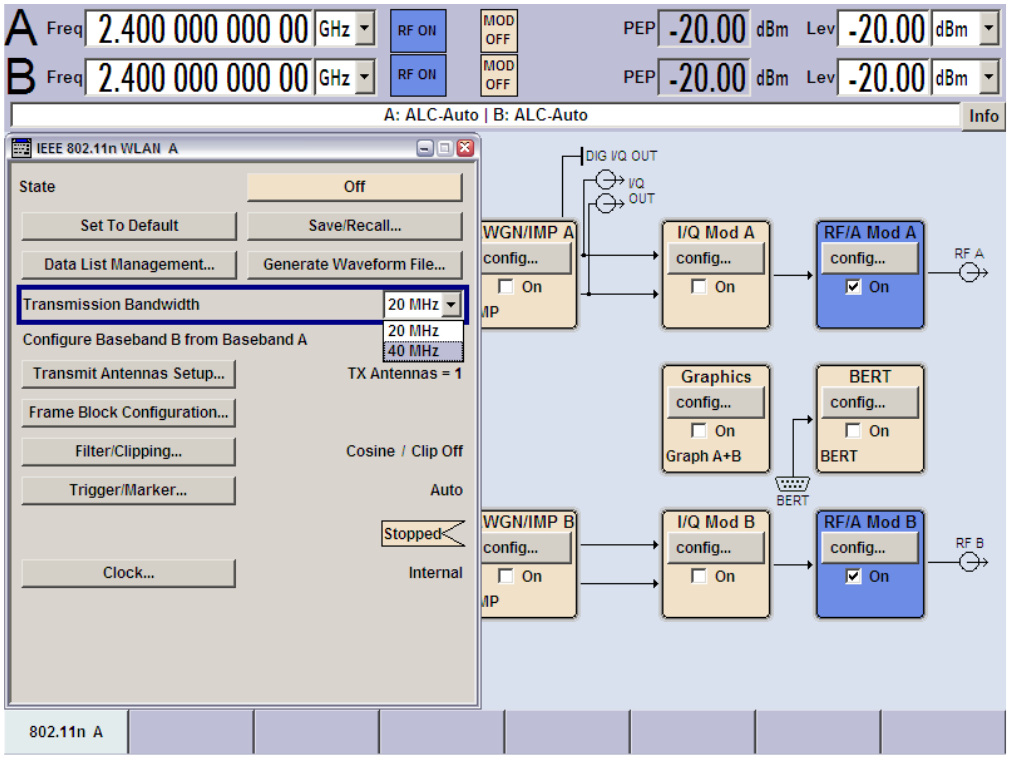
Setting up a MIMO measurement

For this example a 2 Tx MIMO DUT according to IEEE 802.11n is used.

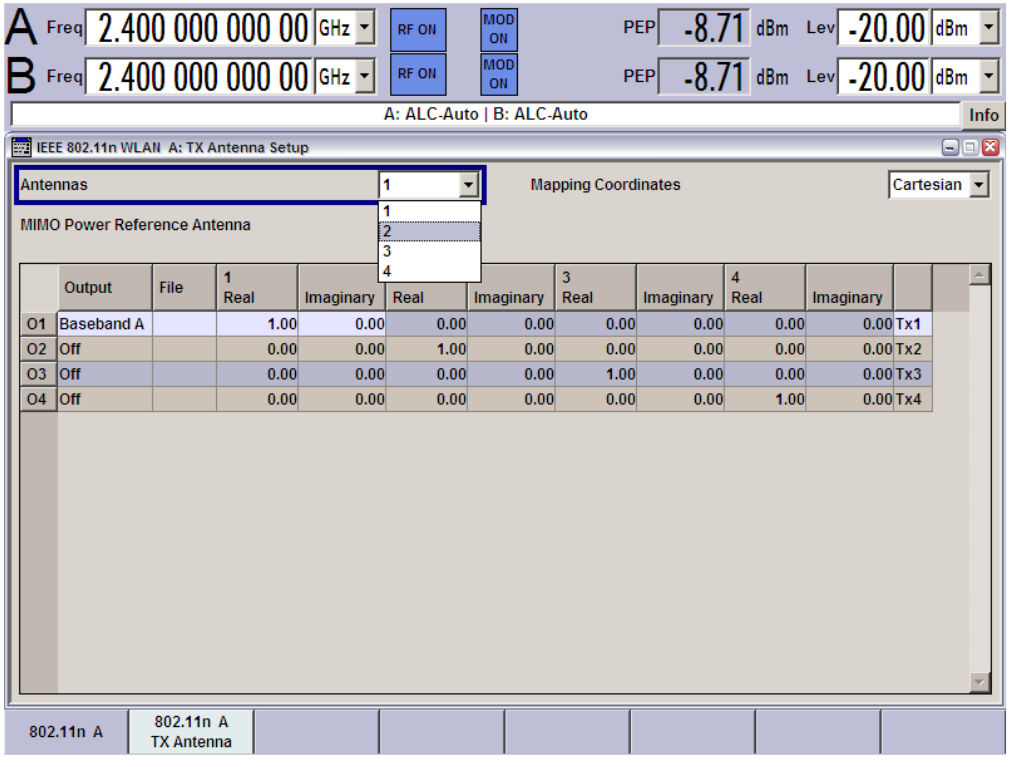
- The MIMO DUT is connected to the analyzers according to the following setup:



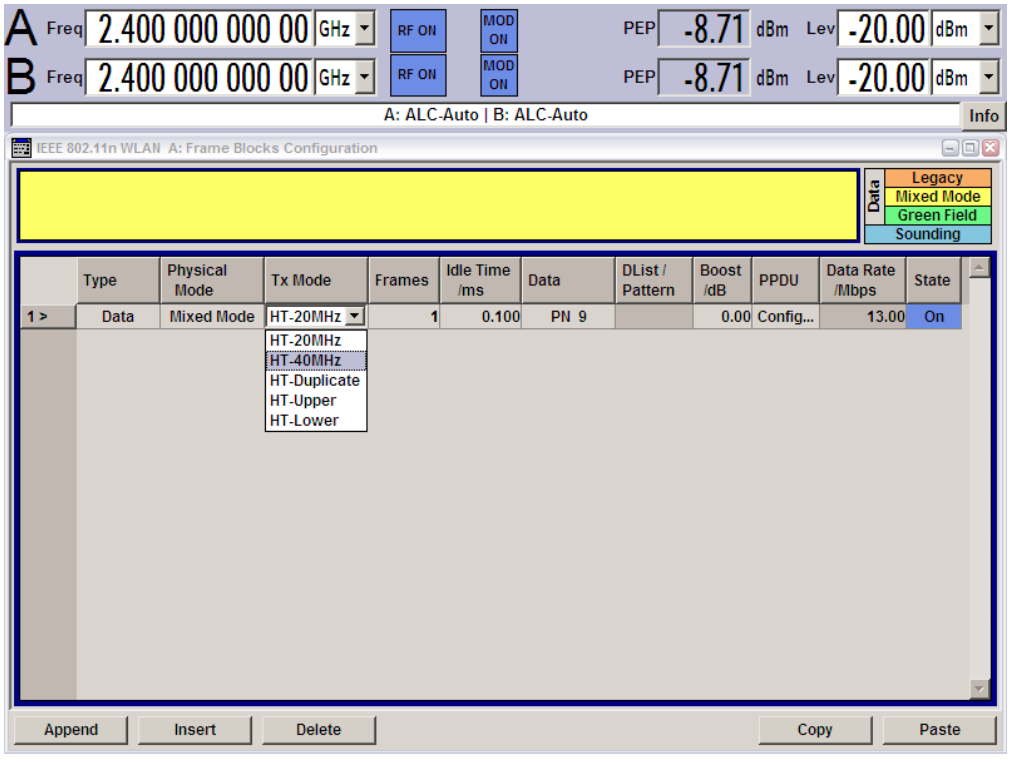
- Connect the external reference REF OUT of the SMU with the external reference REF IN of the analyzers. Switch on the external reference for both analyzers in the spectrum analyzer base system.
- Connect the marker output of the SMU with the Ext Trigger input of the analyzers.
- Either connect Path A RF/Baseband connector with one analyzer and Path B RF/Baseband connector with the other analyzer, or use the air interface with appropriate antennas.
- Connect the master and the slave anaylzer via LAN according to the figure above. As an alternative, it is sufficient, to connect master and slave with a cross LAN cable. The analyzer with the FSQ-K91n option can be used as master. The slave analyzer does not require a WLAN option.
- Setup the SMU to generate a 2 Tx IEEE 802.11n MIMO signal.
  For the SMU *Baseband A* select the *IEEE 802.11n …* option. This raises the *IEEE 802.11n WLAN A* dialog.



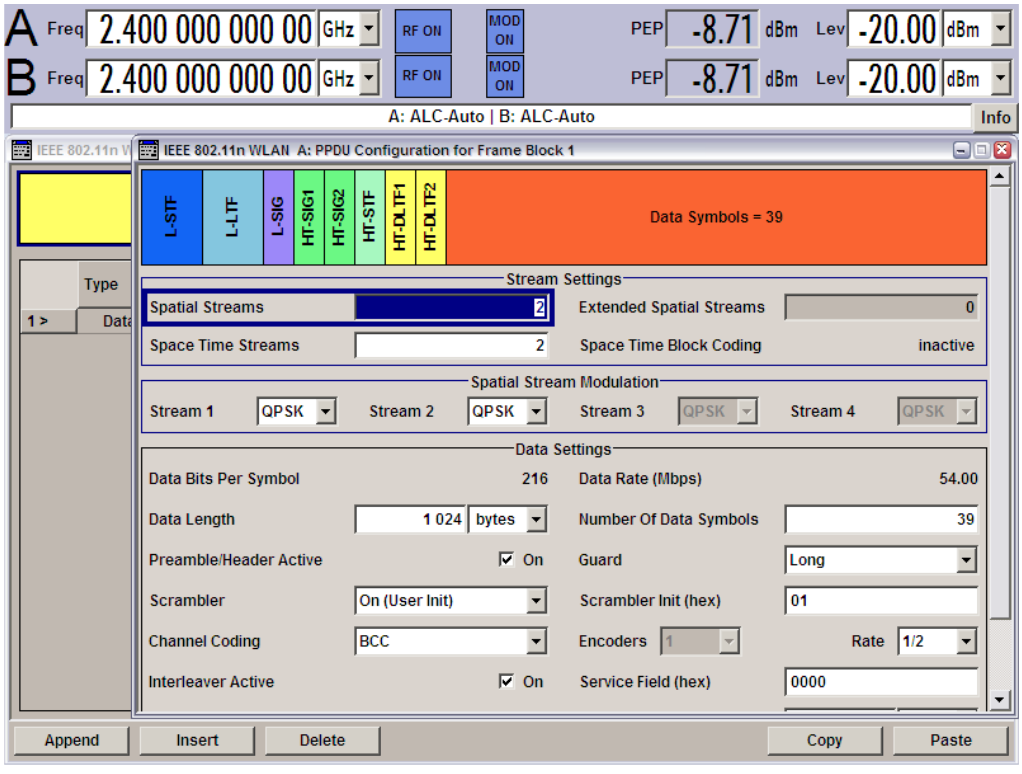
➢ Select the Transmission Bandwidth 40MHz.
The Transmit Antennas Setup … button raises the *IEEE 802.11n WLAN A: Tx Antenna Setup* dialog.



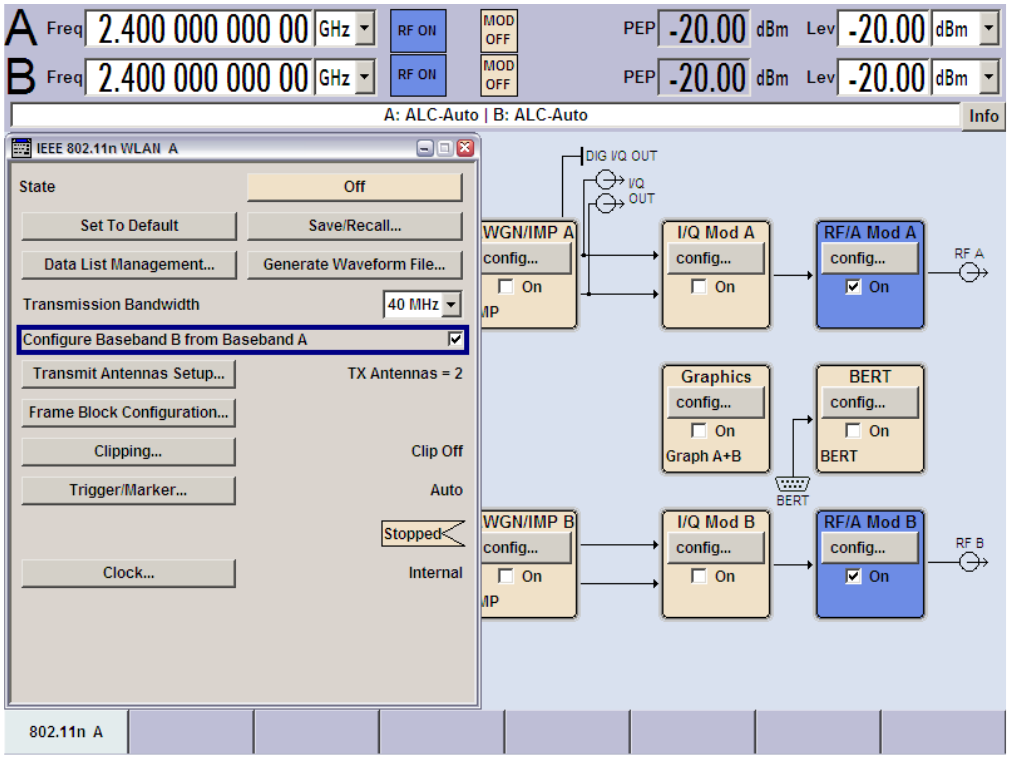
➢ Select Antennas 2.
Back in the IEEE 802.11n WLAN A dialog pressing the Frame Block Configuration … button raises the IEEE 802.11n WLAN A: Frame Blocks Configuration dialog.



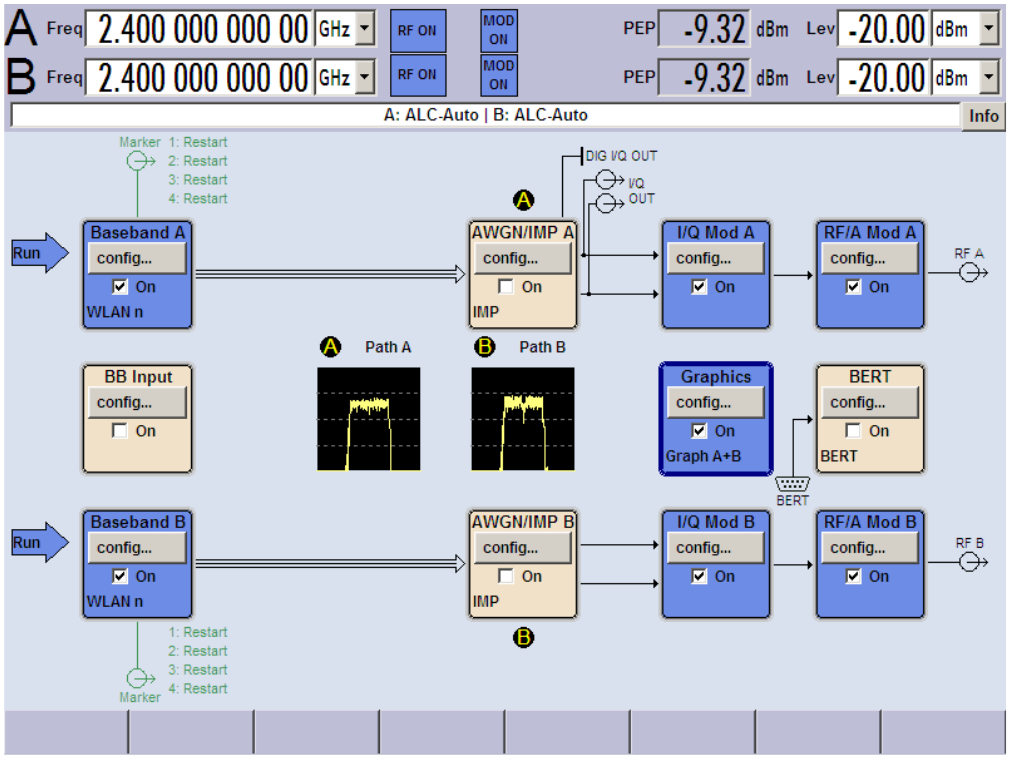
➢ Select Tx Mode HT-40MHz.
Pressing the PPDU Config … button raises the IEEE 802.11n WLAN A: PPDU Configuration for Frame Block 1 dialog.



➢ Select Spatial Streams 2 and Space Time Sttreams 2.
Back in the IEEE 802.11n WLAN A dialog



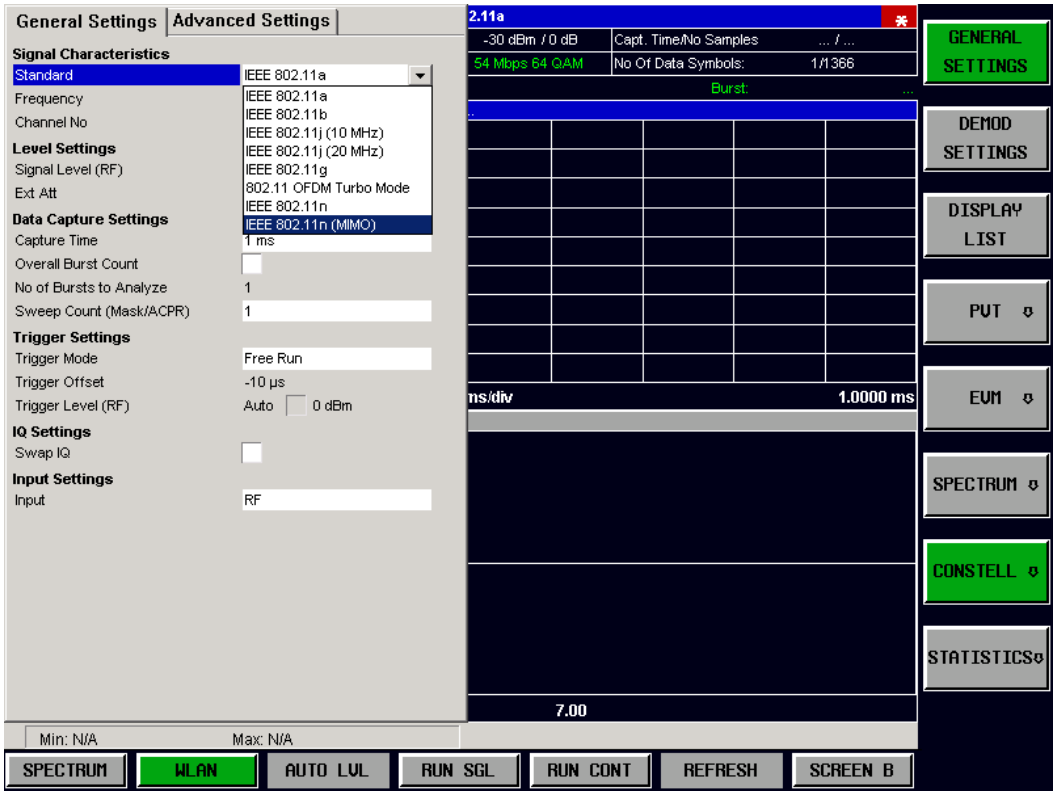
➢ Check Configure Baseband B from Baseband A. This will generate a IEEE 802.11n conform Tx 2 signal for path B of the SMU.
Finally toggle the State to On and make sure RF/A Mod A and RF/B Mod B are switched on!



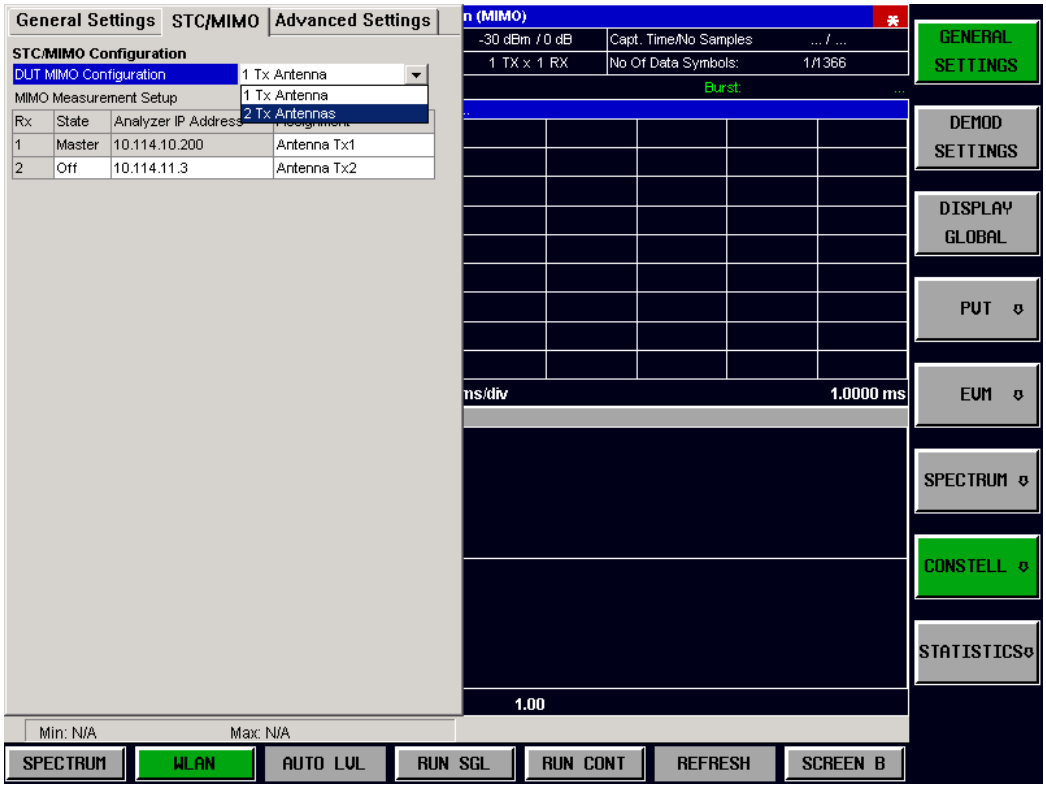
➢ Using the Graphics | Power Spectrum display shows the power spectrum for both antennas.

➢ Now setup the Spectrum analyzer with the R&S FSQ-K90/K91/K91n option to perform the WLAN MIMO measurements. Start the R&S FSQ-K90/K91/K91n application.

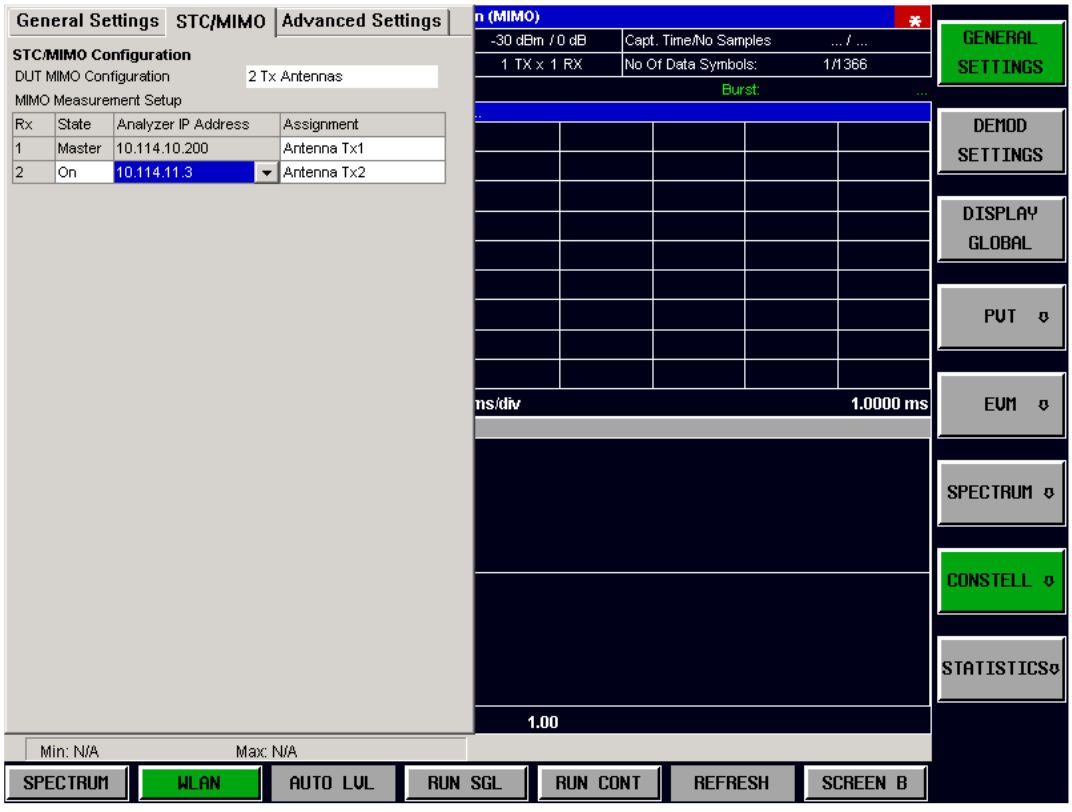
➢ Press the *GENERAL SETTINGS* softkey to open the General Settings dialog.



➢ Select Standard IEEE 802.11, (MIMO).
Set the RF Frequency the DUT is transmitting.
Set Trigger Mode to External
Navigate to the *STC/MIMO* tab by moving the focus onto the *General Settings* tab. Now use the right/left hard keys, below the roll key to, move the focus onto the *STC/MIMO* tab.

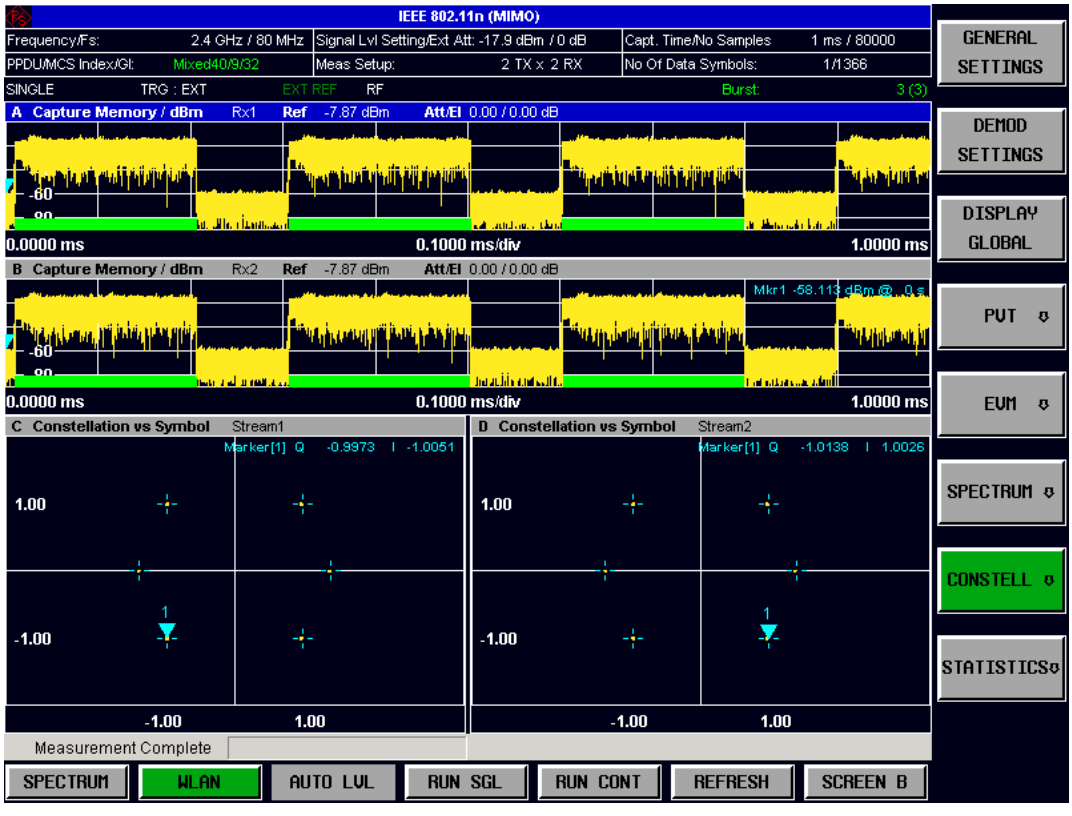


➢ Select DUT MIMO configuration 2 Tx Antennas.



➢ Set the IP Address of the slave in the MIMO Measurement Setup table and turn the state of the slave to on.

➢ Finally press the *RUN SGL* respective *RUN CONT* hot key to start the WLAN signal analysis.



Navigation

This section deals with navigation within the option. Navigation here means all forms of interaction with the option except for remote control. The different methods of interacting with the option are:

- Hotkeys
- Softkeys
- Hardkeys
- Numeric keypad
- Rotary knob
- Cursor keys
- External keyboard
- Mouse

Hotkeys

Hotkeys are allocated to the seven keys at the bottom edge of the screen. On initial startup of the R&S FSQ-K90/K91/K91n option, the hotkeys provided are shown in Fig. 2. These hotkeys are present at all times once the option has been started.

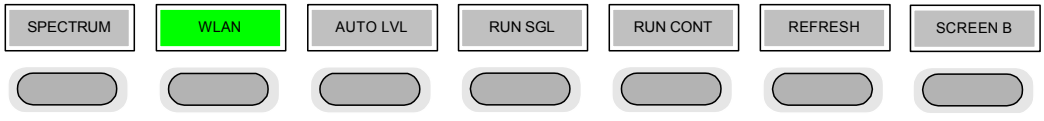
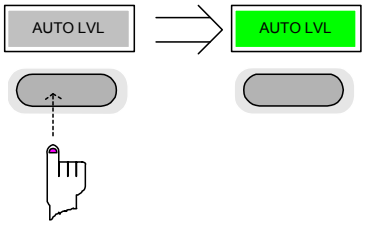
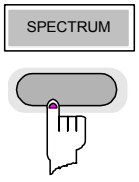


Fig. 2 Initial hotkey menu

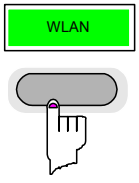
A keystroke activates the associated hotkey. An activated hotkey changes color to green, as shown.



These hotkeys perform the following operations:

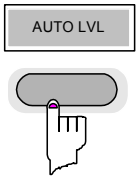


The *SPECTRUM* hotkey exits the R&S FSQ-K90/K91/K91n option and returns to the spectrum analyzer with all previous settings restored.



The *WLAN* hotkey returns the user to the main measurement menu of R&S FSQ-K90/K91/K91n, where measurement results can be seen. All settings, views and dialogs are removed from the display, and the default softkey menu is displayed

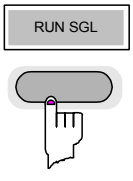
The *WLAN* hotkey remains green whenever R&S FSQ-K90/K91/K91n is active .



The *AUTO LVL* hotkey starts an automatic level detection measurement.

If another measurement is running, it will be aborted before the automatic level detection measurement is started. If a continuous measurement is running when the *AUTO LVL* hotkey is pressed, the continuous measurement will resume after the automatic level detection has been completed.

Pressing the *AUTO LVL* hotkey while an automatic level detection measurement is running causes the measurement to be stopped immediately.



The *RUN SGL* hotkey starts the selected measurement in single sweep mode.

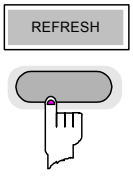
If another measurement is running, such as a continuous sweep measurement, the running measurement will be aborted before the single sweep measurement is started.

Pressing the *RUN SGL* hotkey while a single frequency range measurement is running causes the measurement to be stopped immediately.

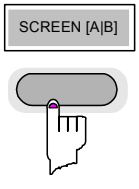
The *RUN CONT* hotkey starts the selected measurement in continuous sweep mode

If another measurement is running, the running measurement will be aborted before the continuous sweep measurement is started.

Pressing the *RUN CONT* hotkey while a continuous sweep measurement is running causes the measurement to be stopped immediately.



The *REFRESH* hotkey updates the current measurement results to reflect the current measurement settings.
The *REFRESH* hotkey is available for all IQ measurement.. The *REFRESH* hotkey becomes available only when IQ data is available.



The *SCREEN [A|B]* hotkey selects the specified screen as the active screen.

In full screen mode, pressing the *SCREEN [A|B]* hotkey will display the specified screen.

Pressing the *SCREEN [A|B]* hotkey changes the label displayed in the hotkey, e.g. pressing *SCREEN A* changes the label of the hotkey is to *SCREEN B.* The label indicates which screen will become the active screen after the hotkey is pressed.

Softkeys

Softkey Settings

The softkeys are assigned to the nine keys on the right-hand side of the display. These enable quick access to all parameter settings and measurement screens of the R&S FSQ-K90/K91/K91n option. When each of the top two softkeys is pressed, it brings up a settings view for a group of parameters. These softkeys are always available (except when using Save/Recall and Print manager or controlling markers) and are as follows:

General Settings: Signal Characteristics, Data Capture, Trigger, IQ Settings

Demod Settings: specifies details about the type of burst to measure

Fig. 3 Main softkeys

Each of these groups of settings is described in detail in the Measurements & Settings on page 37 section of this manual.

Other Softkeys

All other softkeys have different functions depending on the instrument state. Therefore, the labels (text) on the softkeys will vary to reflect their current function. The state of the softkeys is indicated by different appearances and colours, as follows:

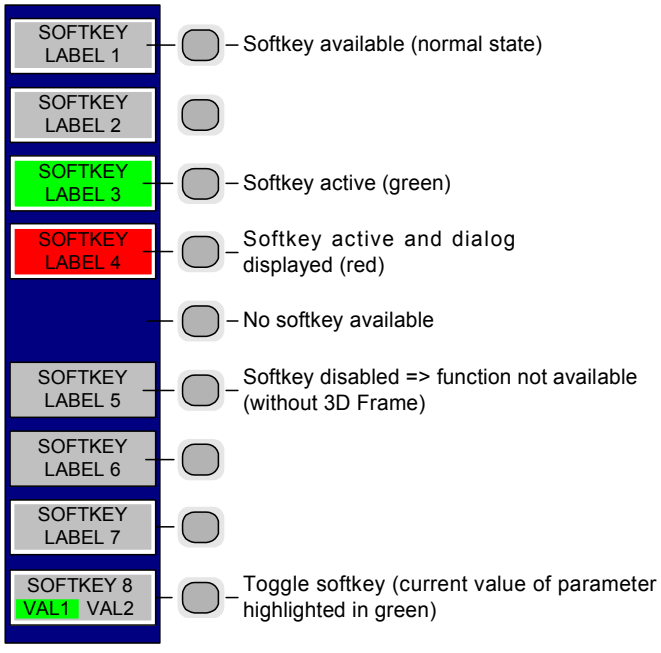


Fig. 4 Setup of the softkey area

A softkey in its normal state, i.e. its function is available, is coloured grey with a 3D border.

A softkey that is disabled, i.e. its function is not available, is coloured grey without a 3D border. Softkeys may become disabled because of the state of the instrument or because other settings disable the function associated with the softkey.

An active softkey (highlighted in green) is used when the softkey selects an item or view. For example, the *GATE SETTINGS* softkey will be highlighted green when the Gate Settings pop-up dialog is displayed.

A toggle softkey is used to change the value of a parameter that has only two states. Each press of the softkey toggles the value of the parameter. The current parameter value is highlighted in green in the lower half of the softkey label. For example, in the measurement results view, the *DISPLAY* softkey will have either *LIST* or *GRAPH* highlighted in green depending on whether the results are currently displayed as a list of measurement points or graphical trace(s).

When no function is assigned to a softkey, no softkey label will be shown.

Hardkeys

Hardkeys allow quick access to the desired parameter and various functions. The hardkeys supported by the R&S FSQ-K90/K91/K91n option are as follows (other hardkeys have no function):

FREQ Hardkey	When the *FREQ* hardkey is pressed, the General Settings view is displayed (if it is not already being displayed) and the *Frequency* parameter is selected.
AMPT Hardkey	When the AMPT hardkey is pressed, the General Settings view is displayed (if it is not already being displayed) and the relevant *Signal Level* parameter for the selected signal input is selected.
MKR Hardkey	When the MKR hardkey is pressed, the main Marker softkey menu is displayed (if it is not already being displayed).
MKR-> Hardkey	When the MKR-> hardkey is pressed, the Marker extension softkey menu is displayed (if it is not already being displayed).
SWEEP Hardkey	When the SWEEP hardkey is pressed, the General Settings view is displayed (if it is not already being displayed) and the *Capture Time* parameter is selected.
MEAS Hardkey	When the *MEAS* hardkey is pressed, the Main softkey menu is displayed (if it is not already being displayed).
TRACE Hardkey	When the *TRACE* hardkey is pressed, the General Settings view is displayed (if it is not already being displayed) and the *Burst Count* parameter is selected.
LINES Hardkey	When the *LINES* hardkey is pressed, the Limit Lines softkey menu is displayed (if it is not already being displayed) and the first limit in the results summary is selected. Note: This hardkey only functions when the results summary is displayed.
DISP Hardkey	When the *DISP* hardkey is pressed, the Display softkey menu is displayed (if it is not already being displayed).
FILE Hardkey	When the *FILE* hardkey is pressed, the Save & Recall softkey menu is displayed, allowing settings and/or measurement results of the R&S FSQ-K90/K91/K91n option to be saved and recalled.
PRESET Hardkey	When the *PRESET* hardkey is pressed, the R&S FSQ-K90/K91/K91n option is exited and a preset will be performed. Note that all options (including R&S FSQ-K90/K91/K91n) will also be preset.
HCOPY Hardkey	When the *HCOPY* hardkey is pressed, the print manager softkey menu is displayed, allowing the items to be printed to be selected.

External Keyboard

The external keyboard is optional. The keys on the external keyboard that can be used to interact with the option are as follows:

Number keys 0 to 9

Decimal point (".") Inserts a decimal point "." at the cursor position.

Minus key ("-") Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position in the case of an alphanumeric parameter.

ESC key Aborts the entry before it has been terminated. The previous value is restored.
Closes the entry field after termination of input.
Closes pop-up dialogs.

ENTER key Terminates the input of dimension quantities. The new value is set.
Invokes the input of parameters or immediately sets the new value.
Selects the highlighted item in drop-down menus.

Left and Right Cursor Keys are used to: Navigate between individual parameters within the setting views and some of the pop-up dialogs.
Navigate between the individual items within drop-down menus.
Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

Up and Down Cursor keys are used to: Navigate between individual parameters within the setting views and some of the pop-up dialogs.
Navigate between the individual items within drop-down menus.
Increment or decrement the value of a parameter during numeric entry.

CTRL keys Used to activate hotkeys. Each of the seven hotkeys is allocated a different function (F) key. To access these hotkeys, press CTRL and the corresponding F key together (see Fig. 5):

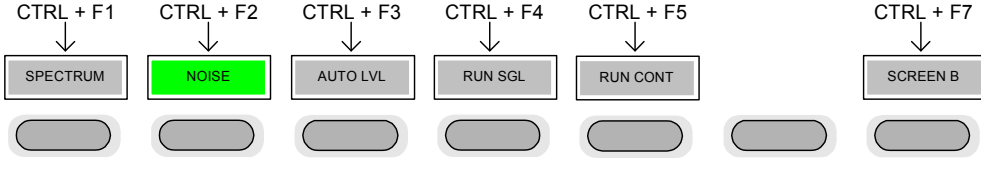


Fig. 5 Quick Access to Hotkeys

Function Keys Used to activate softkeys. Each of the nine softkeys is allocated a different function (F) key. To access these softkeys, press the corresponding F key, as shown below:

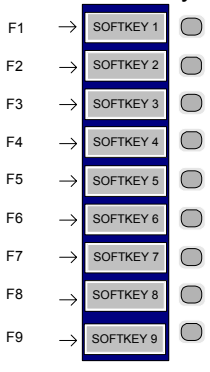


Fig. 6 Quick access to softkeys

Mouse

The mouse can be used to select individual parameters within the setting views or data entry dialogs and to activate hotkeys and softkeys. It can also be used to select values from a drop-down list.

Selecting & Editing Parameters

Parameters are set either by numeric or alphanumeric entry or by simple selection from a list of possible values (a drop-down list is used to select an "enumerated" value) or by using checkboxes to turn a parameter setting on and off.
In all cases, the parameter has to be selected by placing focus on it either by selecting it with the mouse or by navigating to it with the cursor or rotary key. Editing then has to be enabled before its value can be changed.
The rotary knob and cursor keys on the front panel are provided for navigation and selection of parameters.
The numeric keypad, rotary knob and cursor keys on the front panel and an external keyboard (optional) are provided for the entering parameter values.

Numeric Keypad

The numeric keypad is provided for entering numeric parameters. It contains the following keys:

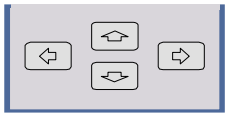
- Number keys 0 to 9
  Starts editing of the selected parameter. This enables a new value to be entered for a parameter directly without having to press *ENTER* first. The digit will be displayed as the first digit of the newly entered value. Inserts a digit at the cursor position when editing an alphanumeric parameter.
- Decimal point
  Inserts a decimal point "." at the cursor position.
- Sign key ("-")
  Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position when editing an alphanumeric parameter.
- Unit keys (GHz/-dBm, MHz/dBm, kHz/dB and Hz/dB)
- Provides the numeric value entered with the selected unit and sets the parameter to that value.
  The unit keys are all assigned the value "1" for dimensionless quantities or for level entries (e.g. in dB). The unit keys thus assume the function of an *ENTER* key.
- *BACK* key
  Deletes the character to the left of the cursor with alphanumeric entry.
- *ESC/CANCEL* key
  Aborts the entry of a new parameter value. The previous value is restored.
  Closes pop-up dialogs.
- *ENTER* key
  Enables editing of the selected parameter (using numeric keys or rotary knob).
  Finishes the editing of a parameter value. The new value is set. For an alphanumeric value, the new value is set to the displayed value (using the current unit if applicable).
  In a drop-down menu, the parameter is set to the currently selected value in the list.

Rotary Knob

The rotary knob has various functions:

- In a settings view, the rotary knob can be used to navigate between individual parameters (the parameter selected being highlighted).
- In drop-down menus, the rotary knob can be used to navigate between the individual values for the parameter.
- During numeric entry, the parameter is incremented (by turning clockwise) or decremented (by turning counterclockwise) at a defined step size (depending on the parameter).
- In setting views and data entry dialogs, pressing the rotary knob invokes the input of parameters or immediately sets the new value, i.e. pressing the rotary knob is like pressing the *ENTER* key.
- In drop-down menus, pressing the rotary knob selects the relevant item.

Cursor Keys



The keys ⇦ and ⇨ are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual values within drop-down menus.
- Move the cursor left & right inside the entry window to reach a particular position in the string during alphanumeric entry.

The keys ⇧ and ⇩ are used to:

- Navigate between individual parameters within the setting views and some of the pop-up dialogs.
- Navigate between the individual items within drop-down menus.
- Increment or decrement the value of a parameter during numeric entry.

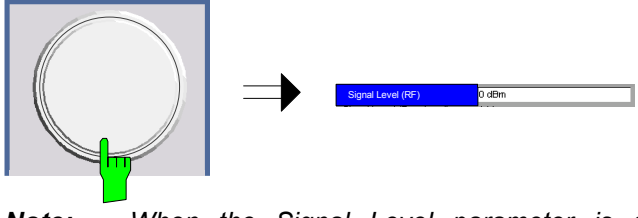
Selection of a parameter within a settings view

Selection using rotary knob

➢ Press *GENERAL SETTINGS* softkey for example (General settings view is displayed).

➢ Rotate the rotary knob until the required parameter is reached.
Turning the rotary knob clockwise selects parameters in the upward direction; turning it counterclockwise selects parameters in the downward direction.

Example: Selecting *Signal Level* (General settings)



Note: *When the Signal Level parameter is selected, its label is highlighted blue.*

When the desired parameter is reached, press the rotary knob to edit the parameter.

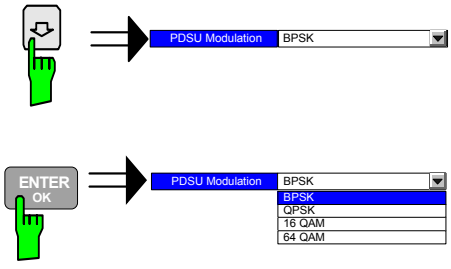
Selection using cursor keys

Cursor , , or until the required parameter is obtained. Within a list of parameters, the *Down* and *Right* keys both move to the next item (down) in the list, and the *Up* and *Left* keys both move to the previous item (up) in the list.
Within a table of parameters, the cursor keys move the cursor in the direction indicated.

To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rotary knob.

For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Example: Selecting PDSU Modulation



Note: *When ENTER is pressed, a drop-down menu is displayed that contains all available settings to which the Demodulator parameter can be set.*

Selection using mouse

- Use the mouse to move the cursor to the parameter and press the left mouse button to select the parameter.
- To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rotary knob.

  For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Selection using external keyboard

- Select parameter using the cursor keys (in the same way as using the cursor keys on the front panel).
- To start editing the parameter, either press the *ENTER* key on the numeric keypad, or press the rotary knob.

  For numeric parameters, editing can also be started by entering the new value directly from the numeric keypad without pressing the *ENTER* key first.

Entry of a numeric value

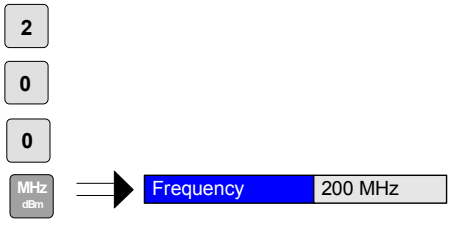
Once a parameter has been selected (see above), a new value for a numeric parameter can be entered in a number of ways. In addition to entering a value via the number keys, you can start editing the parameter either by pressing the *ENTER* key on the numeric keypad, or by pressing the rotary knob before following the instructions below.

If an error occurs (for example, the entered value is out of range), the new value will not be accepted for the parameter setting.

Entry using number keys (numeric keypad)

➢ Enter required value using the number keys.

Example: To enter 200 MHz



Note: *The parameter is not set to the new value until either one of the unit keys on the numeric keypad, the ENTER or the rotary knob is pressed.*

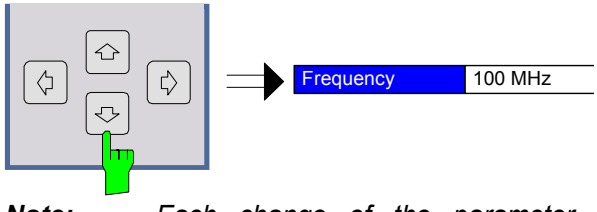
If the new value is not valid, a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed value is entered, the maximum allowed value will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Entry using cursor keys

➢ Cursor ⇧ or ⇩ until the required value is obtained.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.
Note: The cursor keys increment/decrement a parameter value in large steps.

Example: Cursor down to 100 MHz



Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

Entry using rotary knob

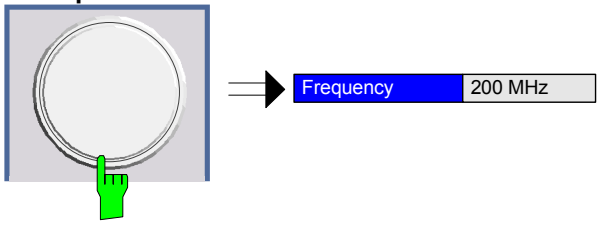
➢ Rotate the rotary knob until the required value is reached.

Turning the rotary knob clockwise increases the value; turning it counterclockwise decreases the value.

The application prevents the minimum and maximum values of the parameter from being exceeded and displays an "Out of range" message box if attempted.

Note: *The rotary knobs increment/decrement a parameter value in small steps*

Example: Rotate to 200 MHz



Note: *Each change of the parameter value takes place immediately. No other keys need to be pressed.*

Entry using external keyboard

➢ Enter value using number keys 0 – 9 in the same way as for using the number keys on the numeric keypad (see above).

Terminating the entry

➢ Press one of the unit keys on the numeric keypad.

The unit is entered in the parameter's edit box and the new parameter value is set immediately.

➢ Press the *ENTER* key (on numeric keypad or external keyboard) or press the rotary knob.

The new parameter value is set immediately.

Note: *Pop-up dialogs, where used, do not close automatically. They can be closed by pressing the ESC key.*

In both cases, if the new value is not valid, a message box is displayed and the entered value will be replaced with a valid value. For example, when a value above the maximum allowed value is entered, the maximum allowed value will be shown in the entry box. The parameter will still be ready for editing so that another value can be entered if desired.

Correcting the entry

➢ Position the cursor to the right of the digit which is to be deleted using the cursor keys ⇦ or ⇨.

➢ Press the BACK key. The digit to the left of the cursor is deleted.

➢ Enter new digits. Each digit is inserted to the left of the cursor; the other digits are shifted to the right.

Aborting the entry

➢ Press the *ESC* key during parameter editing.

The original parameter value is restored. The new entry is deleted.

➢ If a pop-up dialog is displayed, press the *ESC* key again.

The entry window is closed, and the original value remains active.

Entry of an enumerated value

Once a parameter has been selected (see above), a new value for an enumerated parameter can be entered in a number of ways. To start editing the parameter, either press the *ENTER* key on the numeric keypad, press the rotary knob or left-click with the mouse on the drop-down button before following the instructions below.

Note: *When the rotary knob or ENTER is pressed, a drop-down menu is displaye that contains all available settings that may be selected for the parameter.*

Selection of setting using cursor keys

- Cursor ⇧ or ⇩ until the required setting is obtained.
- Press *ENTER* on external keyboard or numeric keypad, or press rotary knob to select the desired setting of parameter.

Note: *The currently selected setting of the parameter is highlighted blue.*
Pressing ENTER sets the new setting of the parameter immediately.

Selection of setting using rotary knob

- Rotate the rotary knob until the required setting is reached.
- Press rotary knob to select setting.

Example: Select *Mode* parameter.

Note: *The currently selected setting of the parameter is highlighted blue.*
Pressing the rotary knob sets the new setting of the parameter immediately.

Selection of setting using mouse

- When the parameter is selected and ready for editing, select a new setting using the mouse by left-clicking the new setting from the drop-down list. The new setting of the parameter is set immediately.

Selection of setting using external keyboard

- Select setting using cursor keys.
- Press *ENTER* to set the parameter to the new value.

Entry of a checkbox

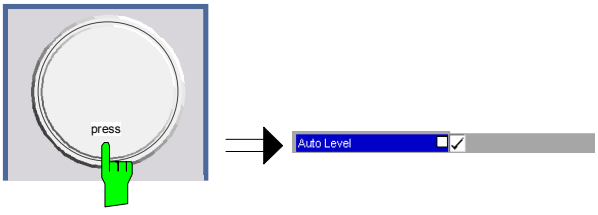
A checkbox is used for parameter settings that are either On or Off (Boolean settings). A checkmark (✓) appears in the box when the setting is On; the checkbox is empty when the setting is Off.

Once a parameter has been selected (see above), a new value for a Boolean parameter can be entered in a number of ways. Because Boolean parameters are very simple, it is not necessary to press the *ENTER* key on the numeric keypad or to press the rotary knob in order to edit them.

Toggle between the two states of a checkbox using rotary knob

➢ Press the rotary knob to toggle between the two states.

Example: Turn *Auto Level* setting to Off



Note: *The checkbox is empty when the settings is Off*

Toggle between the two states of a checkbox using numeric keypad

➢ Press the *ENTER* key to toggle between the two states.

Example: Turn *Auto Level* setting to On

Toggle between the two states of a checkbox using a mouse

➢ Left-click on the checkbox to toggle between the two states.

Toggle between the two states of a checkbox using external keyboard

Press *ENTER* to toggle between the two states.

Status Bar & Title Bar

Title Bar

The title bar is visible at the very top of the display when R&S FSQ-K90/K91/K91n is active and no setting views are displayed.

Fig. 7 Title Bar

The center of the title bar shows the wireless LAN standard applicable to the current measurement. If the IEEE 802.11a standard is selected and a sample rate other than the default sample rate is specified, the sample rate used is displayed on the left-hand side of the title bar.

Status Bar

The main status bar is displayed at the bottom of the display, just above the hotkeys.

When a parameter in a settings view is selected, the status bar will display the minimum and maximum settings for the selected parameter (see Fig. 8).

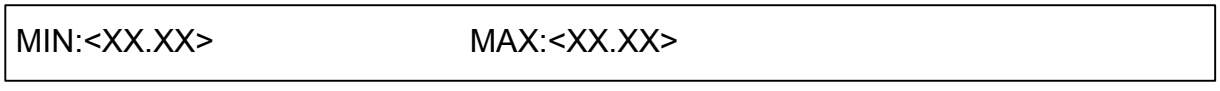


Fig. 8 Status Bar

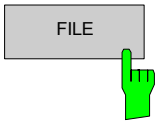
When a parameter whose value is enumerated or Boolean in type is selected in any dialog, the status bar will show "N/A" for the minimum and maximum, since the minimum and maximum values are "Not Applicable."

At other times, the status bar shows the current measurement status along with detailed information about the progress of any running measurement.

The status bar is also used to display warning and error messages to the user. In order to highlight these messages, warning messages are displayed with a blue background and error messages with a red background. Refer to Section 6 for a list of warning and error messages.

Save/Recall

This section of the user manual describes the Save/Recall facility of the option.



The *FILE* hardkey brings up the Save/Recall softkey menu. Any setting views on display when the save/recall softkey menu is displayed will be closed.

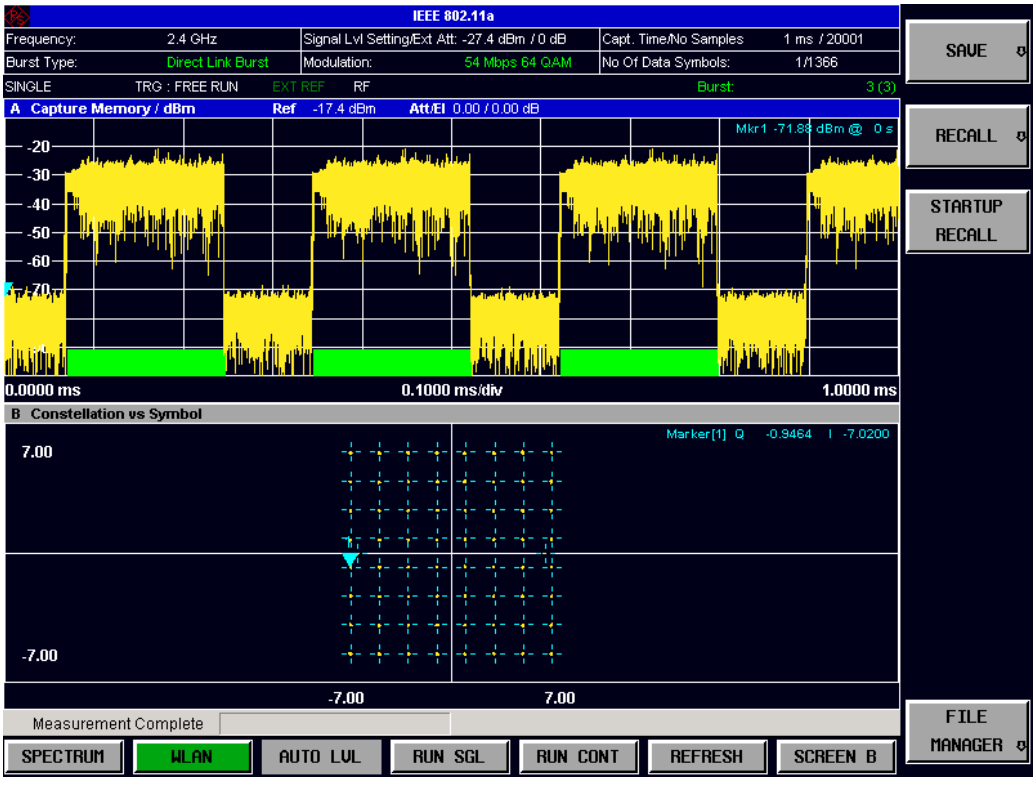


Fig. 9 Save/Recall softkey menu

The save/recall facility provided by R&S FSQ-K90/K91/K91n is exactly the same as that provided by the host analyzer. Refer to the user manual for the spectrum analyzer for details about the save/recall facility operation.

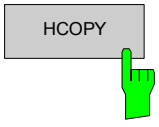
The save/recall facility in R&S FSQ-K90/K91/K91n provides the following items that can be saved and/or recalled:

- Current Settings — All user settings provided by R&S FSQ-K90/K91/K91n.
- WLAN Results — All current trace and table results.
- User Limits — All limit lines and table limit values.
- IQ Data — Allows the raw IQ trace results to be stored. When recalled, the data is reprocessed to generate results. Note: IQ data can also be saved/recalled using the Import/Export feature for .iqw format files (see section *Import/Export of IQ* Data)

To close the save/recall softkey menu and return to the main R&S FSQ-K90/K91/K91n softkey menu, press the *WLAN* hotkey.

Printing

This section of the user manual describes print facility of the option.



The *HCOPY* hardkey brings up the print softkey menu. Any setting views on display when the print softkey menu is displayed will be closed.

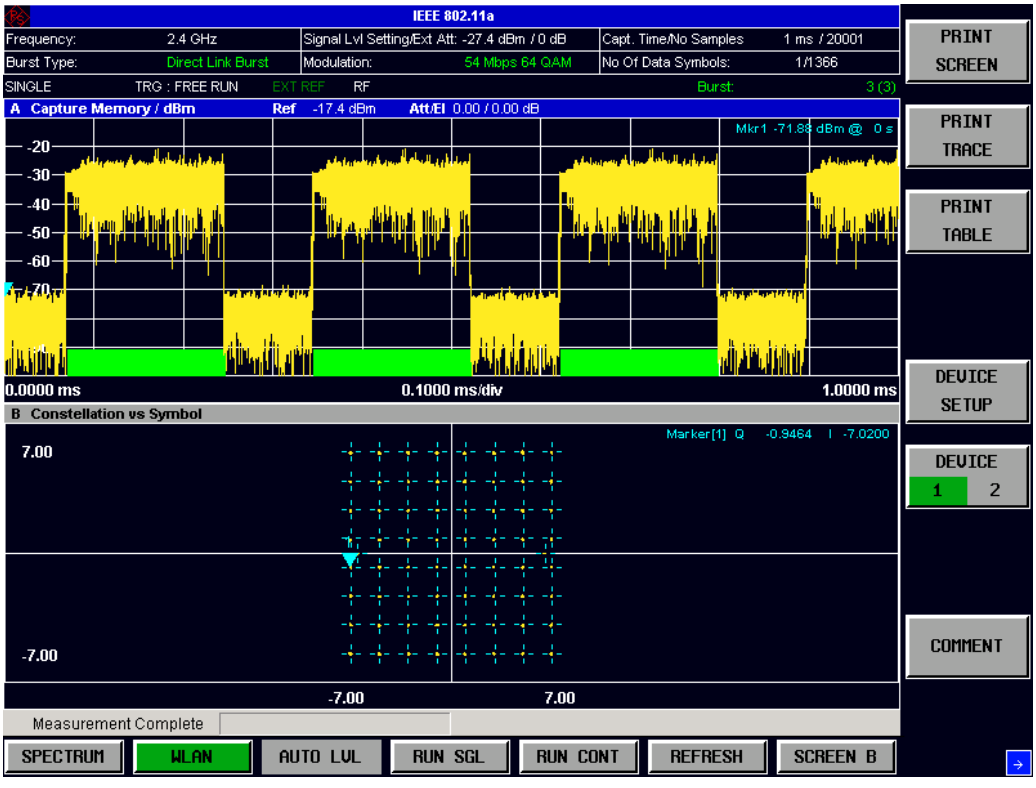


Fig. 10 Print softkey menu

The print facility provided by R&S FSQ-K90/K91/K91n is exactly the same as that provided by the host analyzer. Refer to the user manual for the spectrum analyzer for details about the print facility operation.

To close the print softkey menu and return to the main R&S FSQ-K90/K91/K91n softkey menu, press the *WLAN* hotkey.

2 Measurements & Settings

This section contains a detailed description of all measurement modes, settings & results. It covers the following subjects:

- Measurement modes
- Running measurements
- Measurement results
- General settings
- Demodulation settings
- Gate settings
- Marker settings
- General hints about measurements

Measurements

R&S FSQ-K90/K91/K91n provides two main measurement types:

- IQ measurements (see page 42)
- Frequency Sweep Measurements (see page 71)

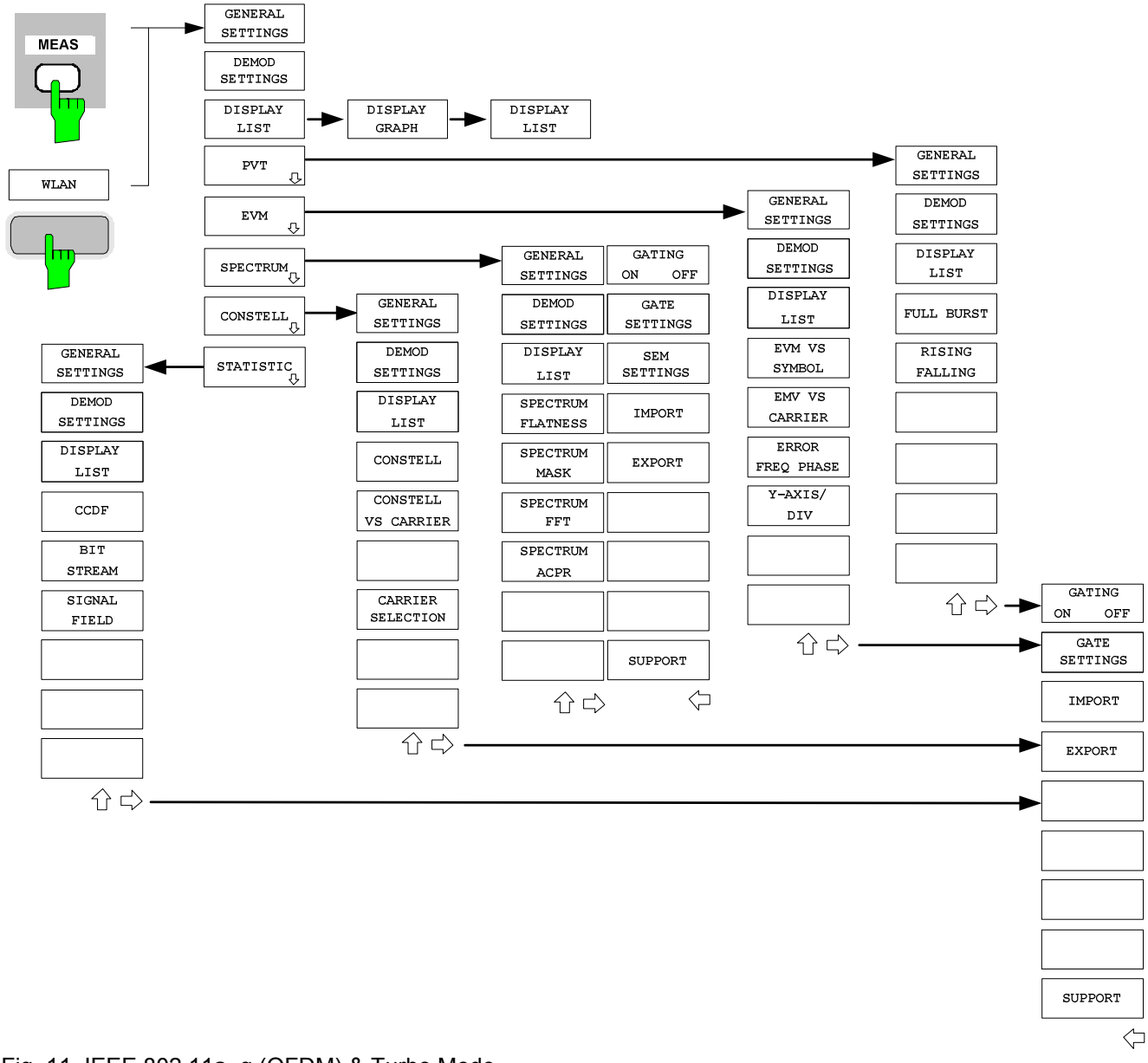


Fig. 11 IEEE 802.11a, g (OFDM) & Turbo Mode

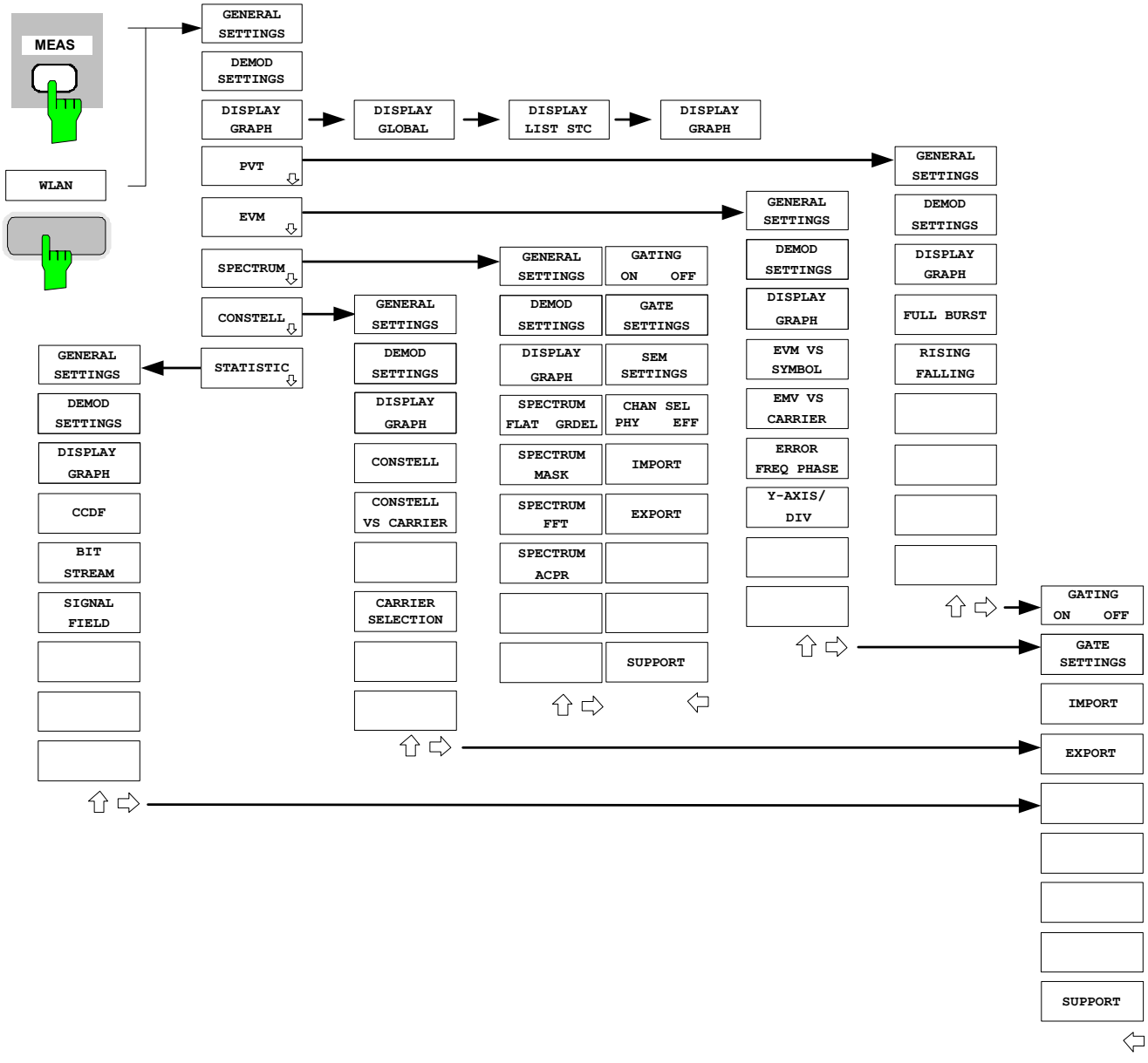


Fig. 12 IEEE 802.11n

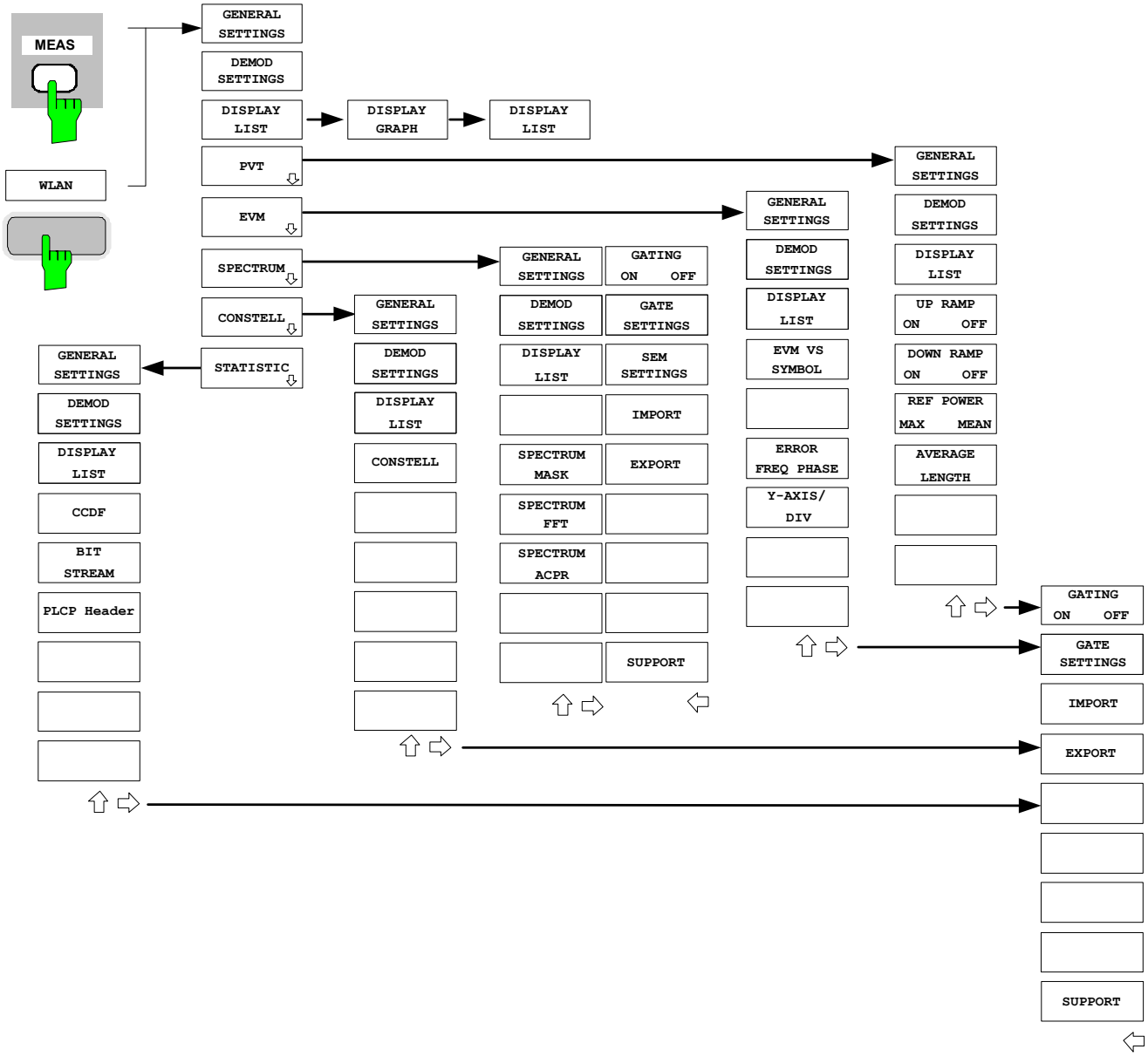


Fig. 13 IEEE 802.11b & g (Single Carrier)

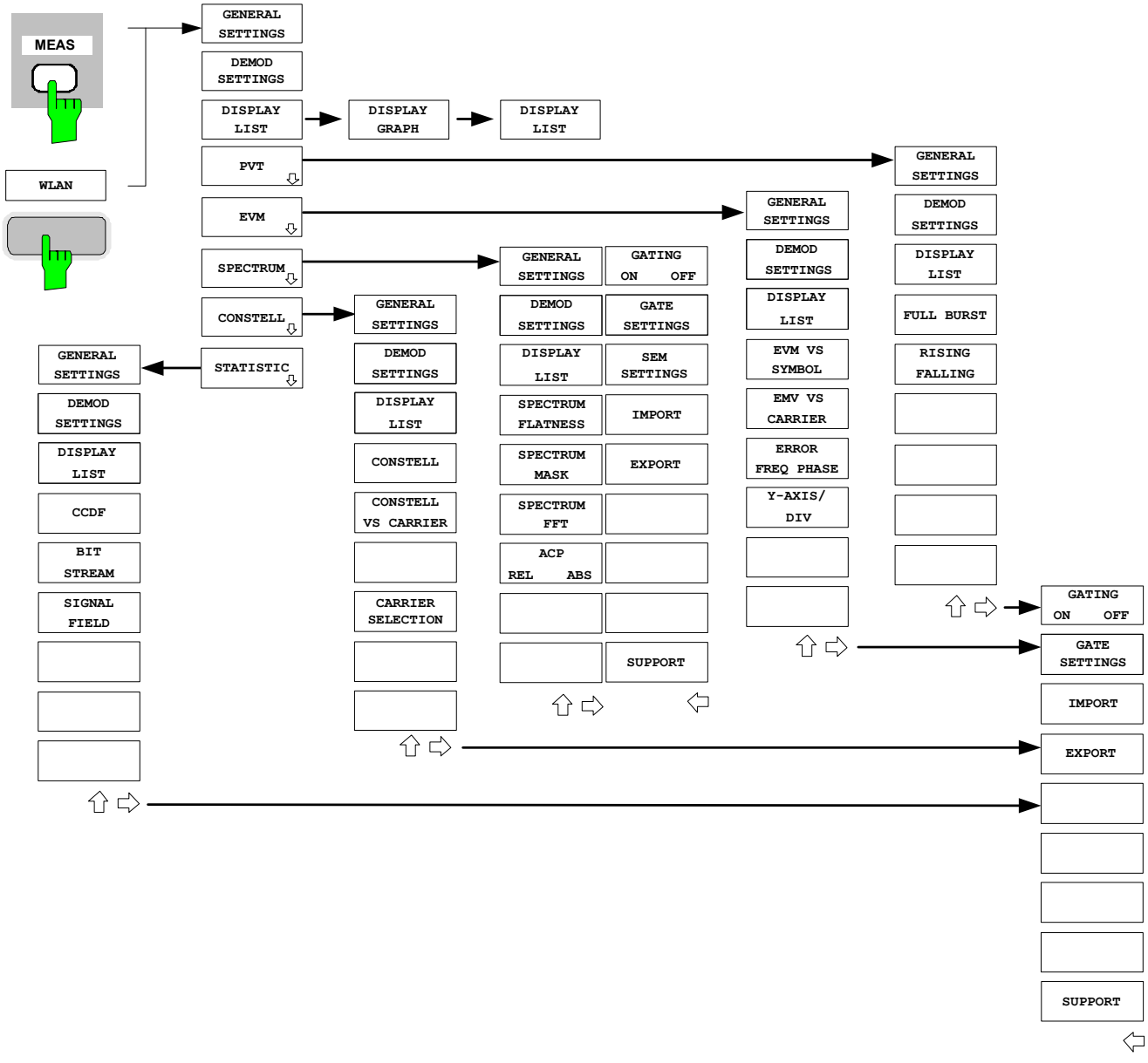


Fig. 14 IEEE 802.11j (10 or 20 MHz)

IQ measurements

The following measurement results are obtained in IQ measurement mode:

- Power Vs Time (PVT)
- EVM Vs Symbol
- EVM Vs Symbol Y Axis
- EVM Vs Carrier
- Error Vs Preamble
- Spectrum Flatness
- Spectrum FFT
- Constellation Vs Symbol
- Constellation Vs Carrier
- Complementary Cumulative Distribution Function
- Bit Stream
- Signal Field
- PLCP Header

For each of the above results, the Magnitude Capture Buffer display is available.

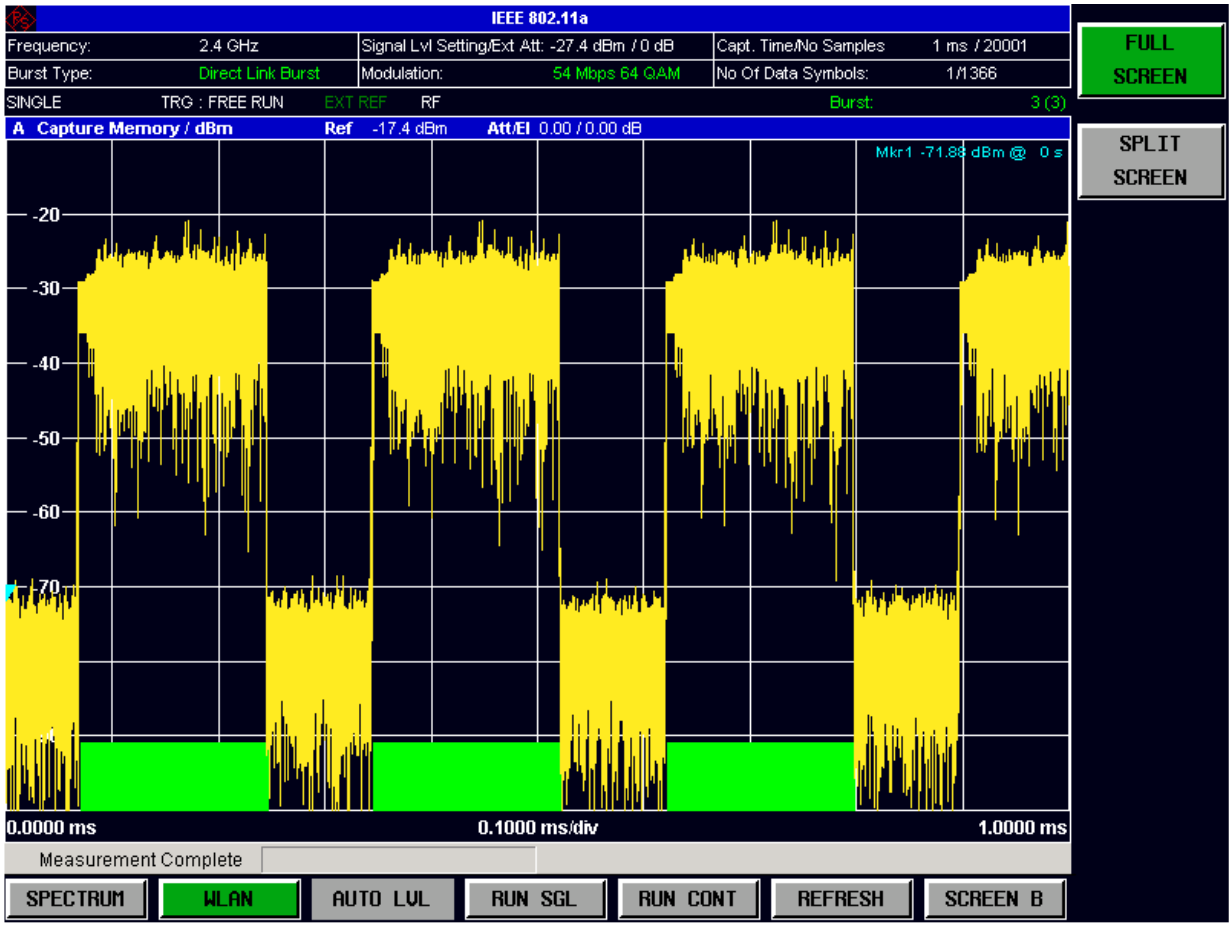


Fig. 15 Magnitude Capture Buffer results

The Magnitude Capture Buffer shows the complete range of captured data for the last measurement. All analzed bursts are identified with a green bar at the bottom of the Magnitude Capture Buffer. Any bursts which are analyzed but have possibly errors are identified with a yellow bar. When the *Use Signal Field Content* parameter is selected in the Demod Settings view, only bursts that matched the required criteria are marked with a green bar. When the selected standard is IEEE 802.11b, the *Use Signal Field Content* parameter is replaced by *Use PLCP Header Content* parameter, which is always selected.

All IQ measurements process the same signal data and, thus, all IQ measurement results are available after a single IQ measurement.
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).
IQ measurements may be performed for RF or baseband input.

11n MIMO measurements

To understand which results come from which part of the data flow it is sensible to have a look at the fundamental processing in Transmitter and receiver. The following figure shows the basic processing steps needed at the transmitter and the complimentary blocks in reverse order applied iat the receiver:

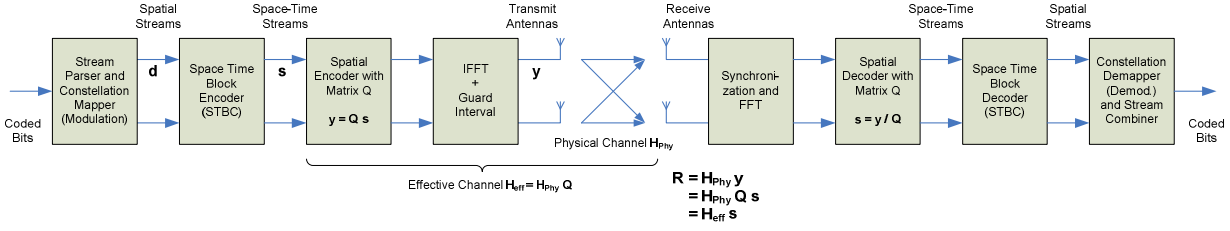


Fig. 16 Transmitter-Receiver block diagram

Especially of interest is the representation of specific results, i.e. for which sections of the processing the results are shown. Usually results are determined for particular signal processing steps in the transmitter (except for the Comosite results which refer tor the receive antennas):

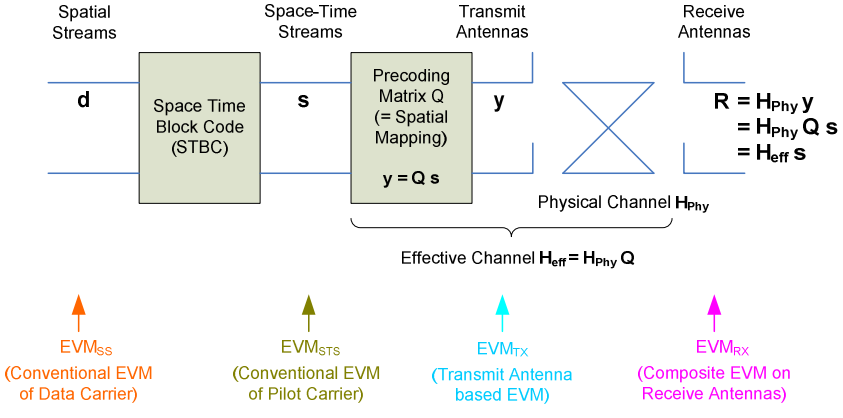
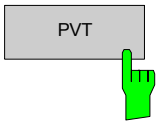


Fig. 17 Possible EVM results and Channel Representation (effective / physical)

For example EVM and Constellation results are measured for the spatial or space time streams in the transmitter, i.e. using the effective channel which includes the spatial mapping. Since Space Time Block Encoding is only applied to data carreriers but pilot carriers are inserted without STBC, the EVM analysis is done on spatial streams (STBC decoded) for data carriers and on space time streams for pilot streams. This results in the situation that we get results for different number of streams for data and pilot carrier if STBC is applied. For example using 2x2 MIMO we would get only pilot carriers in the second stream, because due to STBC there was ony on spatial (data) stream transmitted but 2 space time (pilot) streams.
In contrast to this the results I/Q Offset and I/Q Imbalanced are always calculates for the transmit antennas, which requires to apply the inverse spatial mapping to the initial results in order to relate to the physical channel without Precoding Matrix Q.
Furthermore the spectral results (channel flatness, group delay, channel phase, channel impulse response and channel singular values) are available for the effective and the physical channel, i.e. based on streams or Tx antennas. Note that the physical channel is not computable in any case (only if the precoding matrix is invertibly) and thus only the effective channel results may available for some situations (effective channel results are always available).

Power Vs Time (PVT)



The PVT measurement results are selected by pressing the *PVT* softkey in the main measurement softkey menu.

Fig. 18 PVT Results – Full Burst

The PVT results display shows 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. If the gate start or gate length is altered, the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Using screen B in full-screen mode provides additional power information during this measurement.

IEEE 802.11a, j, g (OFDM), & n

FULL BURST

Pressing the *FULL BURST* softkey displays the results in a single graph with all burst data being displayed.

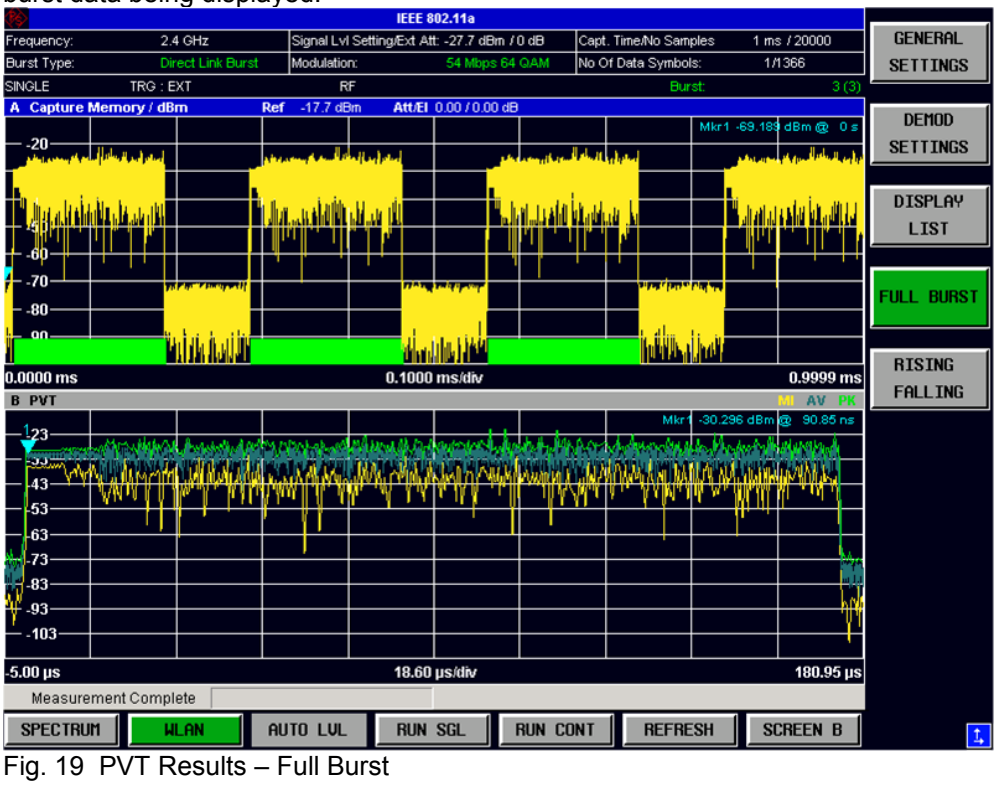


Fig. 19 PVT Results – Full Burst

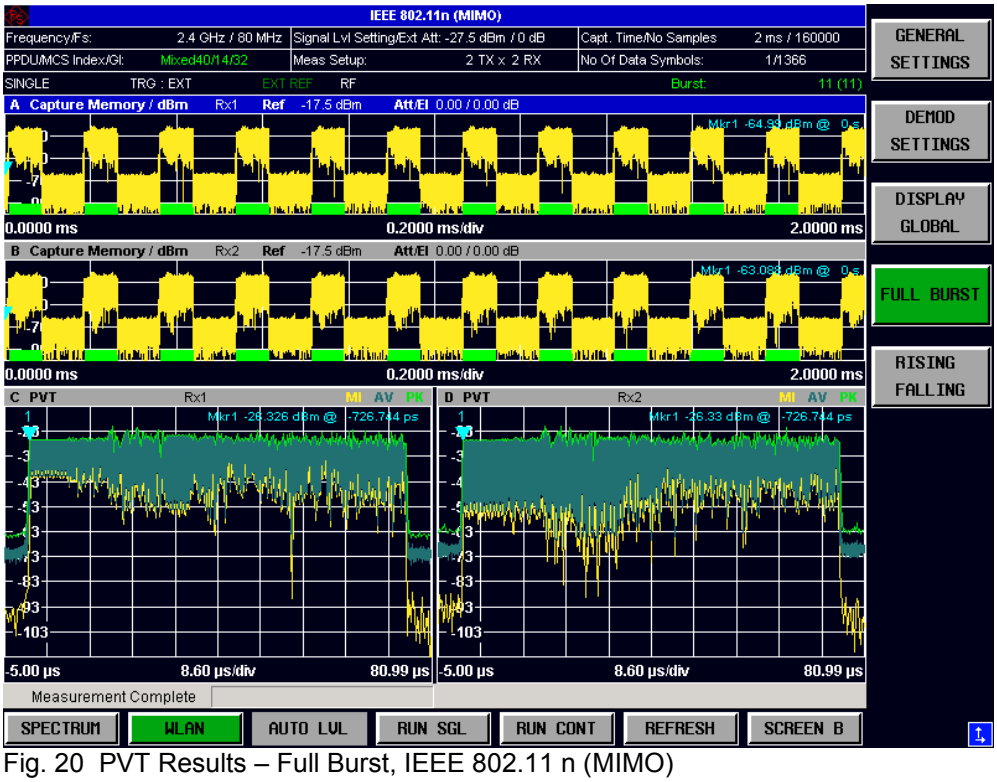


Fig. 20 PVT Results – Full Burst, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:PVT:SEL FULL`

RISING - FALLING

Pressing the *RISING FALLING* softkey displays the results in two separate graphs, the left-hand side showing the rising edge and the right-hand side the falling edge.

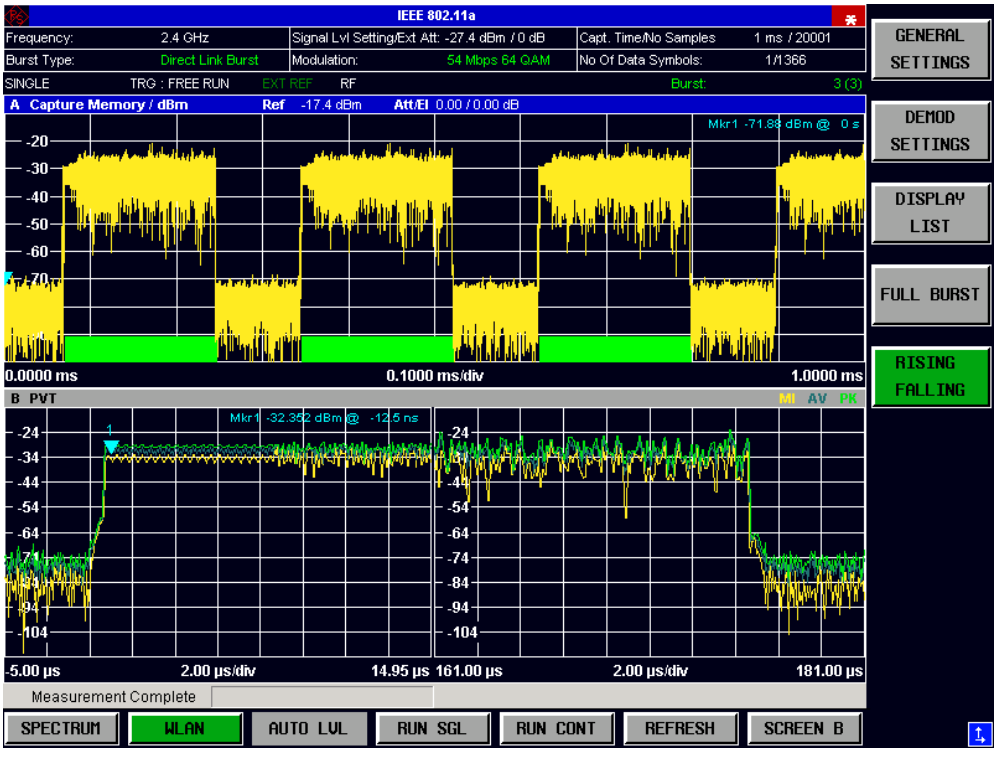


Fig. 21 PVT Results – Rising Falling Edge

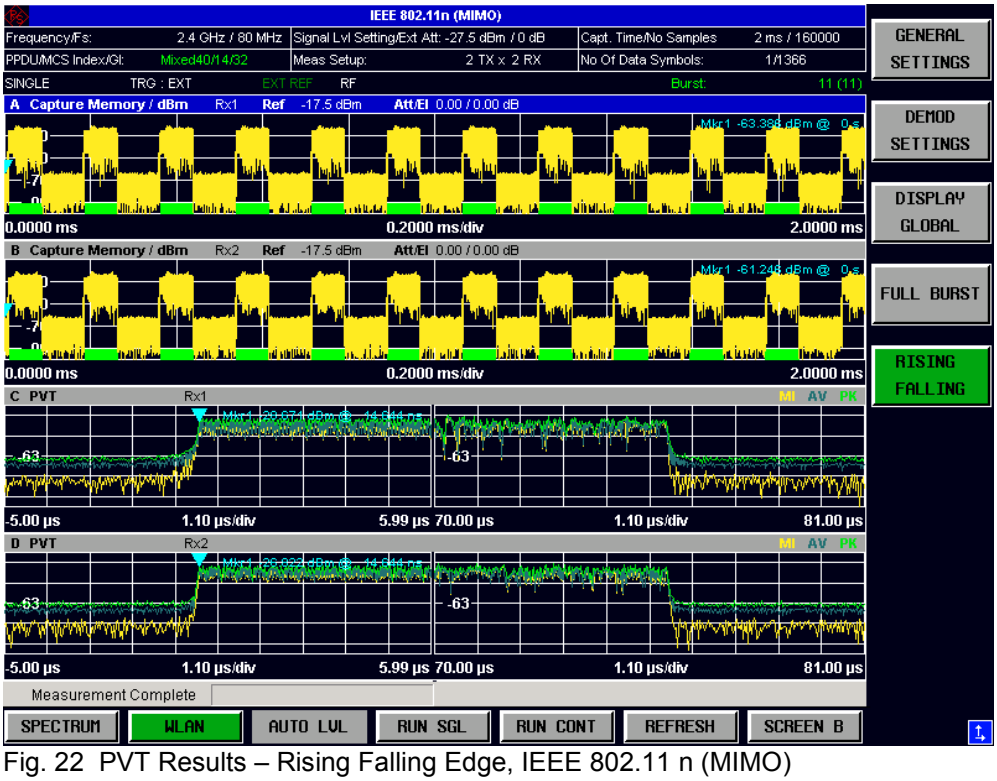
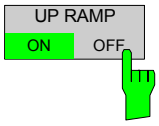


Fig. 22 PVT Results – Rising Falling Edge, IEEE 802.11 n (MIMO)

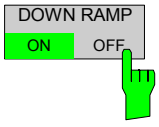
Remote: `CONF:BURS:PVT:SEL EDGE`

IEEE 802.11b & g (Single Carrier)



Pressing the *UP RAMP* softkey toggles the display of the rising edge graph on and off.

Remote: `CONF:BURS:PVT:SEL RISE`



Pressing the *DOWN RAMP* softkey toggles the display of the falling edge graph on and off.

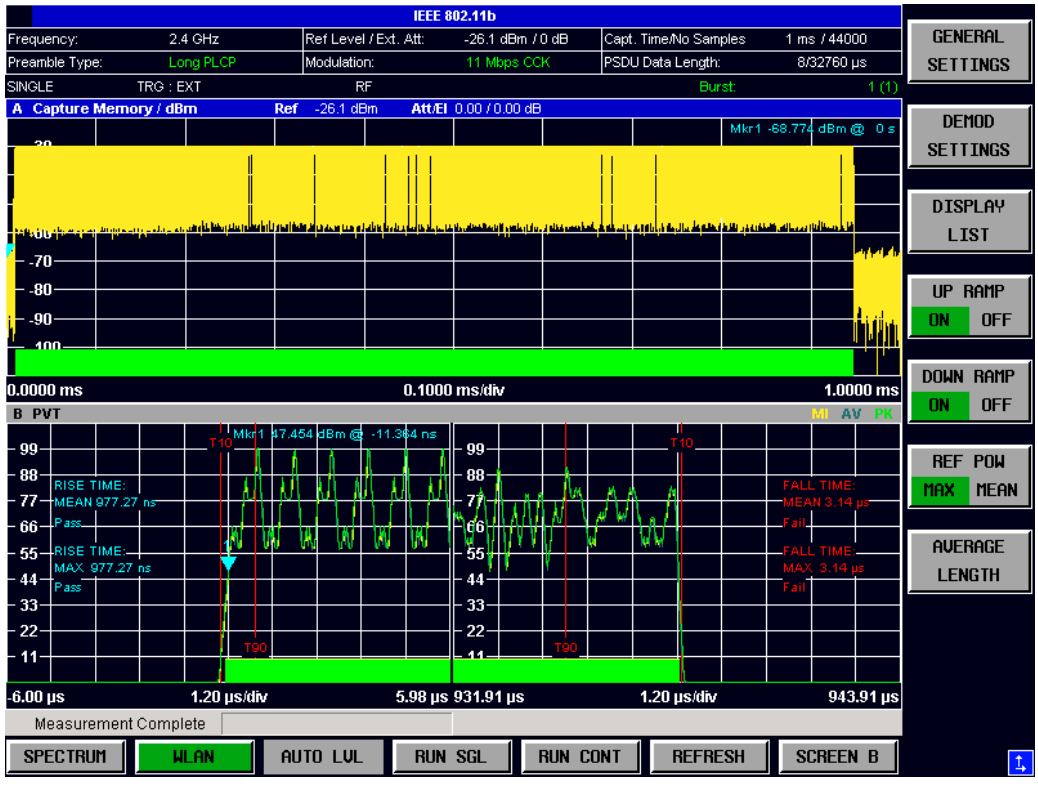
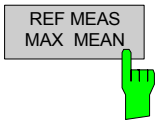


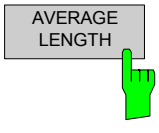
Fig. 23 PVT Results – Up Ramp and Down Ramp Switched On

Remote: `CONF:BURS:PVT:SEL FALL`



Pressing the *REF MEAS* softkey toggles the reference for the trace between the max and mean burst power.

Remote: `CONF:BURS:PVT:RPOW MEAN | MAXimum`



Pressing the *AVERAGE LENGTH* softkey displays a pop-up dialog which allows the length of the smoothing filter to be adjusted.

Remote: `CONF:BURS:PVT:AVER`

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.

Rise / Fall Time Definition

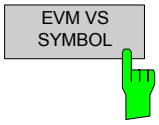
The rise/fall time is calculated according to the following algorithm:

1. Apply a moving average filter across the burst power (adjustable average length)
2. If "REF POW" = 'MAX':
   Search for maximum power $P_{\max}$ across the entire burst. Set $P_{\text{ref}} = P_{\max}$
   If "REF POW" = 'MEAN':
   Calculate mean power P_{mean} of the entire burst. Set $P_{\text{ref}} = P_{\text{mean}}$
3. Rise Time
   - Search for the first crossing of $0.5 \cdot P_{\text{ref}}$ from the left. From there,
   - search backward 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 $T_{\text{rise}} = t_{90} - t_{10}$.
4. Fall Time
   - Search for the first crossing of $0.5 \cdot P_{\text{ref}}$ from the right. From there,
   - search forward for the 10% crossing $0.1 \cdot P_{\text{ref}}$ and note t_{10}.
   - Search backward for the 90% crossing $0.9 \cdot P_{\text{ref}}$ and note t_{90}.
   - Return $T_{\text{fall}} = t_{10} - t_{90}$.

Dealing with Modulated Signals

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 isn't defined in the standard. R&S FSQ-K90/K91/K91n 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 doesn't 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.

EVM Vs Symbol



The EVM Vs Symbol measurement results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *EVM Vs SYMBOL* softkey.

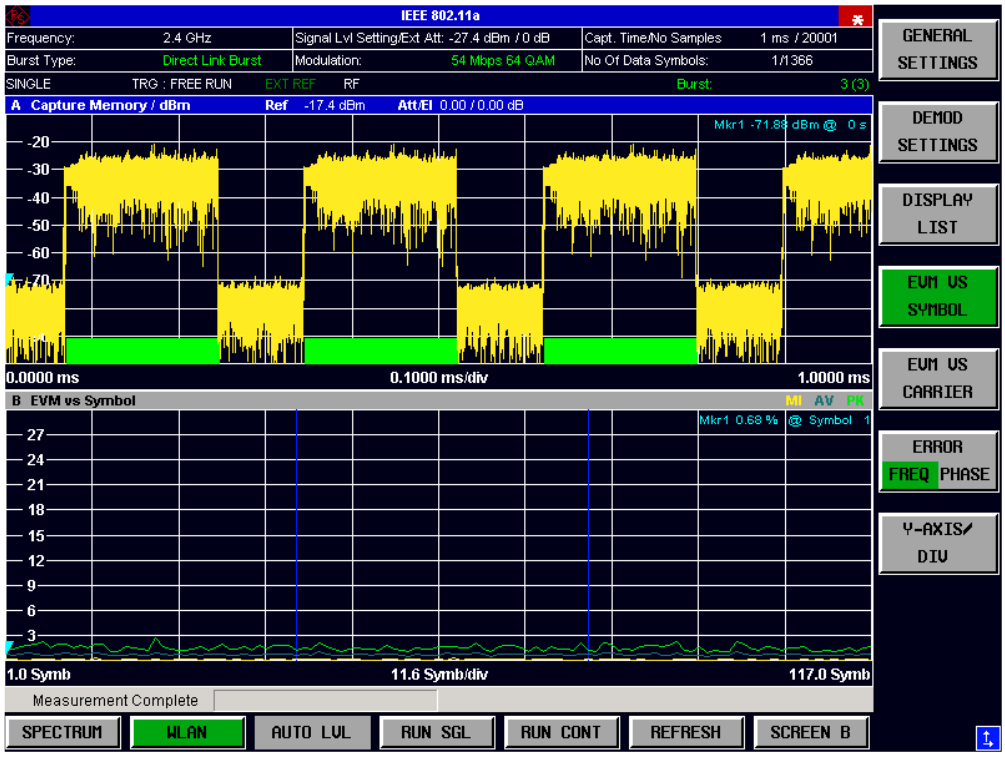


Fig. 24 EVM Vs Symbol

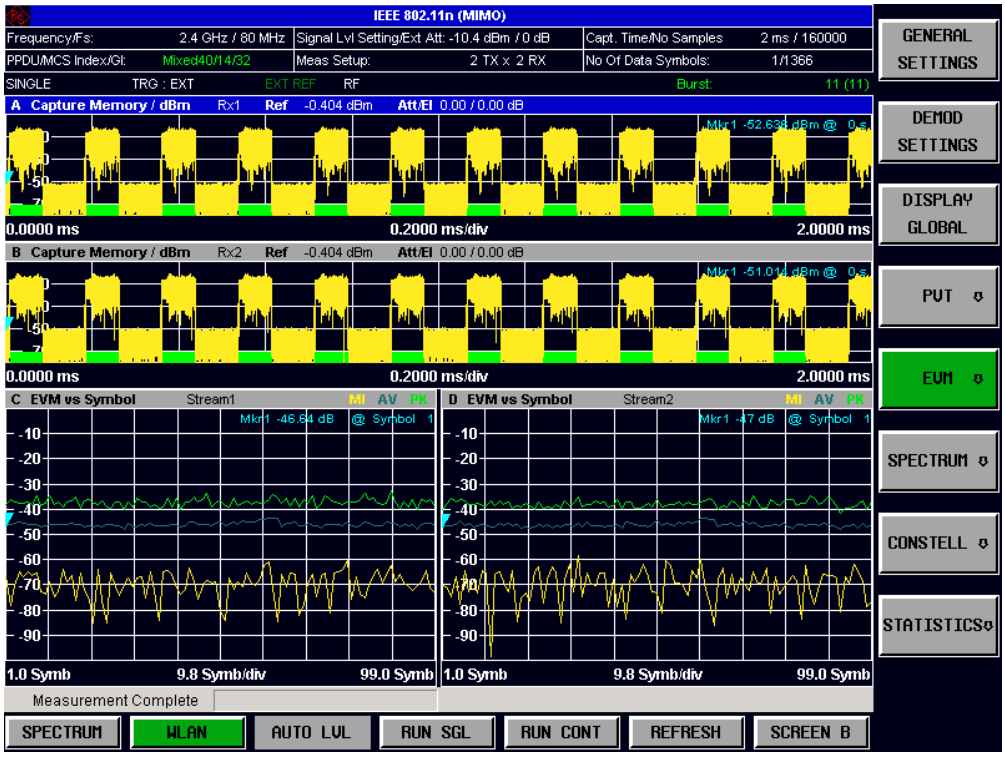
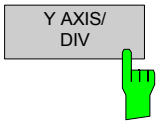


Fig. 25 EVM Vs Symbol, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:EVM:ESYM:IMM`

The EVM Vs Symbol results 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) & n, 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. For details of this measurement, refer to chapter 3.



Pressing the *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-axis to be controlled.

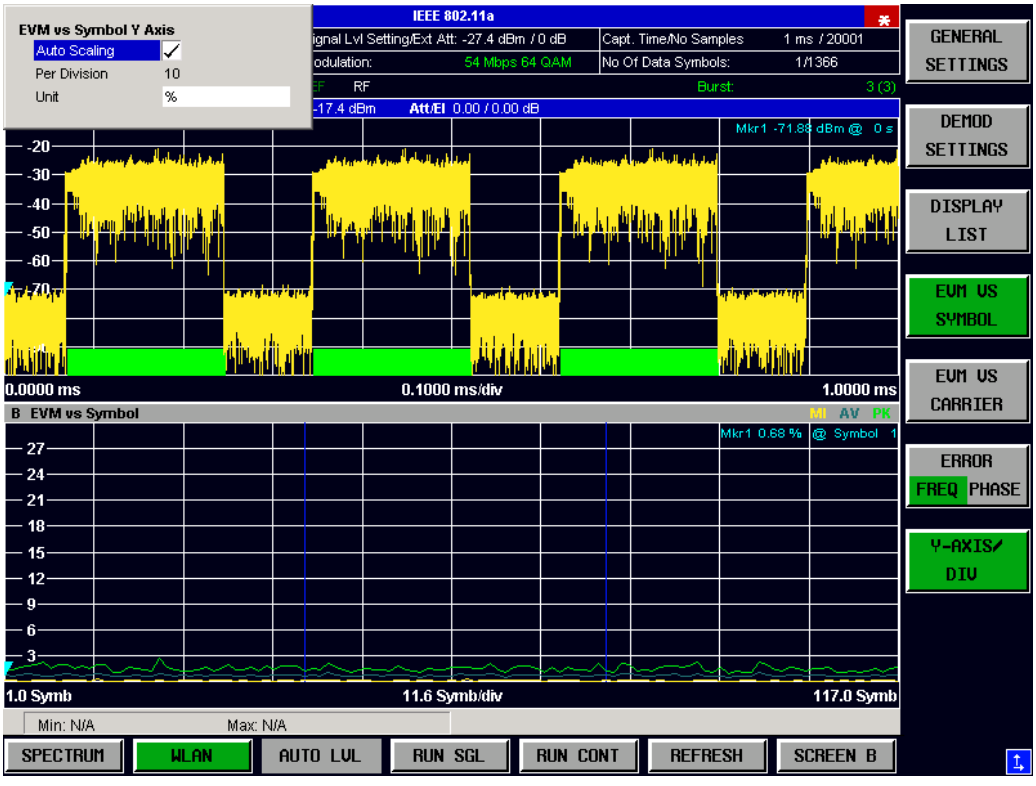
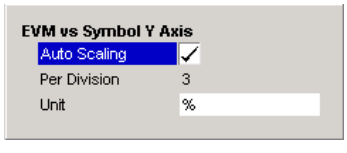


Fig. 26 EVM Vs Symbol - Y-axis Scaling

EVM Vs Symbol Y Axis

Auto Scaling



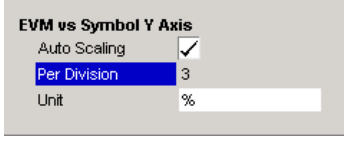
Auto Scaling specifies whether the Y-axis scale should be calculated manually or automatically.

When the *Auto Scaling* parameter is switched OFF, the setting of the *Per Division* setting is used to calculate the Y-axis scale.

Auto Scaling is always enabled when the Unit setting is dB.

Remote: DISP:WIND2:TRAC:Y:SCAL:AUTOo

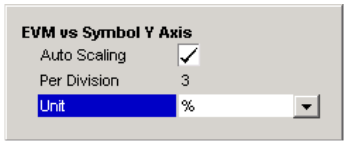
Per Division



Per Division specifies the scaling to be used when *Auto Scaling* is switched OFF.

Remote: DISP:WIND2:TRAC:Y:SCAL:PDIV

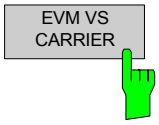
Unit



Unit allows the Y-axis unit to be specified.

Remote: UNIT:EVM

EVM Vs Carrier



The EVM Vs Carrier measurement results are selected by pressing the EVM softkey in the main measurement softkey menu followed by the EVM Vs CARRIER softkey.

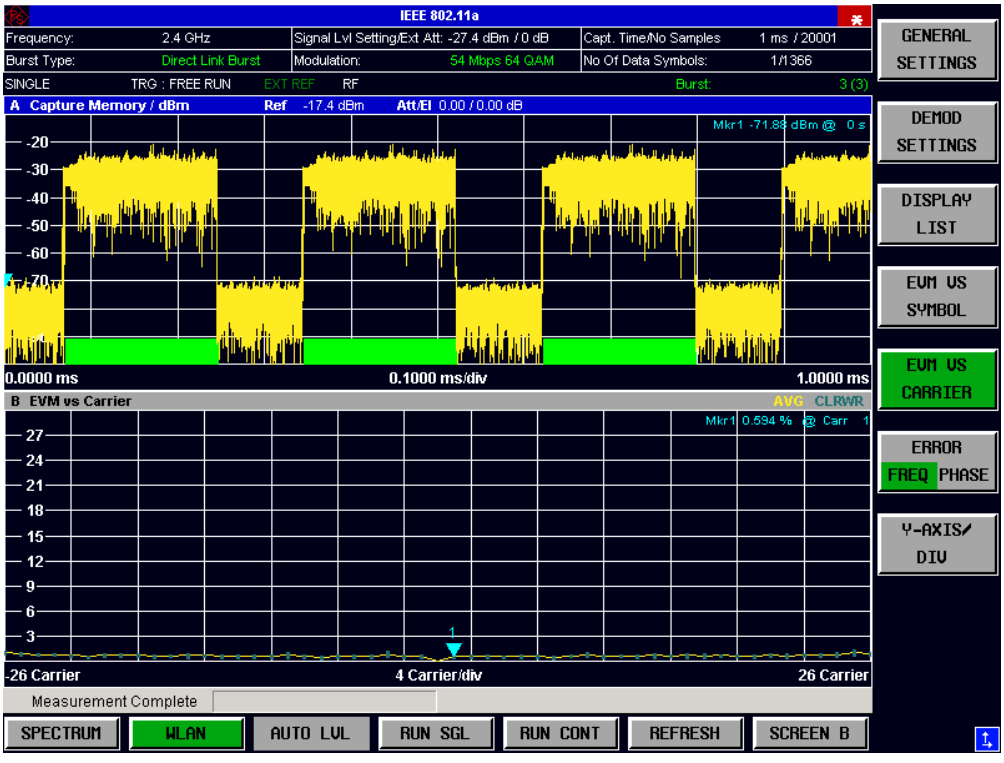


Fig. 27 EVM Vs Carrier Results

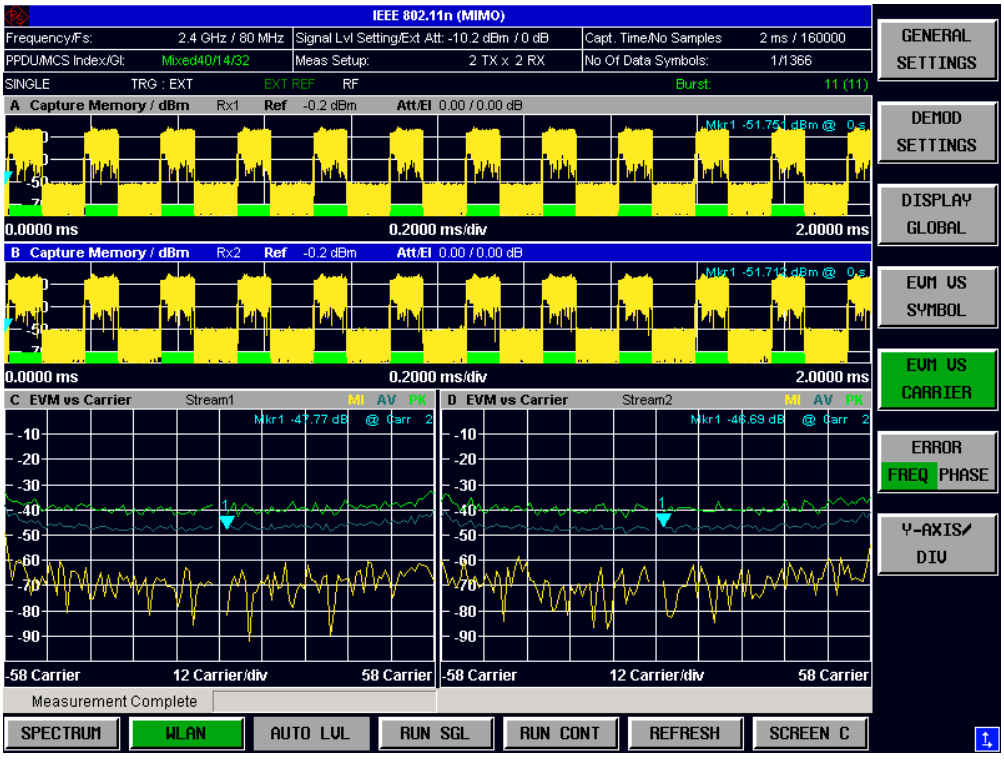
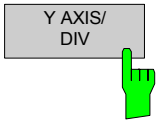


Fig. 28 EVM Vs Carrier Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:EVM:ECAR:IMM`

The EVM Vs Carrier results display shows all EVM values recorded on a per-carrier basis over the full set of measured data. An average trace is also displayed. This measurement is not available when the IEEE 802.11b or g (Single Carrier) standards are selected.

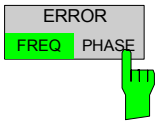
The scaling of the Y-axis can be modified to allow the results to be scaled to an optimum level.



Pressing the *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-axis to be controlled. The settings provided are the same as for the EVM Vs Symbol measurement sceen.

Remote:
```
DISP:WIND2:TRAC:Y:SCAL:AUTO
DISP:WIND2:TRAC:Y:SCAL:PDIV
UNIT:EVM
```

Error Vs Preamble



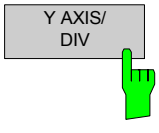
The Error Vs Preamble results are selected by pressing the *EVM* softkey in the main measurement softkey menu followed by the *ERROR FREQ/PHASE* softkey. Subsequent presses of the *ERROR FREQ/PHASE* softkey toggle the error measurement between Frequency Error Vs Preamble and Phase Error Vs Preamble.

Fig. 29 Frequency Error Vs Preamble Results.

Remote:
```
CONF:BURS:PRE:IMM
CONF:BURS:PRE:SEL FREQ
CONF:BURS:PRE:SEL PHAS
```

The Error Vs Preamble results display shows 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.

The scaling of the Y-axis can be modified to allow the results to be scaled to an optimum level.



Pressing the *Y AXIS/ DIV* softkey displays a pop-up dialog which allows the settings of the Y-axis to be controlled. The settings provided are the same as for the EVM Vs Symbol measurement sceen.

Remote:
```
DISP:WIND2:TRAC:Y:SCAL:AUTO
DISP:WIND2:TRAC:Y:SCAL:PDIV
UNIT: PRE
```

Spectrum Flatness and Group Delay

SPECTRUM FLATNESS

The Spectrum Flatness measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM FLATNESS* softkey.

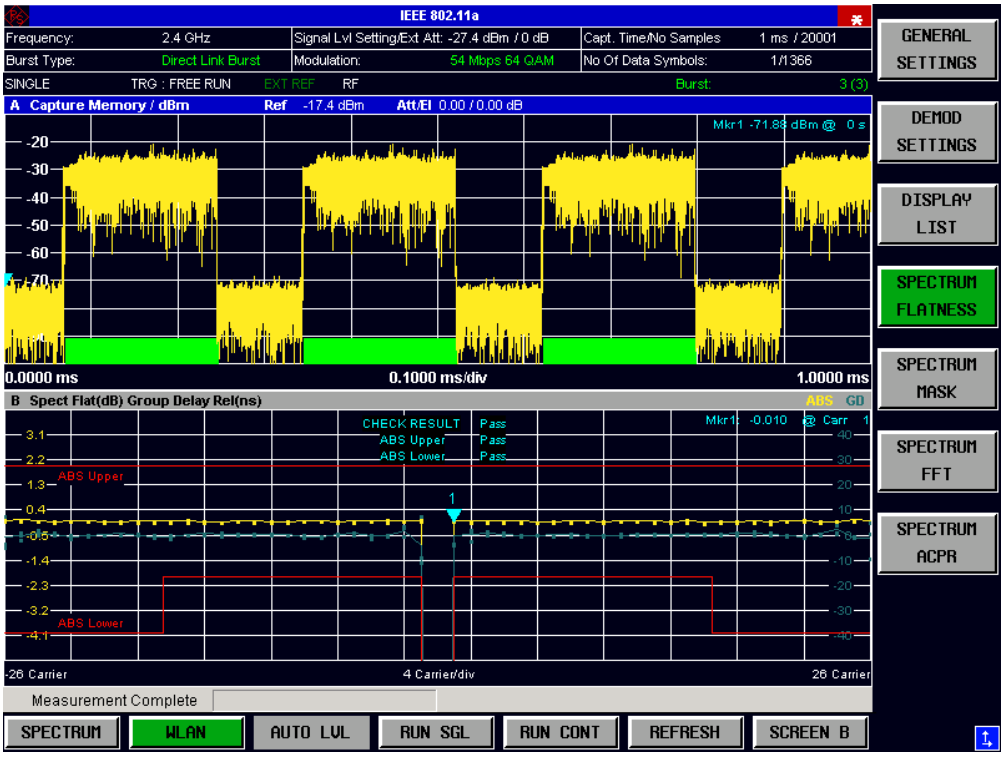


Fig. 30 Spectrum Flatness Results

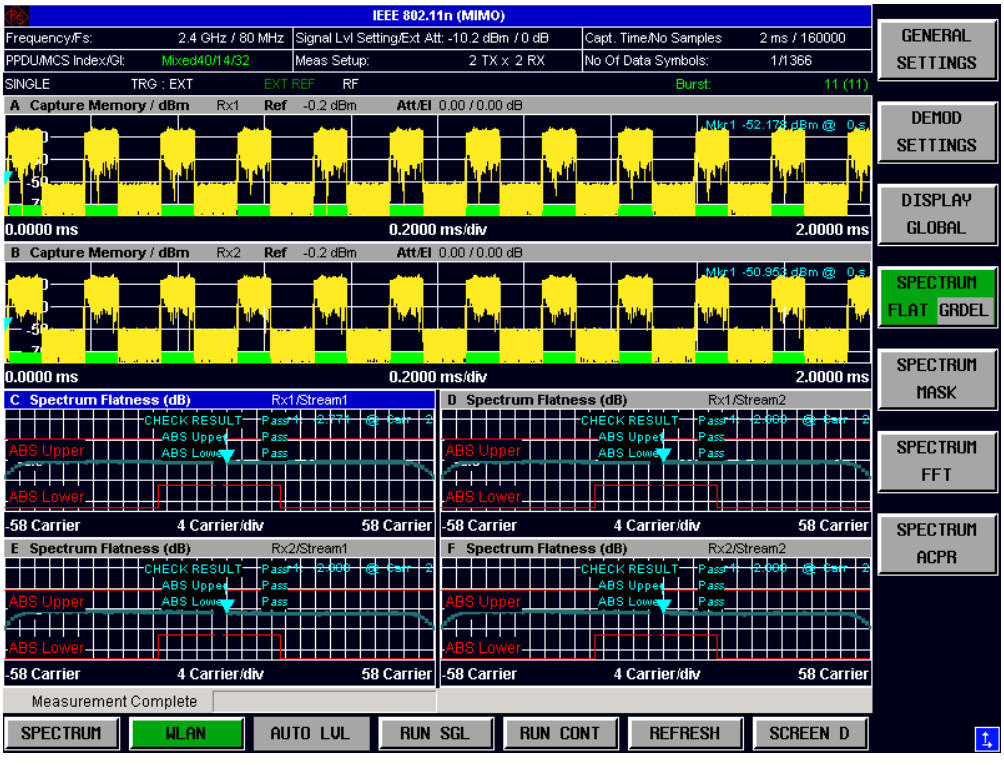


Fig. 31 Spectrum Flatness Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:SPEC:FLAT:IMM`
`CONF:BURS:SPEC:FLAT:SEL FLAT`

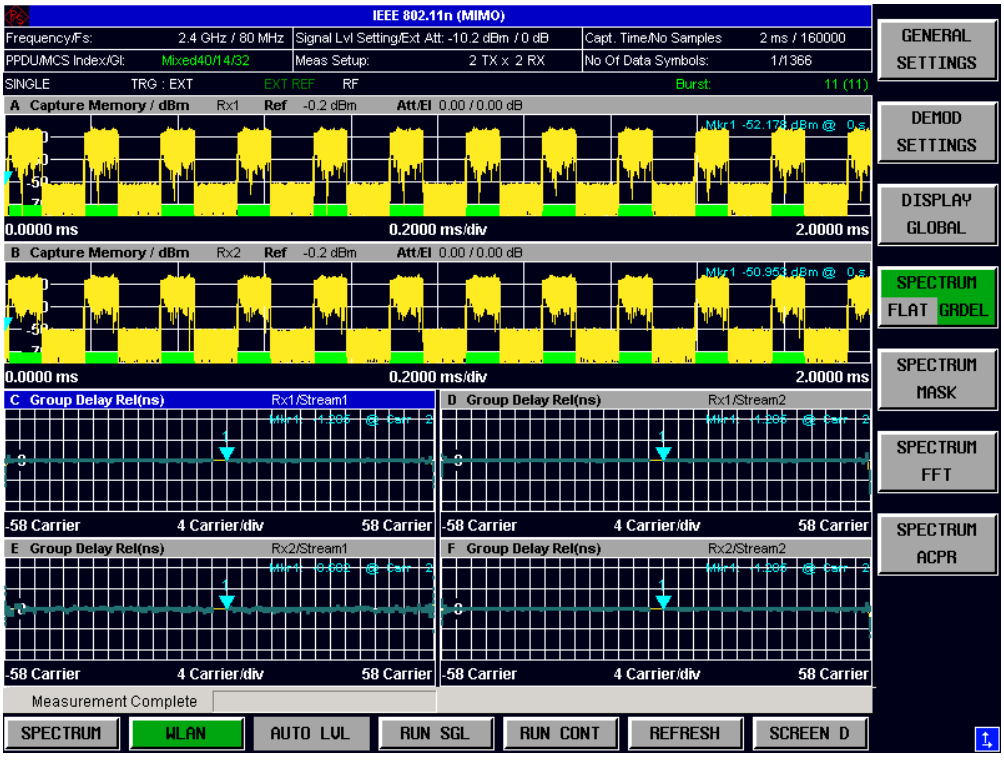
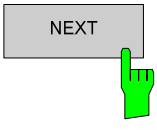


Fig. 32 Group Delay Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:SPEC:FLAT:IMM`
`CONF:BURS:SPEC:FLAT:SEL GRD`



The Spectrum Flatness and Group Delay measurements allow for IEEE 802.11 n (MIMO) the selection between the Physical and Effective Channel model. The Effective Channel Model is the composition of the physical channel and the MIMO encoder. The *CHAN SEL PHY/EFF* softkey is located in the right side menu (*NEXT* hotkey) of the Spectrum measurements.

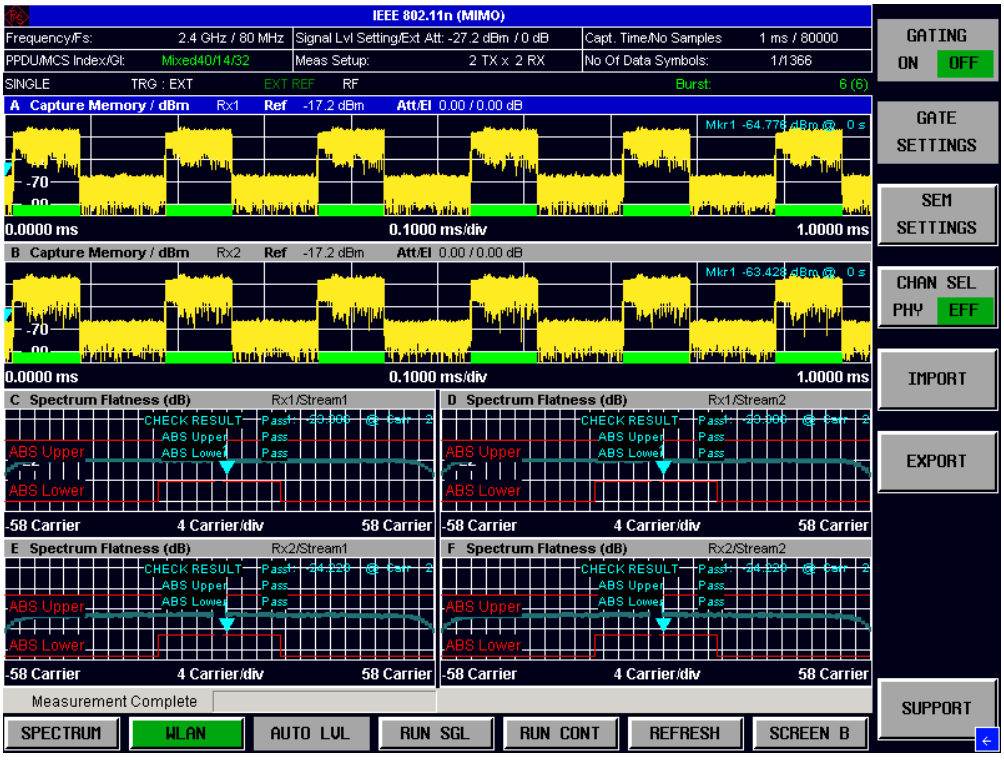


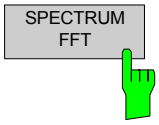
Fig. 33 Right side menu (NEXT hotkey) of the Spectrum measurements, IEEE 802.11n (MIMO)

Remote: `CONF:BURS:SPEC:FLAT:CSEL EFF | PHYS`

The Spectrum Flatness results 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. This measurement is not available when the IEEE 802.11b or g (Single Carrier) standards are selected.

GD is "zero mean" adjusted (every result is reduced by the new GD overall cariers).

Spectrum FFT



The Spectrum FFT measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM FFT* softkey.

Fig. 34 Spectrum FFT Results

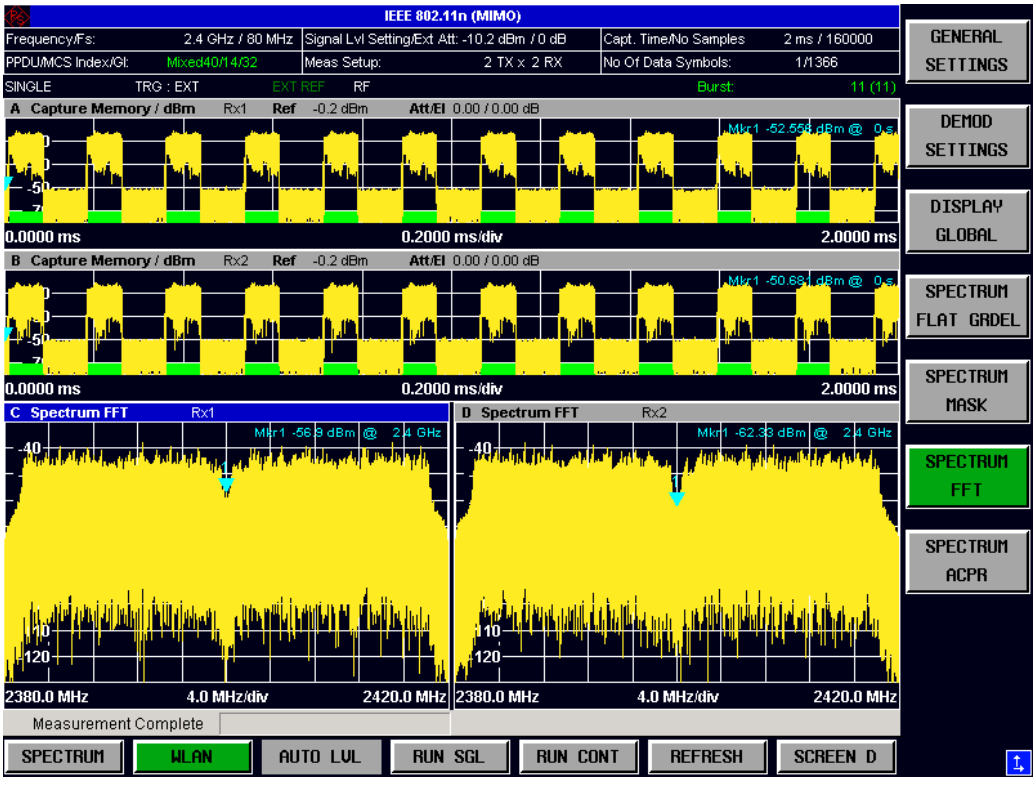
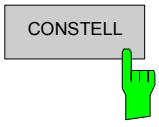


Fig. 35 Spectrum FFT Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:SPEC:FFT:IMM`

The Spectrum FFT results 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. If the gate start or gate length are altered, the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Constellation Vs Symbol



The Constellation diagram is selected by pressing the *CONSTELL* softkey in the main measurement softkey menu followed by the *CONSTELL* softkey,

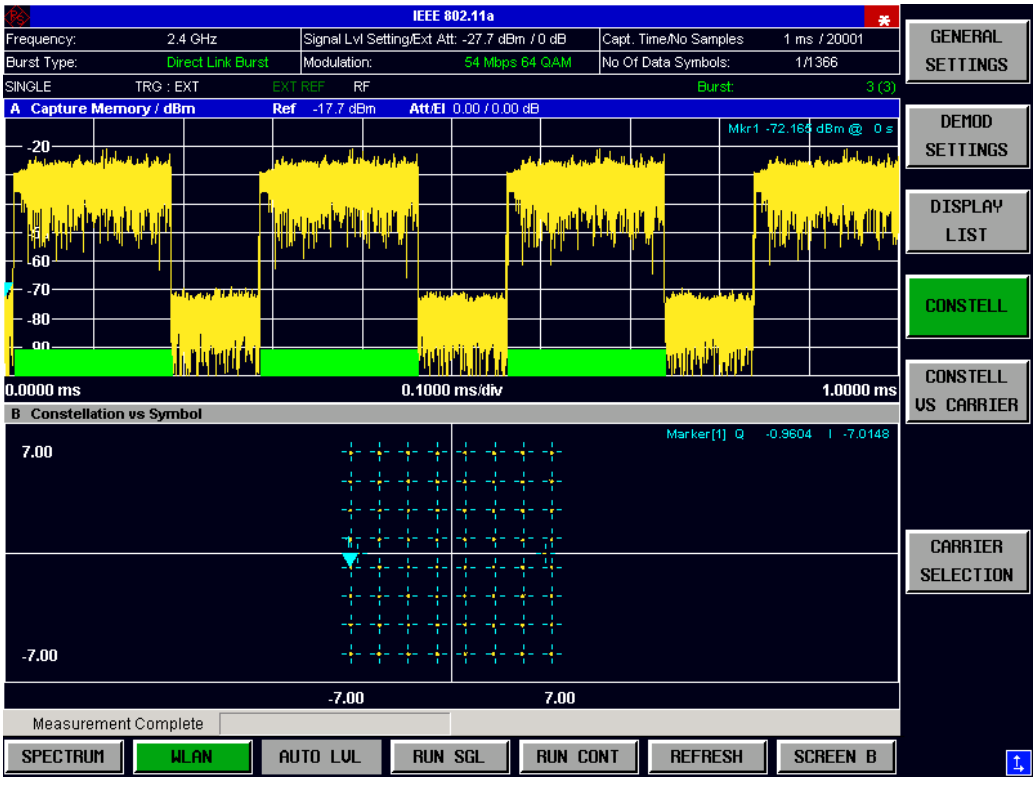


Fig. 36 Constellation Vs Symbol Results

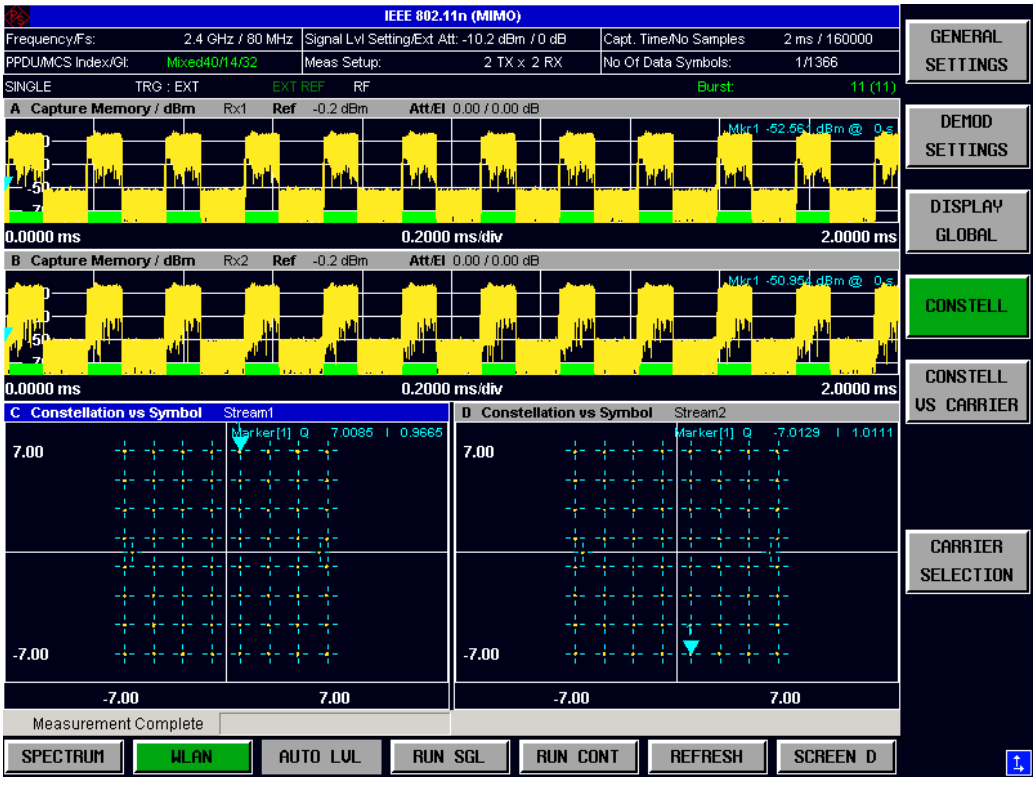
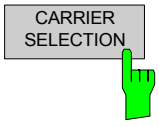


Fig. 37 Constellation Vs Symbol Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:CONS:CSYM:IMM`

The Constellation display shows the Inphase and Quadrature phase results over the full range of the measured input data. The ideal points for the selected modulation scheme are displayed for reference purposes.

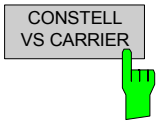
The amount of data displayed in the Constellation results display can be reduced by selecting the carrier or carriers for which data is to be displayed.



Pressing the *CARRIER SELECTION* softkey displays a pop-up dialog which allows the carrier for data display to be selected. Either a specific carrier number or pilots only can be selected. Selecting All Carriers allows all the results to be displayed. This facility is not available when the IEEE 802.11b or g (Single Carrier) standards are selected.

Remote: `CONF:BURS:CONS:CARR:SEL`

Constellation Vs Carrier



The Constellation Vs Carrier measurement results are selected by pressing the *CONSTELL* softkey in the main measurement softkey menu followed by the *CONSTELL VS CARRIER* Softkey.

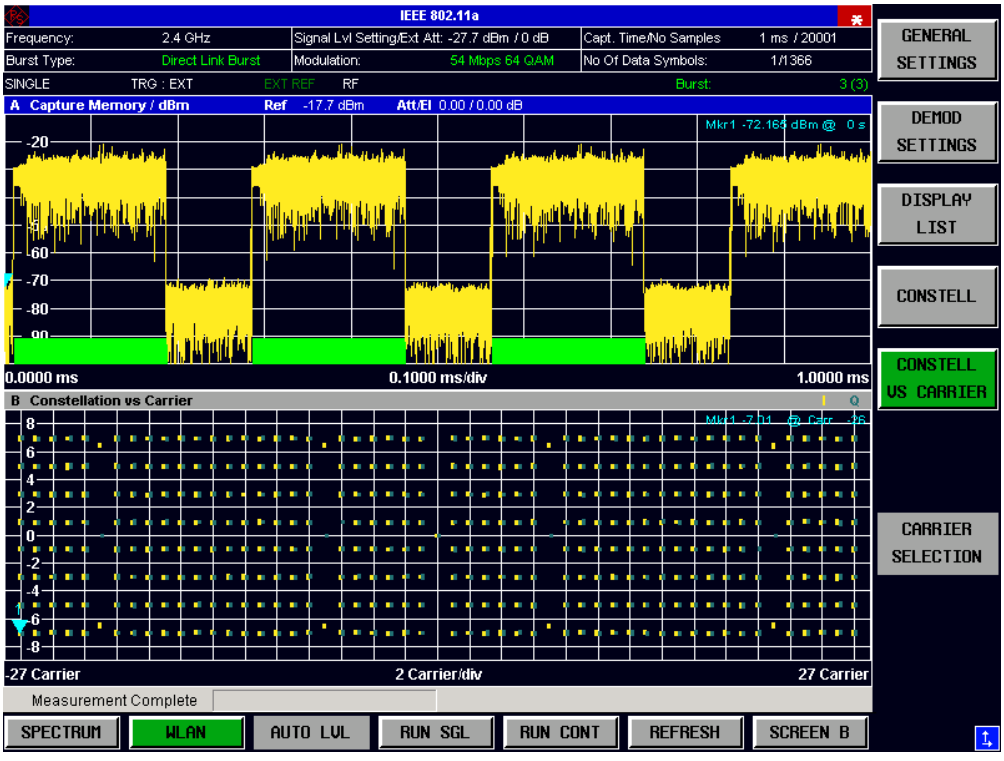


Fig. 38 Constellation Vs Carrier Results

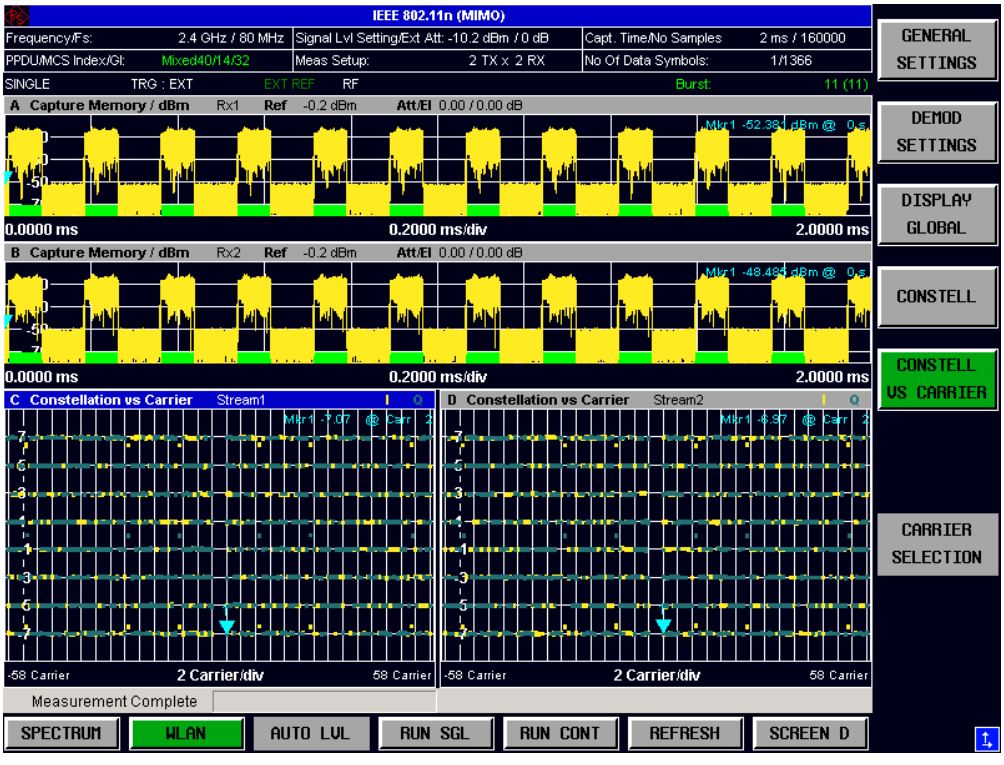
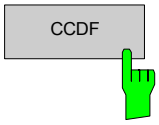


Fig. 39 Constellation Vs Carrier Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:CONS:CCAR:IMM`

The Constellation Vs Carrier results display shows the Inphase and Quadrature phase results over the full range of the measured input data plotted on a per-carrier basis. The magnitude of the Inphase and Quadrature part is shown on the Y-axis; both are displayed as separate traces (I-> trace 1, Q-> trace 2). This measurement is not available when the IEEE 802.11b or g (Single Carrier) standards are selected.

Complementary Cumulative Distribution Function (CCDF)



The CCDF measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *CCDF* softkey,

Fig. 40 CCDF Results

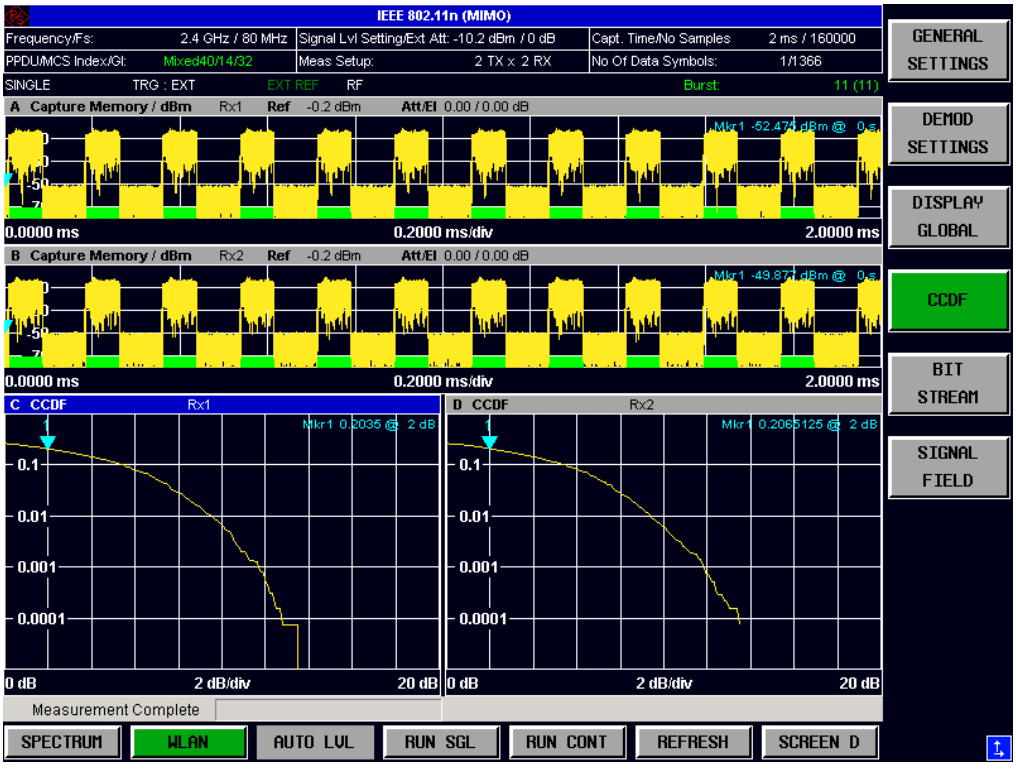
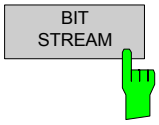


Fig. 41 CCDF Results, IEEE 802.11 n (MIMO)

Remote: CONF:BURS:STAT:CCDF:IMM

The CCDF results 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. If the gate start or gate length is altered, the results can be updated to reflect these changes by pressing the *REFRESH* hotkey.

Bit Stream



The Bit Stream measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the BIT STREAM softkey.

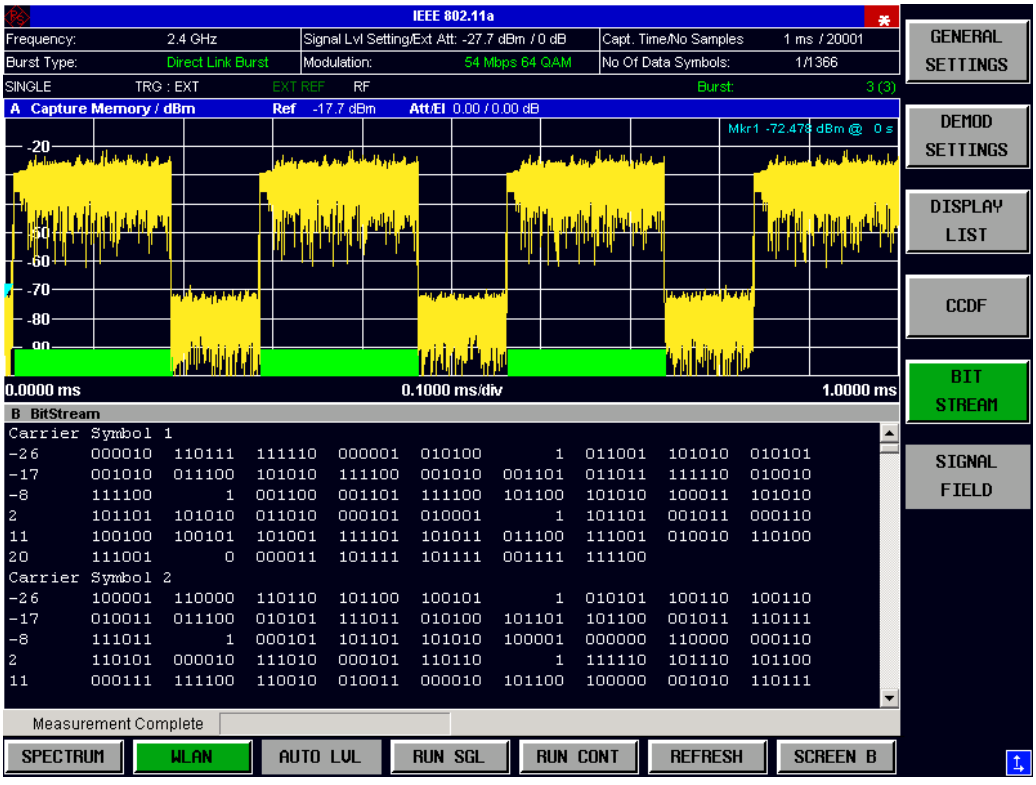


Fig. 42 IEEE 802.11a , j, g (OFDM), n and Turbo Mode Bit-Stream Results

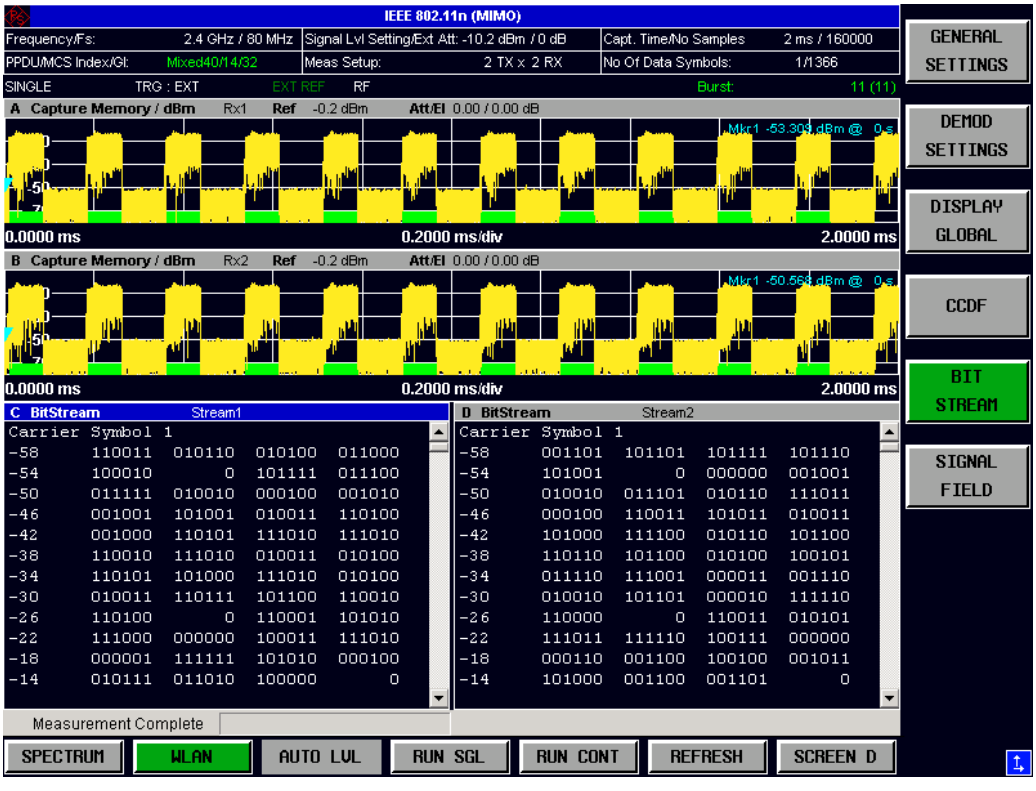


Fig. 43 Bit-Stream Results, IEEE 802.11 n (MIMO)

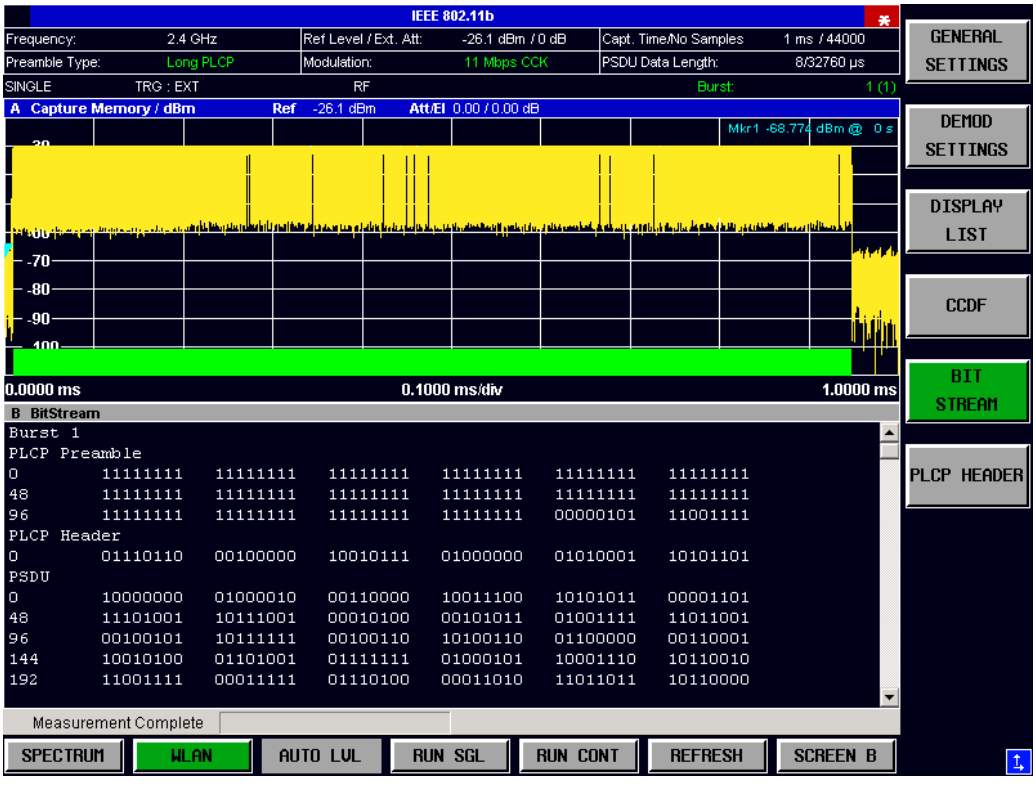


Fig. 44 IEEE 802.11b & g (Single Carrier) Bit-Stream Results

Remote: `CONF:BURS:STAT:BSTR:IMM`

The bit stream results display shows the demodulated data stream. When IEEE 802.11a, j, g (OFDM), n or Turbo Mode is selected, the results are grouped by symbol and carrier. When IEEE 802.11b or g (Single Carrier) is selected, the results are grouped by Burst. When no other dialogs are on display, the results can be scrolled through using the cursor keys or scroll wheel.

Signal Field (IEEE 802.11a, g (Single Carrier), j & n only)

SIGNAL FIELD

The Signal Field measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *SIGNAL FIELD* softkey.

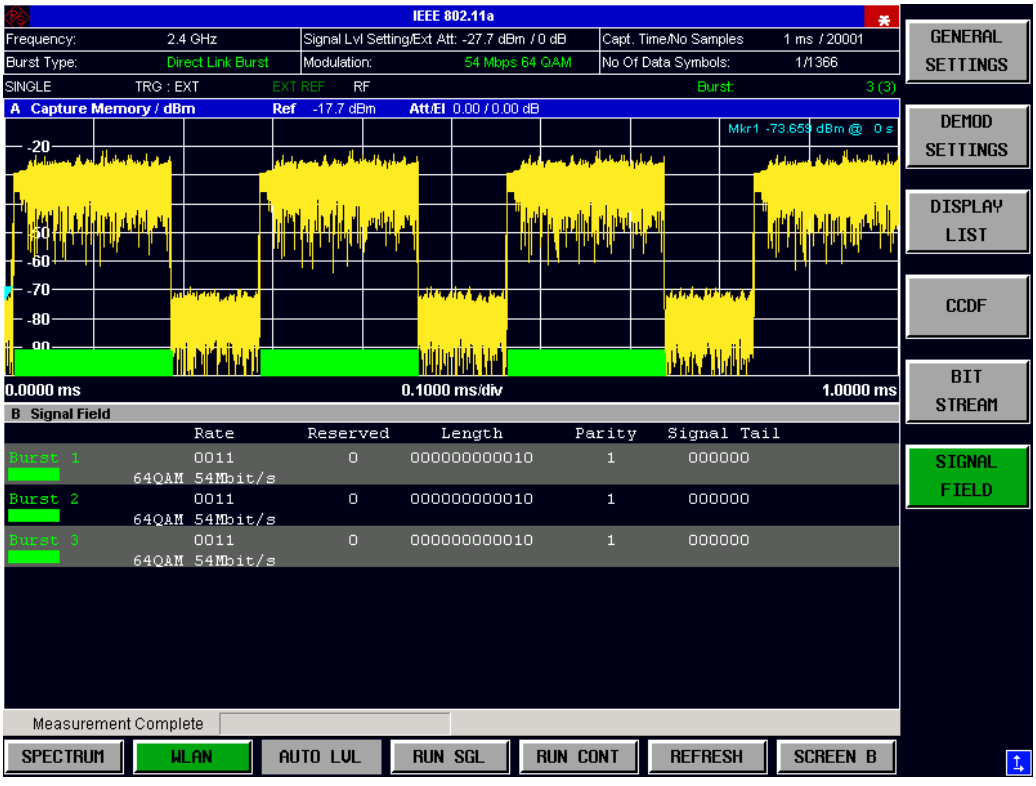


Fig. 2-45 Signal Field Results (IEEE 802.11a, g, j)

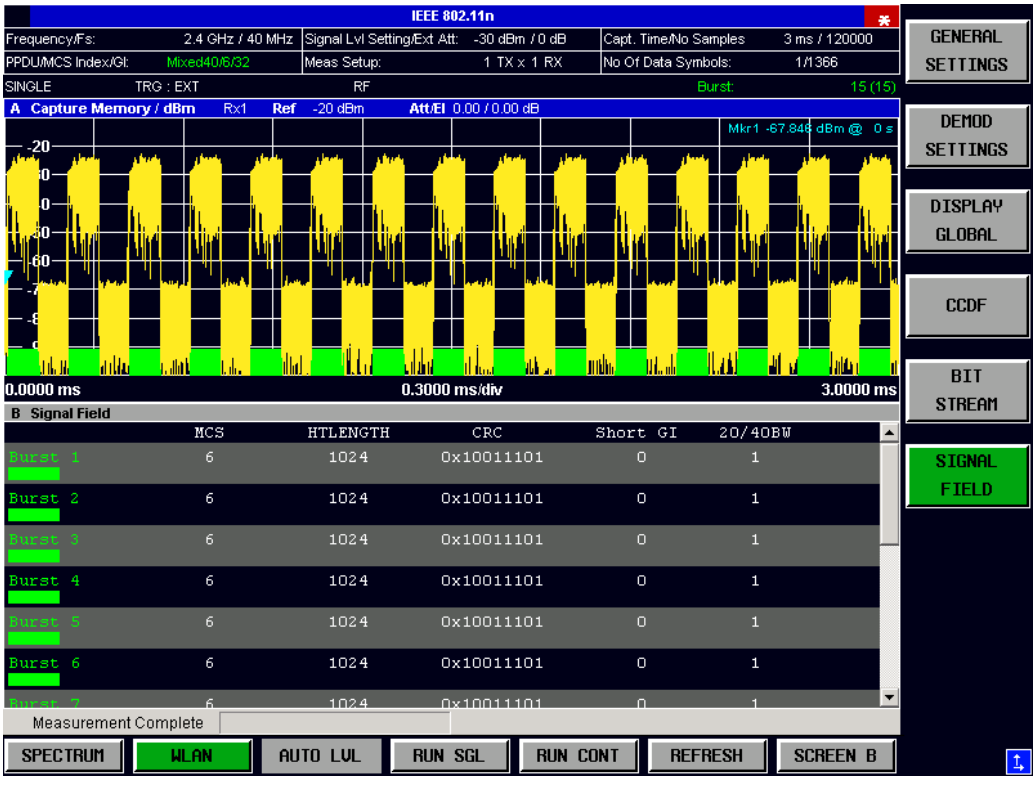


Fig. 2-46 Signal Field Results (IEEE 802.11n)

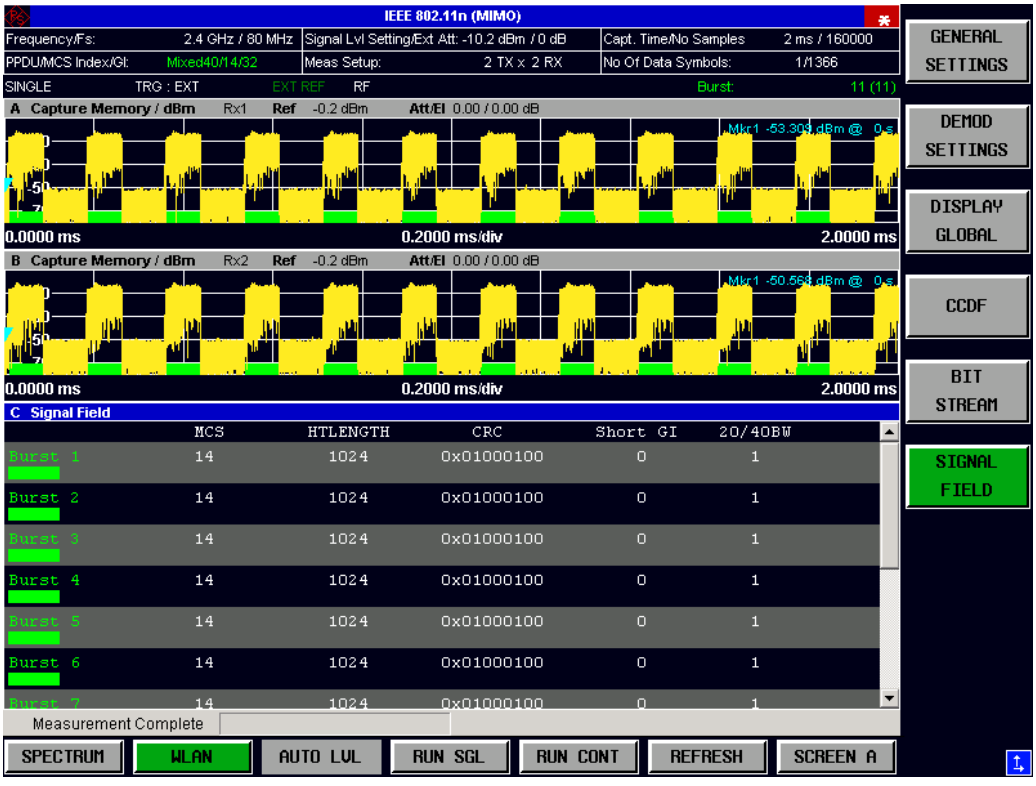
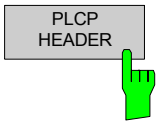


Fig. 47 Signal Field Results, IEEE 802.11 n (MIMO)

Remote: `CONF:BURS:STAT:SFI:IMM`

The Signal Field results display shows the decoded data from the signal field of the burst. For this reason, the Signal Field Measurement results are only selectable when the *Use Signal Field Content* paramter is selected in the Demod Settings When no other dialogs are on display, the results can be scrolled through using the cursor keys or scroll wheel. This measurement is not available when the IEEE 802.11b standard is selected.

PLCP Header (IEEE 802.11b only)



The PLCP Header measurement results are selected by pressing the *STATISTICS* softkey in the main measurement softkey menu followed by the *PLCP HEADER* softkey.

Fig. 2-48 PLCP Header Results

The PLCP Header results display shows the decoded data from the PLCP header of the burst. The format of the results is shown below:

Shows the number of the decoded burst. If a coloured block appears under the label then this indicates that the burst was sucessfully decoded.

Shows the length field. The decoded time to transmit the PSDU is shown below

Shows the CRC field. Below this is shown "OK" if the CRC passes or "Failed" if the CRC fails

	Signal	Service	PSDU Length	CRC
Burst 1	01101110	00100000	0000001011101001	1011010110001010
	11 Mbits/s	Locked/CCK/--	745 µs	OK

Shows the signal field. The decoded date rate is shown below

Shows the service field. The highlighted bits are those bits currently used. The text below shows the decoded meaning of the highlighted bits as follows:

bit 2 - Shows "---" if the symbol clock is not locked
Shows "Locked" if the symol clock is locked

bit 3 - Shows "---" if the data rate is below 5.5 Mbit/s
Shows "CCK" if CCK modulation is selected
Shows "PBCC" if PBCC modulation is slected

bit 7 - Shows "---" if the length extension bit is not set
Shows ">8/11" if the length extension bit is set

When no other dialogs are on display, the results can be scrolled through using the cursor keys or scroll wheel. This measurement is only available when the IEEE 802.11b or g (Single Carrier) standard is selected.

Frequency Sweep Measurements

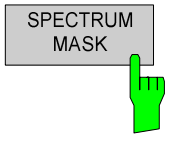
The following measurement results are obtained in frequency sweep mode:

- Spectrum Emission Mask

- Spectrum ACPR (IEEE 802.11a, b, g, n & Turbo Mode only)
- Spectrum ACP (IEEE 802.11j only)

Frequency sweep measurements use different signal data than IQ measurements. Thus, it is not possible to run an IQ measurement and then view the results in the frequency sweep measurement and vice versa. Also, because each of the frequency sweep measurements use different settings to obtain signal data, it is not possible to run a frequency sweep measurement and view the results in another frequency sweep measurement.
All frequency sweep measurements are run in full-screen mode. Frequency sweep measurements are only available when RF input is selected.

Spectrum Emission Mask



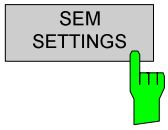
The Spectrum Emission Mask measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM MASK* softkey.

Fig. 49 Spectrum Emission Mask Results

The Spectrum Mask results display shows power against frequency. The span of the results is related to the specified sample rate. 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. If the *Sweep Count (Mask/ACP)* parameter in the General Settings view is set to any value other than 1 then the measurement is performed over the specified number of sweeps.
When the measurement is performed over multiple sweeps a max hold trace is displayed

as well as an average trace.The Spectrum Emission Mask measurement can be configured from the SEM settings dialg. The corresponding softkey is located in the right side menu (*NEXT* hotkey).

Remote: CONF:BURS:SPEC:MASK:IMM



The *SEM SETTINGS* softkey brings up the SEM Settings dialog.

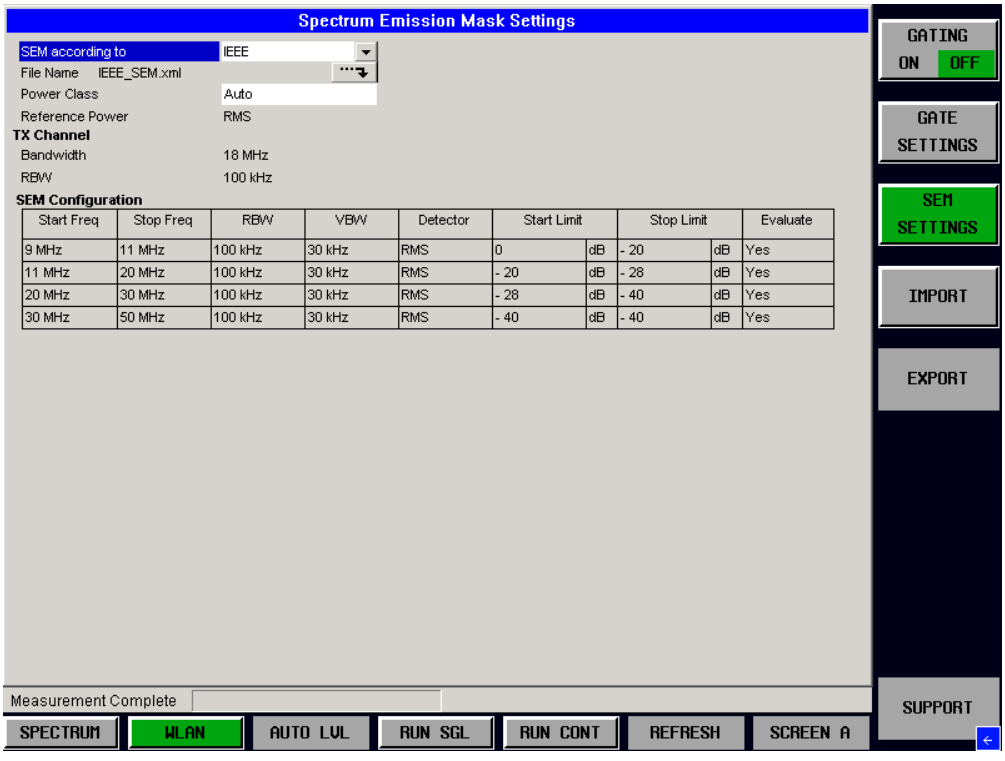
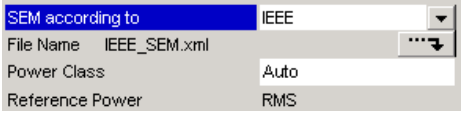


Fig. 50 ACP Settings view

IEC/IEEE-bus command: `SENS:POW:SEM USER|IEEE|ETSI`
IEC/IEEE-bus command: `CONF:BURSt:SPEC:MASK:SEL IEEE | ETSI`
IEC/IEEE-bus command: `SENS:POW:SEM:CLAS`

SEM according to



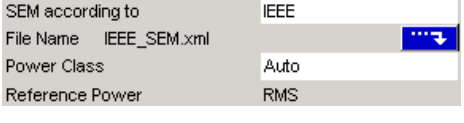
SEM according to specifies how the Spectrum Emission Mask settings and limits are applied. This parameter provides the following settings:

ETSI – Settings and limits are as specified in the standard

IEEE – Settings and limits are as specified in the standard

User – Settings and limits are configured via an XML file

File Name



When **User** settings are specified, *File Name* shows the name of the loaded XML file. Clicking the arrow switches to the File Manager to locate an XML file, and automatically selects *SEM According To:* **User.**
When using TTA/ETSI/IEEE standards, *File Name* reflects the name of the built-in configuration.

Remote: `MMEM:LOAD:SEM:STAT`

SEM Configuration

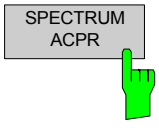
The SEM configuration shows the settings and limits applied over specified frequency ranges around the TX channel. The settings displayed are dependent on the selected *Link Direction* and *Power Class*

SEM Configuration

Start Freq	Stop Freq	RBW	VBW	Detector	Start Limit		Stop Limit		Evaluate
9 MHz	11 MHz	100 kHz	30 kHz	RMS	0	dB	- 20	dB	Yes
11 MHz	20 MHz	100 kHz	30 kHz	RMS	- 20	dB	- 28	dB	Yes
20 MHz	30 MHz	100 kHz	30 kHz	RMS	- 28	dB	- 40	dB	Yes
30 MHz	50 MHz	100 kHz	30 kHz	RMS	- 40	dB	- 40	dB	Yes

Fig. 51 SEM Configuration

Spectrum ACPR (IEEE 802.11a, b, g, n & Turbo Mode only)



The Spectrum ACPR measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *SPECTRUM ACPR* softkey.

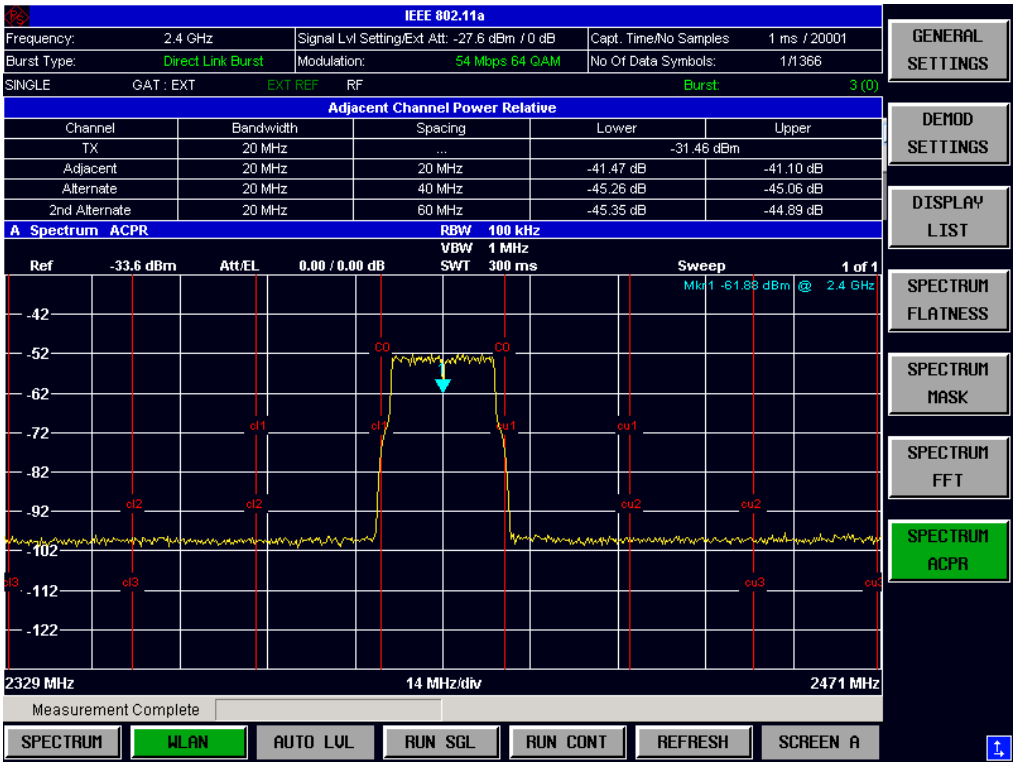
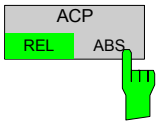


Fig. 52 Spectrum ACPR Results

The Spectrum ACPR (Adjacent Channel Power (Relative)) 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 on either side of the measured channel. This measurement is the same as the Adjacent Channel Power measurement provided by the Spectrum Analyzer. If the *Sweep Count (Mask/ACPR)* parameter in the General Settings view is set to any value other than 1, the measurement is performed over the specified number of sweeps. When the measurement is performed over multiple sweeps, a max hold trace is displayed as well as an average trace.

Remote: CONF:BURS:SPEC:ACPR:IMM

Spectrum ACP (IEEE 802.11j only)



The Spectrum ACP measurement results are selected by pressing the *SPECTRUM* softkey in the main measurement softkey menu followed by the *ACP REL/ABS* softkey. Subsequent presses of the *ACP REL/ABS* softkey toggle the measurement between relative and absolute results display.

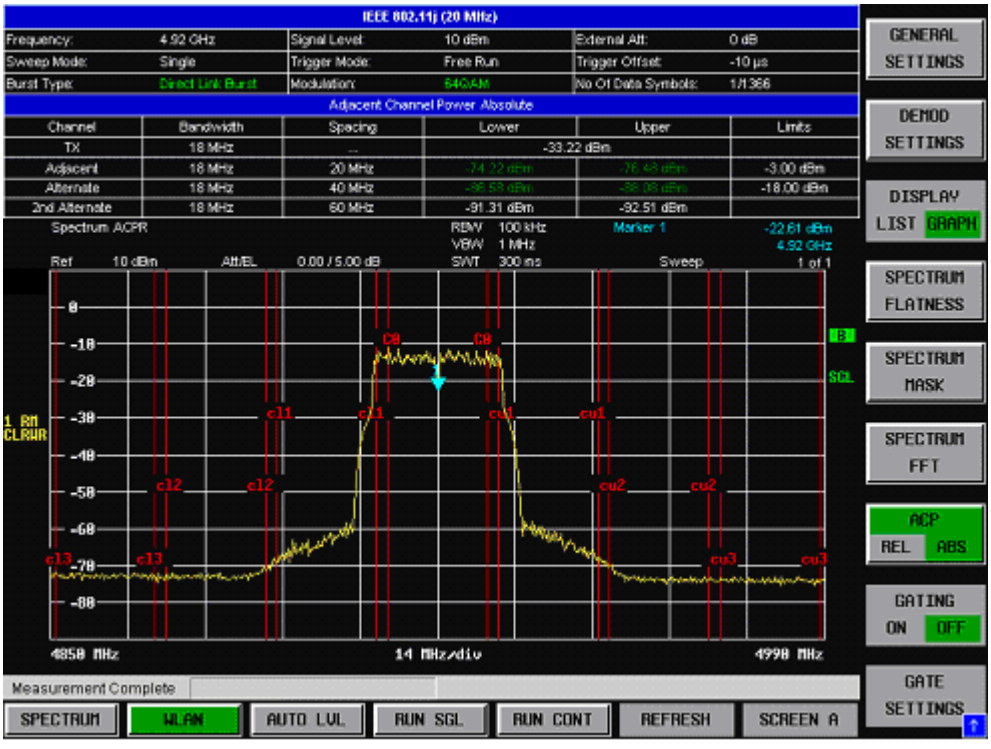


Fig. 53 Spectrum ACPR Results

The Spectrum ACPR (Adjacent Channel Power (Relative)) 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 on either side of the measured channel. This measurement is the same as the Adjacent Channel Power measurement provided by the Spectrum Analyzer. If the *Sweep Count (Mask/ACP)* parameter in the General Settings view is set to any value other than 1, the measurement is performed over the specified number of sweeps. When the measurement is performed over multiple sweeps, a max hold trace is displayed as well as an average trace.

If the current measurement frequency and measurement type (relative or absolute) have a limit specified by the standard, the limit is displayed and the result is displayed in either green or red depending on whether the result passes or fails the associated limit.

Remote: `CONF:BURS:SPEC:ACPR:IMM`
`SENS:POW:ACH:MODE`

Automatic Level Detection

Automatic level detection allows the Signal Level setting to be calculated from the input signal.

Automatic level detection can be performed in one of two ways:

- Pressing the *AUTO LVL* hot-key
- Setting *Auto Level* in the General Settings view to ON

Running the Automatic Level Detection by pressing the *AUTO LVL* hotkey allows the level detection to be run at any time. Once the Automatic Level Detection has been completed, the trace is displayed in the Magnitude Capture Buffer display.

Running the Automatic Level Detection by setting *Auto Level* in the General Settings view to ON means that an Automatic Level Detection measurement is executed before each main measurement sweep.

When running the Automatic Level Detection this way, no trace for the Automatic Level Detection measurement is displayed. This way of running the Automatic Level Detection will cause measurements to run more slowly. Thus, it is recommended that Automatic Level Detection is run in this way only when the speed of measurement is not important or when continuous measurements are being run with a signal that varies in level from one sweep to the next.

Automatic Level Detection Vs Manual Settings

In most situations, automatic level detection provides the simplest and most accurate method for setting the signal level. In some cases, it may be preferable to use manual settings to specify the signal level, e.g:

- The automatic level detection algorithm uses a free-run trigger. The meas time can be set (Auto Level Time). Default value is 100 ms. If the signal being measured has an idle period between bursts of greater than the default value of Auto Level Time the value has to be corrected correspondingly.
- The automatic level detection can be used for signals with bursts of varying level only if the highest level burst is always contained in the Auto Level Time interval.
- If measurement speed or reduction of the mechanical attenuator use is a priority, manual settings should be used.
- The automatic level detection algorithm does not work successfully for signals near 0 Hz. Manual settings should be used in this case.

In the above cases, the *Auto Level* setting in the General Settings view should be switched off. The Signal Level, Reference Level and Attenuation settings can then be set in the Advanced Settings in the General settings view. See Section *Advanced Settings* for further details.

For measurement speed issues please see also the chapter for Auto power trigger level settings.

Running measurements

To start a measurement, press the *RUN SGL* hotkey (single) or *RUN CONT* hotkey (continuous).

A single measurement will complete once the requested number of bursts has been obtained or a single sweep has been completed, depending on the measurement settings. When a measurement is completed in continuous mode, a new measurement will be started.

Note: If one measurement is started while another measurement is in progress (for example, a single measurement is started while a continuous measurement is in progress), the first measurement will be aborted and the new measurement started immediately.

During a measurement, the text "*Running...*" is displayed in the Status Bar at the bottom of the screen. After successful completion of a single measurement, the Status Bar will display "*Measurement Complete*".

Measurement results

The tabular settings summary below the title bar shows the overall measurement settings used to obtain the current measurement results.

Fig. 37 Overall measurement settings summary for IEEE 802.11a , g (OFDM), j and Turbo Mode

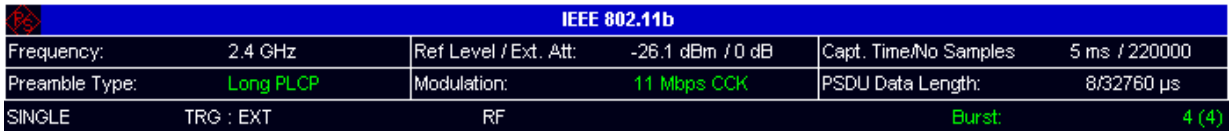


Fig. 38 Measurement settings summary for IEEE 802.11b & g (Single Carrier)

Fig. 54 Measurement settings summary for IEEE 802.n SISO

The settings summary includes the following information:

- yFrequenc — The frequency of the measured input signal. Note that no value is displayed in this field when baseband input is selected.
- Fs — The spectrum analyzer sampled the signal with this *Input Sample Rate Fs*. IEEE 802.11n only.
- Signal Level Setting — The expected mean signal level for the input signal. IEEE 802.11a, g (OFDM), j, n and Turbo Mode only.
- Ref Level — The reference level (hardware setting of the analyzer) used for the input signal. IEEE 802.11b & g (Single Carrier) only.
- 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).

  For example:

  External Att = 10 dB means that a 10 dB attenuator is used before the RF connector of the R&S FSQ

  External Att = -20 dB means that an amplifier with 20 dB gain is used before the RF-connector of the R&S FSQ
- Capture Time — The spectrum analyzer samples the signal for this time interval length.
- No Samples — Number of samples for this *Capture Time* interval generated at *Input Sample Rate Fs.*
- Burst Type — The type of burst being analyzed. IEEE 802.11a, g (OFDM), j and Turbo Mode only.
- Preamble Type — The type of preamble of analyzed bursts. IEEE 802.11b & g (Single Carrier) only.
- PPDU/MCS Index/GI — The PPDU Type, MCS Index and Guard Interval used for the analysis of the signal is displayed. Depending on the Demod Settings, these values are either automatically detected from the signal or the user settings are applied. IEEE 802.11n only.
- Modulation — Shows either the settings of the *Demodulator* or *PSDU Modulation to Analyze* from the Demod Settings view depending on which parameter is active.

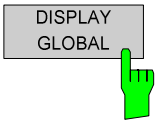
- Meas Setup — MIMO measurement setup according the the *STC/MIMO* settings panel configuration. 802.11n MIMO only.
- No Of Data Symbols — Shows the minimum and maximum number of data symbols that a burst may have if it is to be considered in results analysis. IEEE 802.11a, g (OFDM), j, n and Turbo Mode only.
- 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.
- Sweep Mode — The sweep mode according to the user hot key selection is shown here. *SINGLE* for *RUN SGL* and *CONTINUOUS* for *RUN CONT*.
- Trigger Mode — The trigger source used to start the measurement sweep. In case of a gated sweep, this information is displayed in this field as well.
- Input Path — The input path of the signal according to the selection of the General Settings panel is displayed here.
- Burst *x* of *y* (*z*) — In case statistic over bursts is switched on (*Overall Burst Count*), *x* bursts of totally required *y* (*No of Bursts to Analyze*) bursts have been analyzed so far. The value *z* gives the number of analyzed bursts by the last update of the statistic.

Result Summary

The result summary table is displayed for IQ measurements when the display mode is set to List. This table shows the overall measurement results and provides limit checking for result values in accordance with the selected standard.

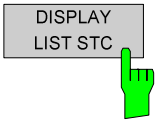
Fig. 55 Result Summary Table

Result values that are within the limit specified by the standard are displayed in green. Result values that are outside the limits specified by the standard are displayed in red with a '*' to the left. Results that have no limits specified by the standard are displayed in white. Limit values are displayed in white (not bold).



The global result summary (IEEE 802.11 n (MIMO) only) is displayed by pressing the *DISPLAY GLOBAL* softkey in the main measurement softkey menu.

Fig. 56 Global Result Summary, IEEE 802.11 n (MIMO)



The overview STC result summary (IEEE 802.11 n (MIMO) only) is displayed by pressing the *DISPLAY LIST STC* softkey in the main measurement softkey menu.

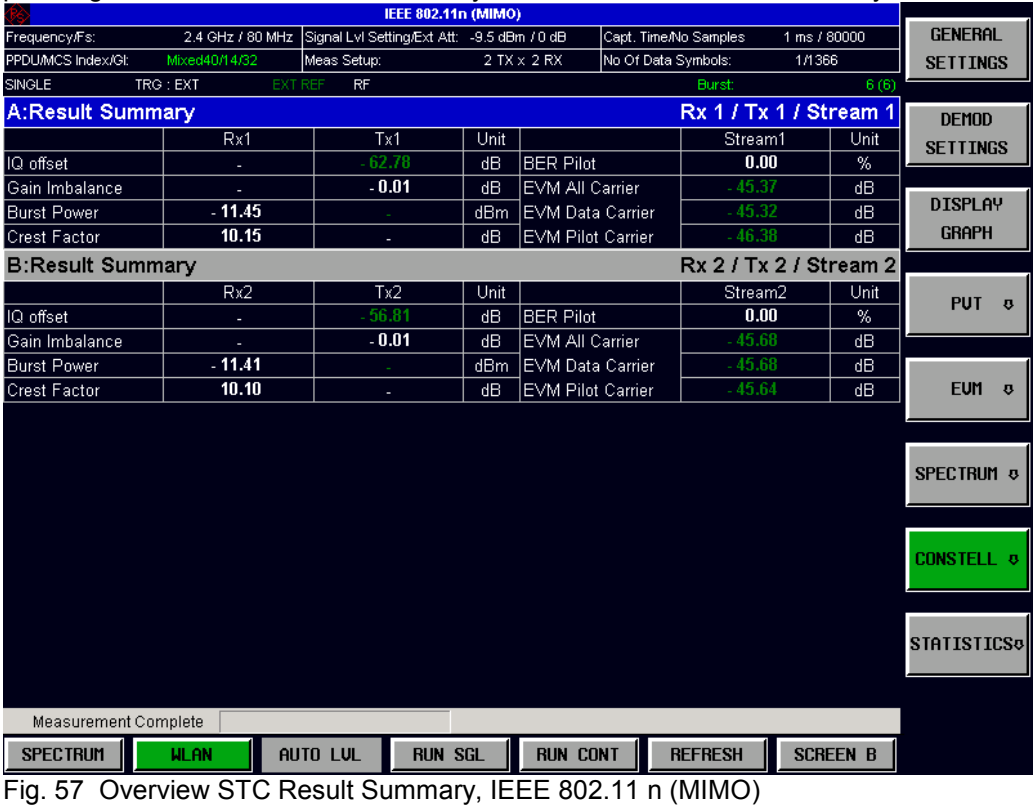
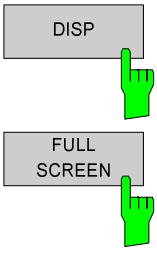


Fig. 57 Overview STC Result Summary, IEEE 802.11 n (MIMO)



The detailed STC result summary (IEEE 802.11 n (MIMO) only) is displayed by selecting overview STC result summary - with the Rx/Tx/Stream results in question - pressing the *SCREEN* … hotkey. Afterwards press the *DISP* hardkey followed by the *FULL SCREEN* softkey to show the detailed STC result summary .

IEEE 802.11n (MIMO)

Frequency/Fs:	2.4 GHz / 80 MHz	Signal Lvl Setting/Ext Att:	-9.5 dBm / 0 dB
Capt. Time/No Samples	1 ms / 80000	PPDU/MCS Index/GI:	Mixed40/14/G2
Meas Setup:	2 TX x 2 RX	No Of Data Symbols:	1/1366
SINGLE	TRG : EXT	EXT REF	RF
Burst:	6 (6)		

Tx 2

	Min	Mean	Max	Unit
IQ Offset	-57.43	-56.81	-55.96	dB
Gain Imbalance	-0.11	-0.09	-0.07	%
	-0.01	-0.01	-0.01	dB
Quadrature Error	0.00	0.01	0.02	°
Burst Power	-	-	-	dBm
Crest Factor	-	-	-	dB

Rx 2

	Min	Mean	Max	Unit
Burst Power	-11.41	-11.41	-11.41	dBm
Crest Factor	10.09	10.10	10.11	dB

Stream 2

	Min	Mean	Max	Unit
BER Pilot	0.00	0.00	0.00	%
EVM All Carriers	0.50	0.52	0.54	%
	-45.94	-45.68	-45.29	dB
EVM Data Carrier	0.50	0.52	0.55	%
	-45.96	-45.68	-45.23	dB
EVM Pilot Carrier	0.48	0.52	0.56	%
	-46.40	-45.64	-45.10	dB

Measurement Complete

SPECTRUM | WLAN | AUTO LVL | RUN SGL | RUN CONT | REFRESH | SCREEN A

FULL SCREEN | SPLIT SCREEN

Fig. 58 STC Overview Result Summary, IEEE 802.11 n (MIMO)

For a detailed explanation of the results displayed in the Results Summary table, see Section 3.

The limit values in the table of results can be modified.

LINES

Pressing the *LINES* hardkey allows limits to be selected and modified.

Fig. 59 Editting Limit Values

Remote:
```
CALC:LIM:BURS:ALL
CALC:LIM:BURS:EVM:ALL:AVER
CALC:LIM:BURS:EVM:ALL:MAX
CALC:LIM:BURS:EVM:DATA:AVER
CALC:LIM:BURS:EVM:DATA:MAX
CALC:LIM:BURS:EVM:PIL:AVER
CALC:LIM:BURS:EVM:PIL:MAX
CALC:LIM:BURS:FERR:AVER
CALC:LIM:BURS:FERR:MAX
CALC:LIM:BURSt:IQOF:AVER
CALC:LIM:BURSt:IQOF:MAX
CALC:LIM:BURSt:SYMB:AVER
CALC:LIM:BURSt:SYMB:MAX
```

Limits are modified for the currently selected modulation scheme. Each modulation scheme may have its own set of user-defined limits.

DEFAULT CURRENT

Pressing the *DEFAULT CURRENT* hardkey resets all limits for the current modulation scheme to the values specified in the selected standard.

Remote: `CALC:LIM:BURS:ALL DEF`

DEFAULT ALL

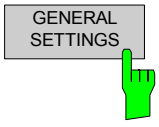
Pressing the *DEFAULT ALL* hardkey resets all limits for all modulation schemes to the values specified in the selected standard.

Remote: `CALC:LIM:BURS:ALL DEF`

The results displayed in this table are for the entire measurement. If a specific number of bursts has been requested that requires more than one sweep, the results summary 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.
If more than one burst is evaluated (several analyzed bursts in the capture buffer or with the help of Overall Burst Count), the Min/Mean/Max columns show the minimum, mean or maximum values of the burst results.

General Settings

This section of the user manual describes the General Settings view where all settings related to the overall measurement can be modified, i.e. the Signal Characteristics, Data Capture, Trigger, IQ, Input and Advanced Settings.



The *GENERAL SETTINGS* softkey brings up the General Settings view.

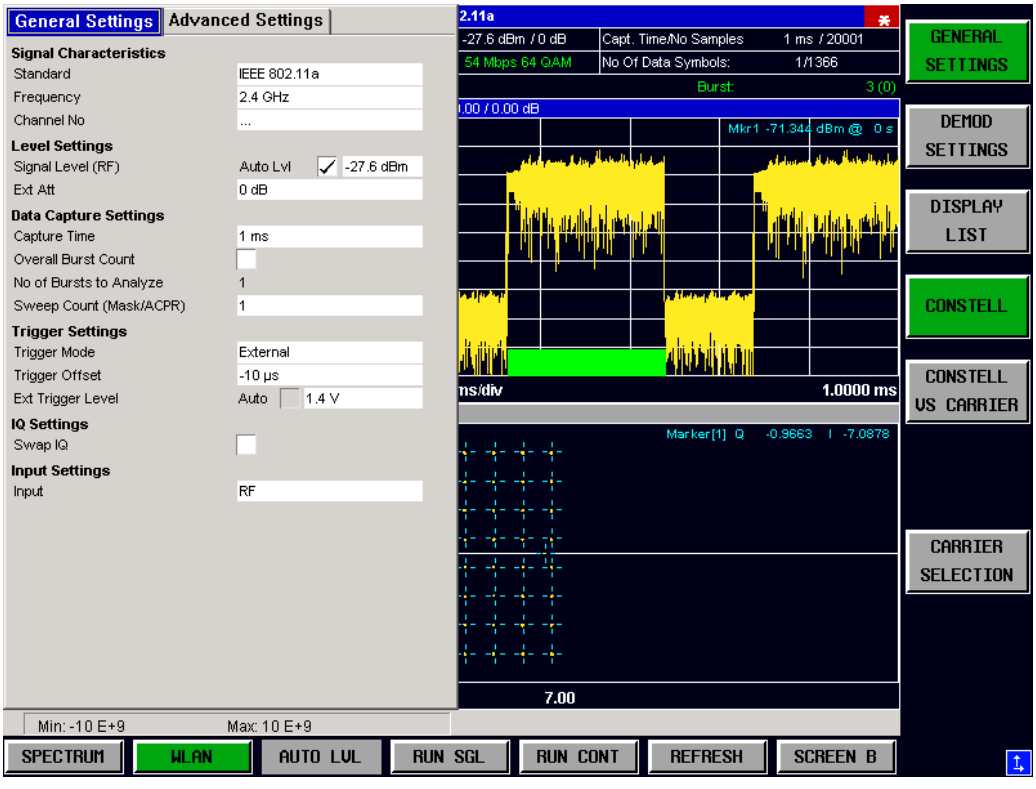


Fig. 60 General Settings view

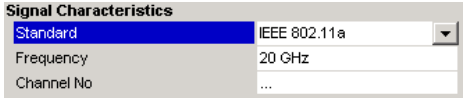
The parameters within the General settings view are logically grouped together into:

- Signal Characteristics
- Level Settings
- Data Capture Settings
- Trigger Settings
- IQ Settings
- Input Settings

Signal Characteristics

The Signal Characteristics settings are the general settings concerning the standard and frequency of the signal to be measured.

Standard

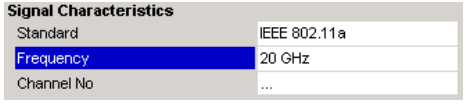


Standard is used to select the wireless LAN standard to be measured against. This is necessary to ensure that the measurements are performed according to the specified standard with the correct limit values and limit lines.

This parameter provides a list of settings. The list provided depends on the standards that have been installed.

Remote: `CONF:STAN`

Frequency



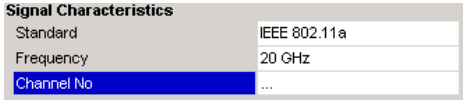
Frequency specifies the Center Frequency of the signal to be measured.
When the *Frequency* is modified, the *Channel No* parameter is updated accordingly.

The *Frequency* parameter is editable when baseband input is selected however the frequency range is limited according to the setting of the IQ Path parameter as follows:

IQ Path = I or Q. Range = 0 to 35 MHz
IQ Path = I + j*Q Range = -35 to 35 MHz

Remote: `SENS:FREQ:CENT`

Channel No



Channel No specifies the channel to be measured.

When the *Channel No* is modified, the *Frequency* parameter is updated accordingly.

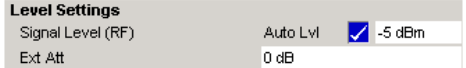
The *Channel No* parameter is not editable when baseband input is selected, because *Channel No* only makes sense for an RF signal

Remote: `CONF:CHAN`

Level Settings

The Level Settings are the general settings concerning the level of the signal to be measured.

Auto Level



Auto Level selects whether the reference level for measurements is measured automatically (ON) or entered manually by the user (OFF).
When *Auto Level* is set to ON, R&S FSQ-K90/K91/K91n will measure the reference level automatically at the start of each measurement sweep. This ensures that the reference level is always set at the optimum level for obtaining accurate results but will result in slightly increased measurement times. For details about automatic level detection, see section Automatic Level Detection.

Remote: `CONF:POW:AUTO`

Signal Level (RF)

Signal Level (RF) specifies the expected mean level of the RF input signal.

The *Signal Level (RF)* is updated after an automatic level detection measurement has been executed when RF input is selected.

The *Signal Level (RF)* parameter is not editable when baseband input is selected because *Signal Level (RF)* only makes sense for an RF signal.

For all standards other than IEEE 802.11b & g that apply when the *Signal Level (RF)* is updated, the *Reference Level* will be set 10 dB higher because of the expected Crest Factor of the signal. For standards IEEE 802.11b & g, the *Reference Level* will be set to the *Signal Level (RF).*

Remote: `CONF:POW:EXP:RF`

Signal Level (Baseband)

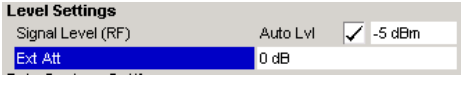
Signal Level (Baseband) specifies the expected level of the Analog Baseband input signal.

The *Signal Level (Baseband)* is updated after an automatic level detection measurement has been executed when baseband input is selected.

The *Signal Level (Baseband)* parameter is only editable when Baseband analog input is selected because *Signal Level (Baseband)* only makes sense for a baseband signal.

Remote: `CONF:POW:EXP:IQ`

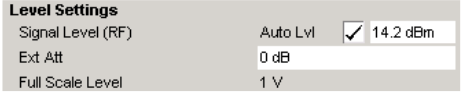
Ext Att



Ext Att 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 will be shifted by this value.

Remote: `DISP:WIND:TRAC:Y:SCAL:RLEV:OFFS`

Full Scale Level



Full Scale Level specifies the expected level of the digital baseband input signal

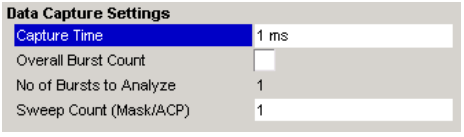
The *Full Scale Level* parameter is only editable when IQ Digital input is selected because *Full Scale Level* only makes sense for a IQ Digital input.

Remote: `DISP:WIND:TRAC:Y:SCAL:RLEV:IQ`

Data Capture Settings

The Data Capture settings specify how much data is to be captured and measured.

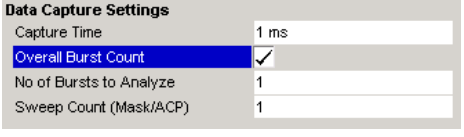
Capture Time



Capture Time specifies the time (and therefore the amount of data) to be captured in a single measurement sweep.

Remote: `SENS:SWE:TIME`

Overall Burst Count

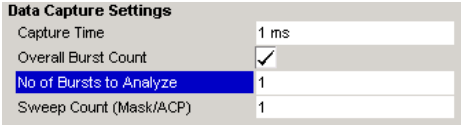


Overall Burst Count specifies whether a specified number of bursts is to be captured and analyzed.

When *Overall Burst Count* is set to OFF, data analysis will be performed on a single measurement sweep. When *Overall Burst Count* is set to ON, data analysis may be performed over a number of consecutive sweeps until the required number of bursts has been captured and analyzed.

Remote: `SENS:BURS:COUN:STAT`

No of Burst to Analyze



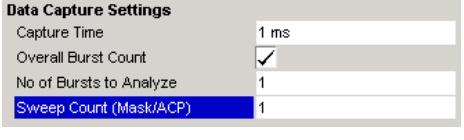
No of Burst to Analyze specifies the number of bursts to be measured.

If the number of bursts of the specified type is not contained in a single measurement sweep, R&S FSQ-K90/K91/K91n will continue to perform measurement sweeps until the requested number of bursts of the specified type has been captured.

The *No of Bursts to Analyze* parameter disabled in case *Overall Burst Count* is cleared.

Remote: `SENS:BURS:COUN`

Sweep Count (Mask/ACPR)



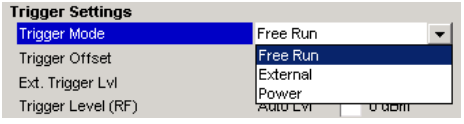
Sweep Count (ACPR/Mask) specifies the number of sweeps that should be performed for Spectrum ACP/ACPR and Spectrum Mask measurements.

Remote: `SENS:SWE:COUN`

Trigger Settings

The Trigger Settings section contains all the settings related to the triggering of a measurement sweep.

Trigger Mode



Trigger Mode is the source of the trigger for the measurement sweep.

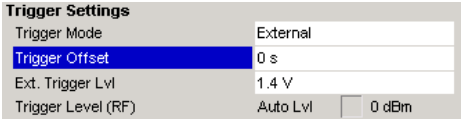
The possible values for the *Trigger Mode* are:

Free Run The measurement sweep starts immediately.
External Triggering via a TTL signal at the input connector *EXT TRIGGER/GATE* on the rear panel.
Power The measurement sweep starts when the signal power meets or exceeds the specified power trigger level.

Note: The *Trigger Mode* Power setting is not available for ETSI Spectrum Mask measurements. If an ETSI Spectrum Mask measurement is selected while the power trigger is active, the *Trigger Mode* automatically changes to Free Run.
In case of *Baseband Digital Input* the only possible trigger setting is *Free Run*.

Remote: `TRIG:SEQ:MODE`

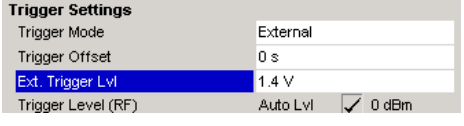
Trigger Offset



Trigger Offset specifies the time offset between the trigger signal and the start of the sweep. A negative value indicates a pre-trigger.
The *Trigger Offset* parameter is not editable when *Trigger Mode* is set to Free Run because this indicates that the measurement sweep should trigger immediately. Thus, a trigger delay or pre-trigger would not be appropriate.

Remote: `TRIG:SEQ:HOLD`

Ext. Trigger Lvl

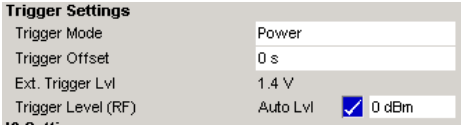


External Trigger Level specifies the trigger level when a external trigger is selected.

The *External Trigger Level* parameter is editable only when *Trigger Mode* is set to External.

Remote: `TRIG:SEQ:LEV:EXT`

Auto Power Trigger Level



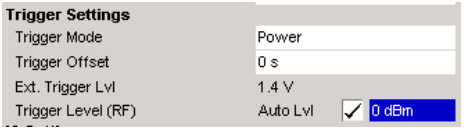
Auto Power Trigger Level selects whether the level for the power trigger is measured automatically (ON) or entered manually by the user (OFF).

When *Auto Power Trigger Level* is set to ON, R&S FSQ-K90/K91/K91n will measure and determine the power trigger level automatically at the start of each measurement sweep. This ensures that the power trigger level is always set at the optimum level for obtaining accurate results but will result in slightly increased measurement times.

The *Auto Power Trigger Level* parameter is editable only when *Trigger Mode* is set to Power.

Remote: `TRIG:SEQ:LEV:POW:AUTO`

Power Level (RF)



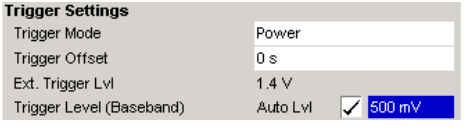
Power Level (RF) specifies the trigger level when a power trigger is selected and RF input is selected.

The *Power Level* parameter is editable only when *Trigger Mode* is set to Power.

The *Power Level (RF)* parameter is not editable when baseband input is selected because *Power Level (RF)* only make sense for an RF signal.

Remote: `TRIG:SEQ:LEV:POW`

Power Level (Baseband)



Power Level (Baseband) specifies the trigger level when a power trigger is selected and baseband input is selected.

The *Power Level* parameter is editable only when *Trigger Mode* is set to Power.

The *Power Level (Baseband)* parameter is not editable when RF input is selected because *Power Level (Baseband)* only makes sense for a baseband signal.

Remote: `TRIG:SEQ:LEV:POW`

IQ Settings

The IQ settings contains settings related to the inphase and quadrature phase of the input signal.

Swap IQ

Swap IQ allows selection between normal and inverted I/Q modulation. The settings for this parameter are:
OFF Normal I/Q modulation.
ON I and Q signals are interchanged.

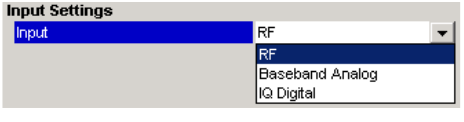
The *Swap IQ* parameter is editable only when *IQ Path* is set to I + j*Q.

Remote: `SENSe:SWAP`

Input Settings

The Input settings contain settings related to the input source of the signal to be measured. Note that this group is only available when the FSQ-B71 I/Q Baseband (Analog Baseband) or FSQ-B17 Digital Baseband option is fitted.

Input



Input allows the selection between *RF, Baseband Analog* and *IQ Digital* inputs.

Remote: `INP:SEL`

Peak Vector Error (IEEE) (IEEE 802.11b & g only)

The Peak Vector Error (IEEE) settings contains settings related to the calculation of Peak Vector Error results.

Meas Range (IEEE 802.11b & g only)

Meas Range specifies whether the Peak Vector Error results are calculated over the complete burst or just over the PSDU.

Remote: `CONF:WLAN:PVER:MRANge`

STC/MIMO Settings IEEE 802.11n MIMO only

The *STC/MIMO* settings panel is used provide the measurement application with the MIMO measurement setup.

The *STC/MIMO* panel is selected by placing the focus on the *General Settings* tab and navigating with the arrow keys below the roll key to the right respective left.

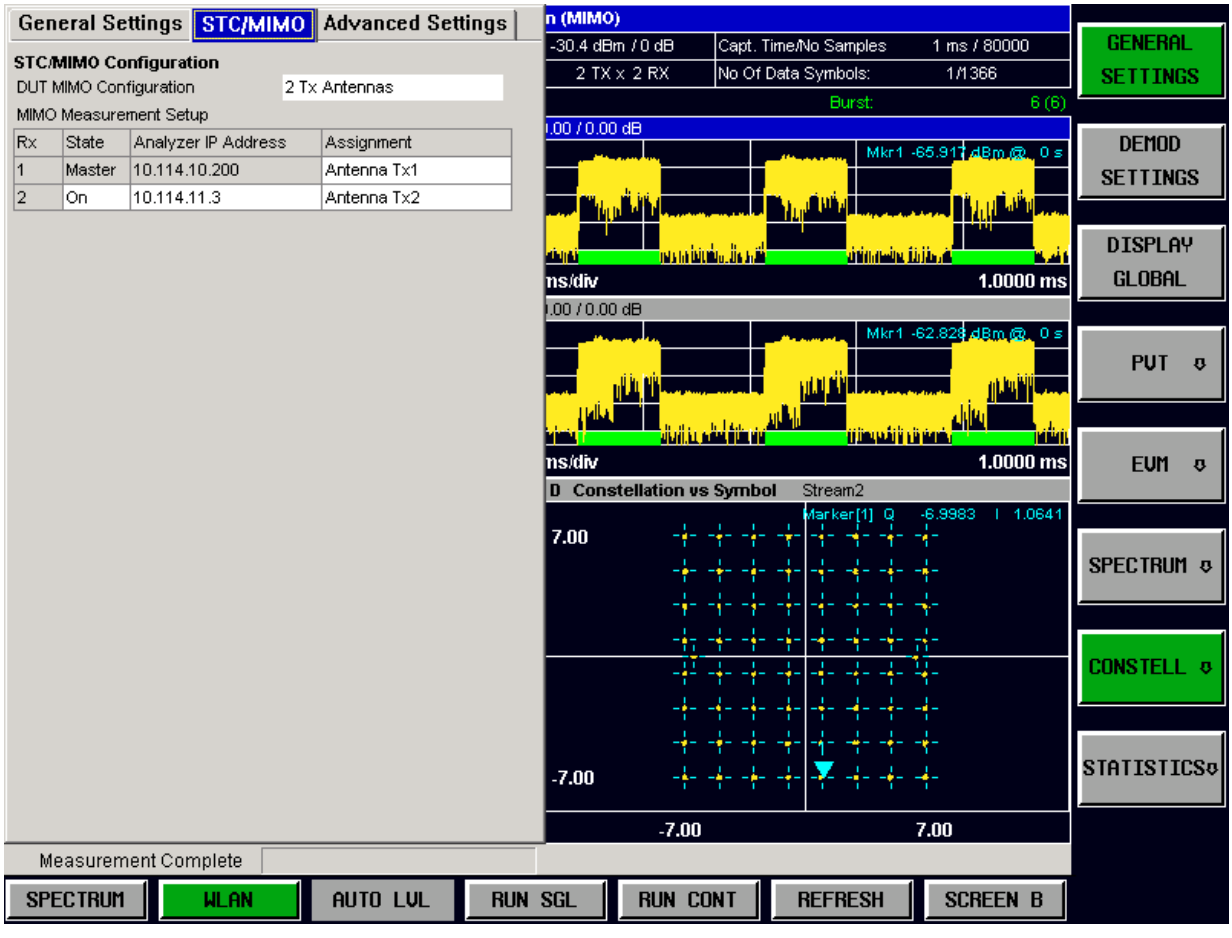
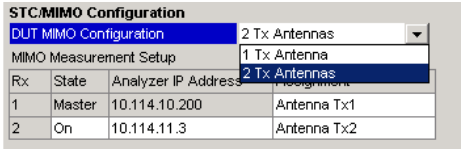


Fig. 61 STC/MIMO Settings

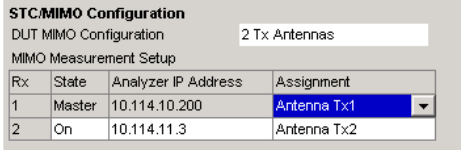
DUT MIMO Configuration



DUT MIMO Configuration defines the number of Tx antennas of the device under test (DUT). Currently up to *2 Tx Antennas* are supported.

Remote: `CONF:WLAN:DUTC`

MIMO Measurement Setup Assignment

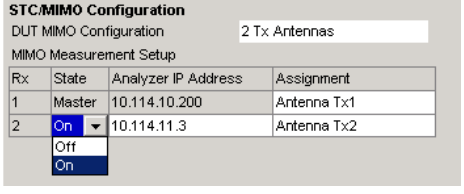


Assignment of the expected antenna to an analyzer. For a wired connection the assignment of the Tx antenna connected to the analyzer is a possibility.

For a wired connection and Direct Spatial Mapping the Spectrum Flatness traces in the diagonal contain the useul information, in case the signal transmitted from the antennas matches with the expected antennas. Otherwise the secondary diagonal will contain the useful traces.

Remote: `CONF:WLAN:ANTM:ANT[1|2]`

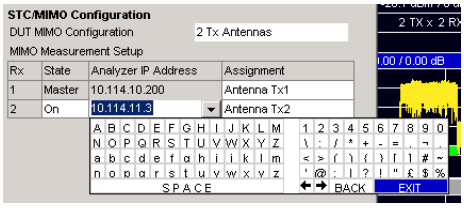
MIMO Measurement Setup State



State switches the corresponding slave analyzer On respective Off. In On state the slave analyzer captures data. This data is transferred via LAN to the master for analysis of the MIMO system.

Remote: `CONF:WLAN:ANTM:STAT`

MIMO Measurement Setup Analyzer IP Address



Analyzer IP Address rises the screen key pad. Enter the IP addresses of the slaves connected via LAN to the master. The numerical keys can also be used to enter the IP address.

Remote: `CONF:WLAN:ANTM:ADDR[1|2]`

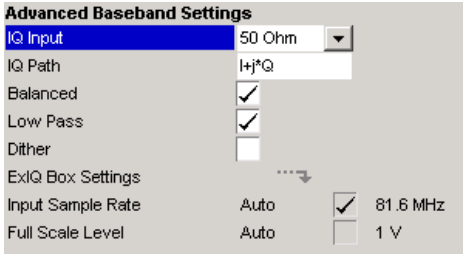
Advanced Settings

The *Advanced Settings* panel contains settings that control details about how the instrument operates and how measurements are performed.

The *Advanced Settings* panel is selected by placing the focus on the General Settings tab and navigating with the arrow keys below the roll key to the right respective left.

Fig. 62 Advanced Settings

IQ Input

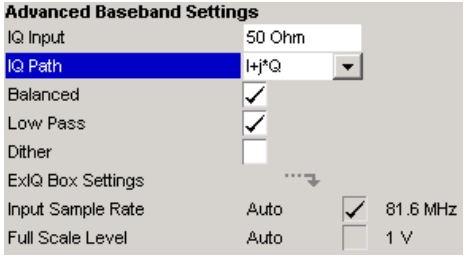


IQ Input allows the selection of the impedance of the baseband inputs. The values that can be selected are 50 Ω and 1 K/1 MΩ (device-dependent).

The *IQ Input* parameter is editable only when baseband analog input is selected.

Remote: `INP:IQ:IMP LOW`

IQ Path

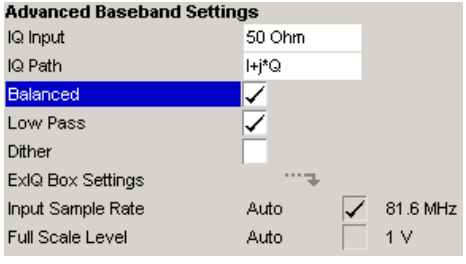


IQ Path allows the selection of the input path for Baseband inputs. Either a single input (either I or q) may be used or both may be used. If only a single input is selected then the *Swap IQ* parameter is not used and becomes disabled

The *IQ Path* parameter is editable only when baseband analog input is selected.

Remote: `INP:IQ:TYPE IQ`

Balanced

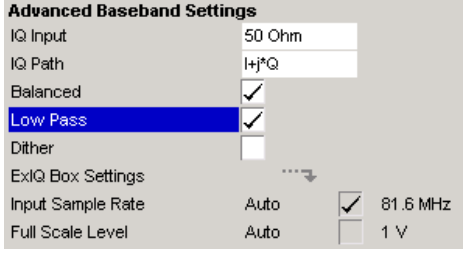


Balanced switches the baseband inputs between symmetrical (balanced) and asymmetrical (unbalanced).

The *Balanced* parameter is editable only when baseband analog input is selected.

Remote: `INP:IQ:BAL ON`

Low Pass

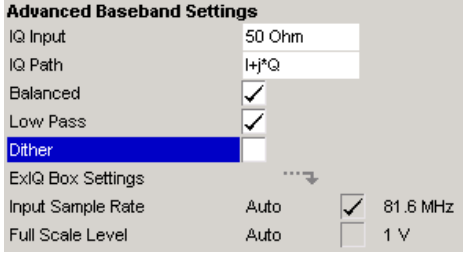


When switched on, the *Low Pass* parameter specifies that a filter is applied from 36 MHz for the IQ inputs.

The *Low Pass* parameter is editable only when baseband analog input is selected.

Remote: `SENS:IQ:LPAS ON`

Dither

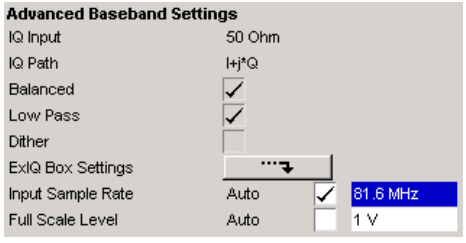


When switched on, the *Dither* parameter specifies that a 2 MHz-wide noise signal at 42.67 MHz is injected into the signal path of the baseband input. It appears in the spectrum at 38.92 MHz.

The *Dither* parameter is editable only when baseband analog input is selected.

Remote: `SENS:IQ:DITH 1`

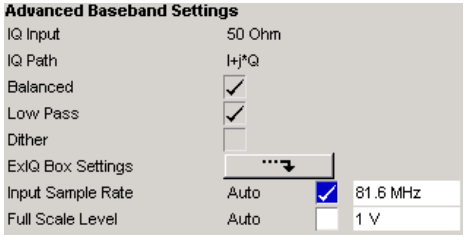
Input Sample Rate Auto



Input Sample Rate Auto specifies whether the input sample rate for the digital baseband input is automatically set from the LVDS interface or whether it is specified manually.

Remote: INP:DIQ:SRAT:AUTO

Input Sample Rate

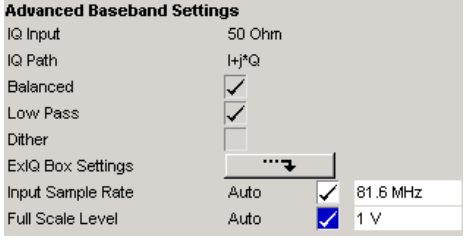


Input Sample Rate parameter specifies the sampling rate of the IQ-Data received from the Digital Baseband input. In case it is not the sampling rate as expected from the WLAN application an internal resampler resampes it to the expected *Sample Rate*.
This allows eg. to measure signals generated with slow IQ-Mode.

The *Dig. In. Sample Rate* parameter is editable only when Digital Baseband input is selected and *Input Sample Rate Auto* is switched off

Remote: INP:DIQ:SRAT

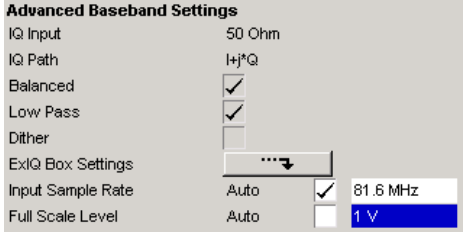
Full Scale Level Auto



Full Scale Level Auto specifies whether the the expected voltage of the digital baseband input signal is automatically set from the LVDS interface or whether it is specified manually.

Remote: INP:DIQ:SRAT:AUTO

Full Scale Level



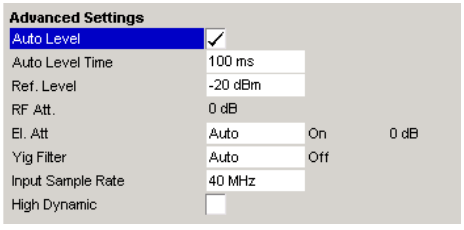
Full Scale Level specifies the expected voltage of the digital baseband input signal.

The *Full Scale Level* parameter is only editable when IQ Digital input is selected and *Full Scale Level Auto* is switched off.

The *Full Scale Voltage* advanced settings is the same as the *Full Scale Voltage* in the Level Settings. It is repeated in the Advanced Settings for convenience.

Remote: INP:DIQ:RANG

Auto Level

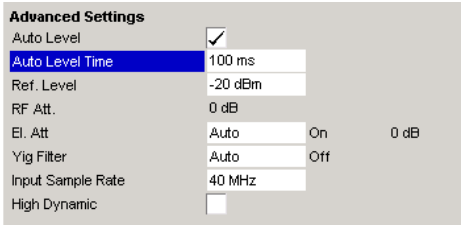


Auto Level selects whether the reference level for measurements is measured automatically (ON) or entered manually by the user (OFF).

The *Auto Level* advanced settings is the same as the *Auto Level* in the Signal Characterstics. It is repeated in the Advanced Settings for convenience.

Remote: `SENS:SWE:ACPR:TIME:AUTO ON`

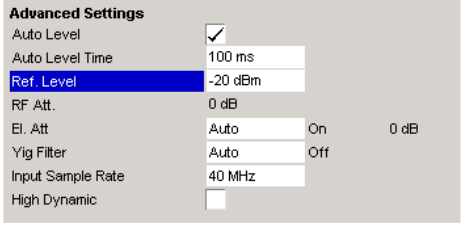
Auto Level time



Auto Level Time specifies the measurement time to be used for the auto level measurement

Remote: `CONF:POW:AUTO:SWE:TIME`

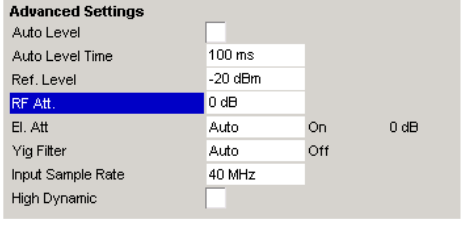
Ref Level



Ref Level specifies the reference level to use when running measurements.
When the *Ref Level* is modified, the *Signal Level* parameter is updated accordingly (depending on the currently selected standard and measurement type).
The *Ref Level* is editable only when *Auto Level* is switched off.

Remote: `DISP:WIND:TRAC:Y:SCAL:RLEV?`

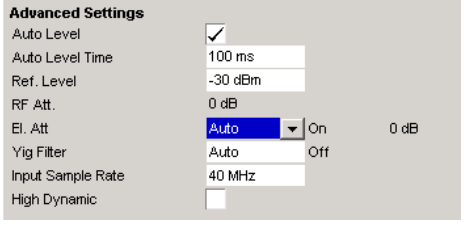
RF Att



The *RF Att* parameters specify the settings for the meachanical attenuator.
The *RF Att* is editable only when *Auto Level* is switched off.
When *Auto Level* is switched on, the *RF Att* setting is coupled to the *Ref Level* setting. When *Auto Level* is switched off, the *RF Att* setting is independent from the *Ref Level* setting and must be specified separately.

Remote: `INP:ATT 0DB`

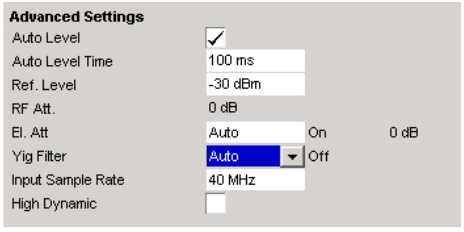
El Att



The *El Att* parameters specify the settings for the electronic attenuator.
The *El Att* parameters are:
Mode – Specfies whether the electronic attenuator should be controlled manually (Manual) or by the Auto option.
State – Specfies whether the electronic attenuator should be switched ON or OFF.
Settings – Specifies the attenuation value the electronic attenuator should be switched to.
When the mode is set to Auto, the state and setting fields will be automatically calcuated by the option, i.e. fields will not be editable.
When the state is switched off, the setting field is non-editable.
When the frequency is set such that the electronic attenuator cannot be used or the electronic attenuator is not installed, all Electronic Attenuator fields are read-only.

Remote: `INP:EATT:AUTO ON`

YIG Filter



The *YIG Filter* parameter specifies how the YIG filter is used during measurements.

The *YIG Filter* parameters are:

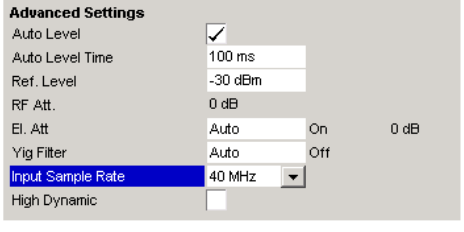
Mode – Specfies whether the YIG filter should be controlled manually (Manual) or by the Auto option.

State – Specfies whether the YIG filter should be switched ON or OFF.

When the mode is set to Auto, the state field will be automatically calcuated by the option, i.e. this field will not be editable.

Remote: `INP:FILT:YIG:AUTO ON`
`INP:FILT:YIG:STAT OFF`

Input Sample Rate



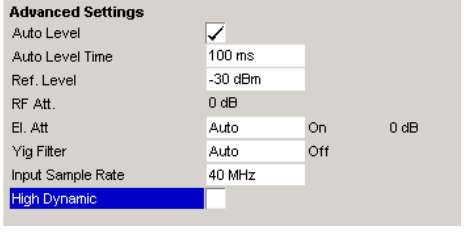
Input Sample Rate specifies the sample rate used for IQ measurements.

In case the WLAN *Standard* IEEE 802.11a is selected, the *Input Sample Rate* can be chosen continuously.

In case the WLAN *Standard* IEEE 802.11n is selected, the *Input Sample Rate* can be chosen from the discrete set {20MHz, 40MHz, 80MHz}.

Remote: `TRAC:IQ:SRAT`

High Dynamic



The *High Dynamic* parameter is automatically set, if the B72 option is installed, and the sample rate is set between 20.4 MHz and 40.8 MHz.

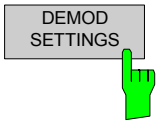
When the *High Dynamic* parameter is set to ON then measurements are performed using a wide filter in the normal signal path rather than using the B72 option.

The advantage of setting the *High Dynamic* parameter ON is a higher resolution (because the "normal" signal path uses a 14 bit ADC). The disadvantage is that all signals left or right the spectrum of interest are folded into the spectrum itself.

Remote: `TRAC:IQ:FILT:FLAT`

Demod Settings

This section of the user manual describes the Demod (short for Demodulation) Settings view where the settings associated with the signal modulation can be modified.



The *DEMOD SETTINGS* softkey brings up the Demod Settings view.

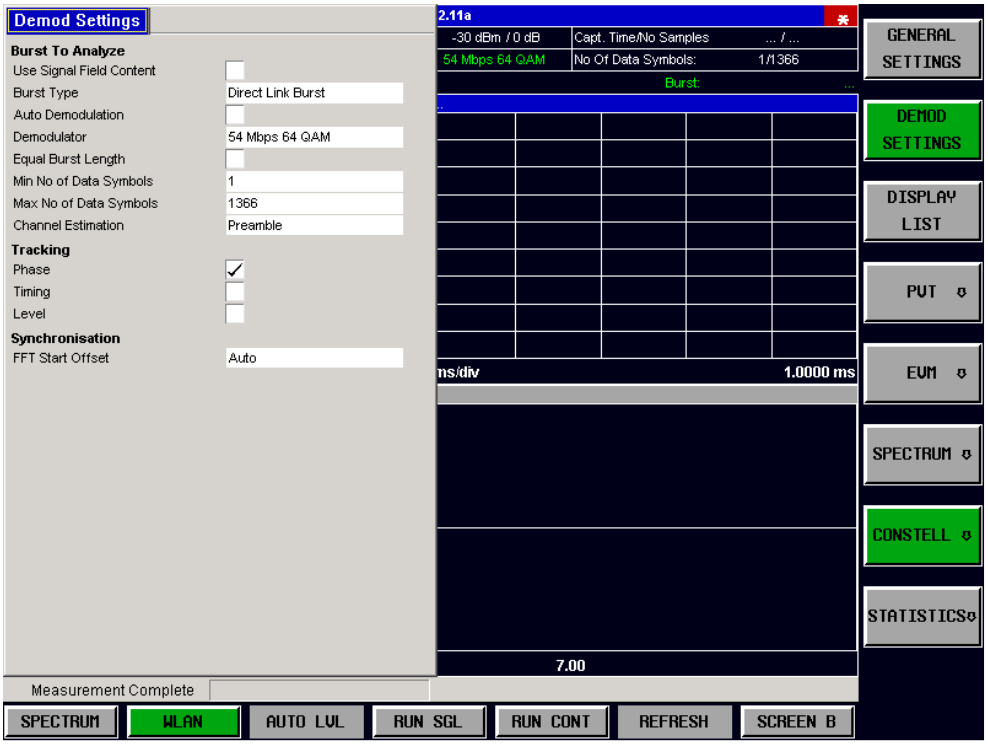


Fig. 63 IEEE 802.11a, g (OFDM) Demod Settings view

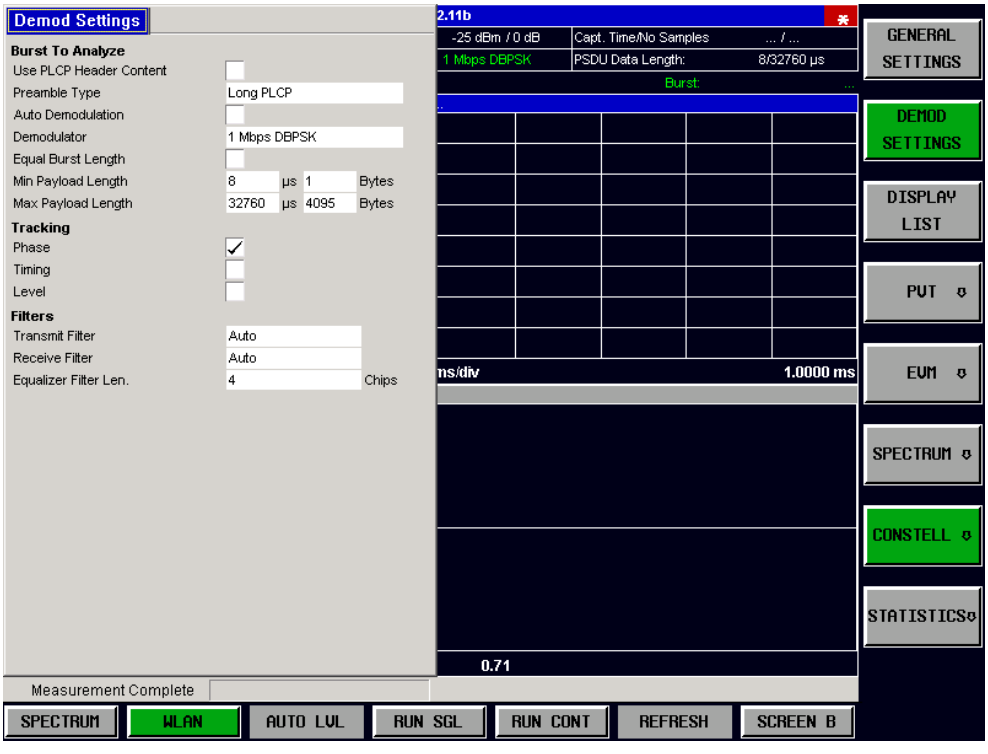


Fig. 64 IEEE 802.11b Demod Settings view

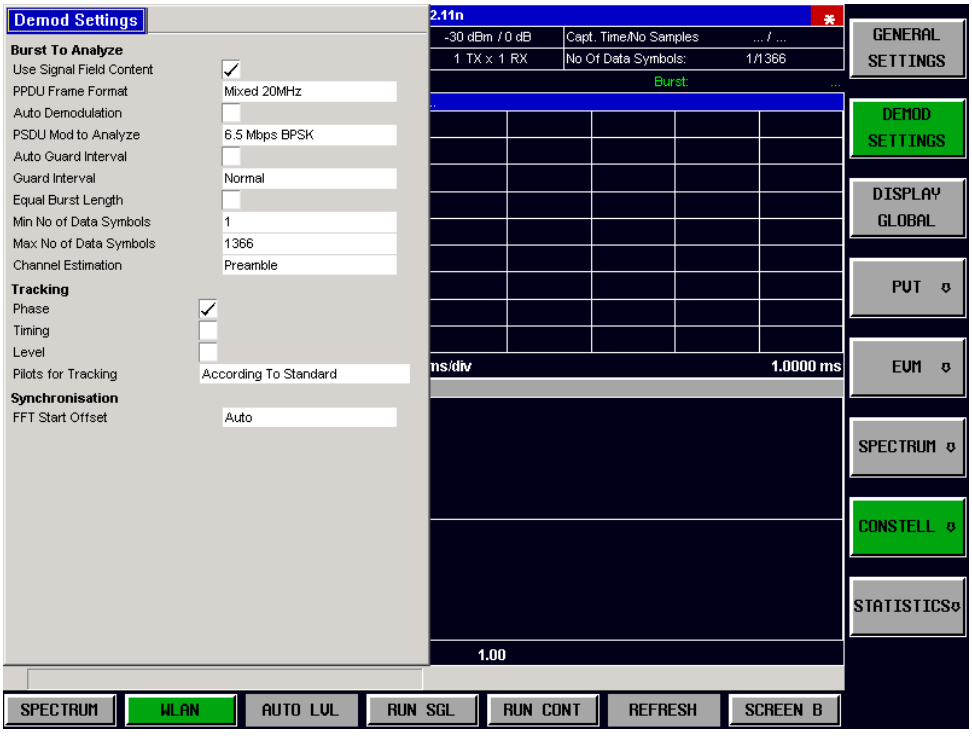


Fig. 65 IEEE 802.11n SISO Demod Settings view

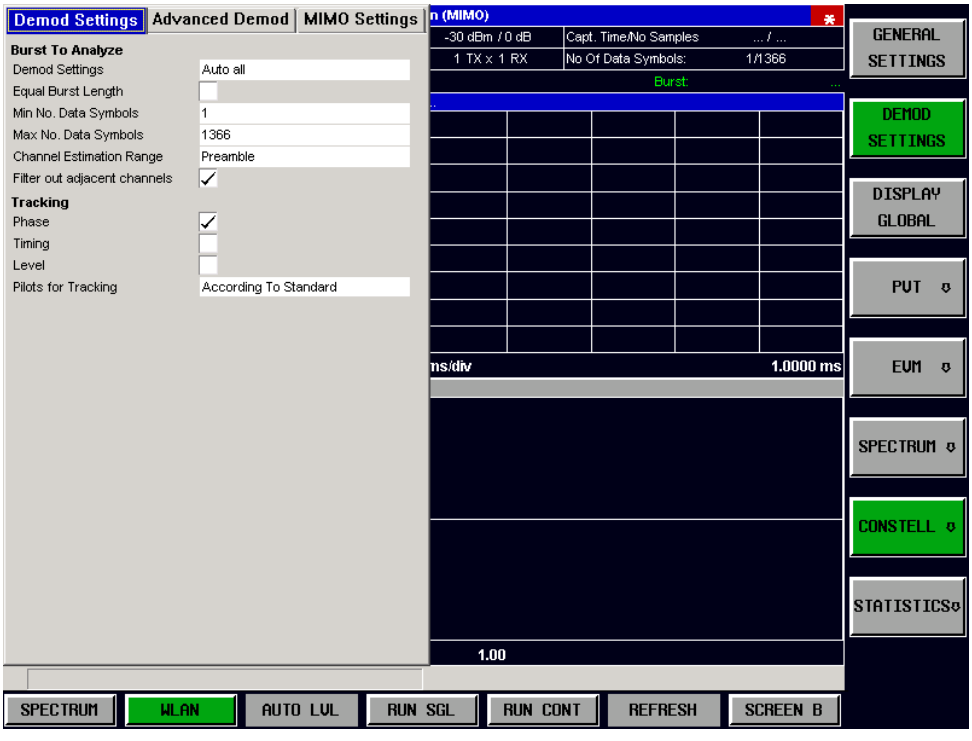


Fig. 66 IEEE 802.11n MIMO Demod Settings view

The Demod settings are logically grouped together into:

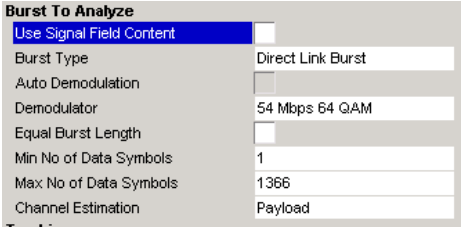
- Burst To Analyze Settings
- Tracking Settings
- Filter Settings (IEEE 802.11b & g only)

When a particular parameter is selected within the Demod Settings view, the status bar changes to display information about the valid settings for the selected parameter. The parameters available in the Demod setting view are dependent on the currently selected standard.

Burst To Analyze Settings

The Burst to Analyze settings specify the characteristics of the bursts to be considered in the measurement results. Only burst that meet the criteria specified in this group will be included in the measurement analysis.

Use Signal Field Content (IEEE 802.11a, g (OFDM), j, n (SISO) & Turbo Mode only)



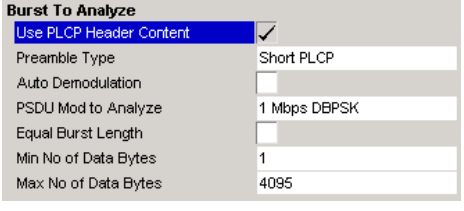
Use Signal Field Content specifies whether the Signal Symbol field of the captured burst data should be decoded.

When *Use Signal Field Content* is set to ON, only bursts whose modulation format specified in the signal symbol field matches the modulation format specified in the *PSDU Modulation* parameter are included in the results analysis.

When *Use Signal Field Content* is set to OFF, the data is demodulated according to the modulation scheme specified in the *Demodulator* parameter. Note: If any of the analyzed data exhibits a modulation different from that specified, the results will be of limited use in this case.

Remote: SENS:DEM:FORM:SIGS

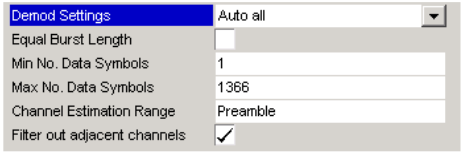
Use PLCP Header Content (IEEE 802.11b & g (Single Carrier) only)



Use PLCP Header Content specifies whether the PLCP Header field of the captured burst data should be decoded. When *Use PLCP Header Content* is set to ON, only bursts whose modulation format specified in the signal symbol field matches the modulation format specified in the *PSDU Mod to Analyze* parameter are included in the results analysis.

Remote: SENS:DEM:FORM:SIGS

Demod Settings (IEEE 802.n (MIMO) only)

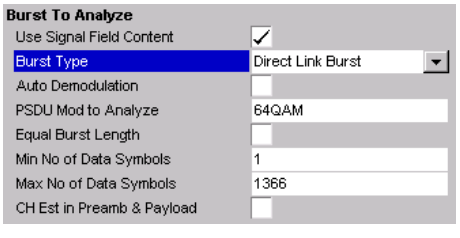


Demod Settings Auto All sets in the *Advanced Demod* settings panel all controls to '*Auto, same as first burst'*.

Demod Settings Manual (Advanced MIMO settings) sets in the *Advanced Demod* settings panel all controls to the state prior activating *Auto All*.

Remote: :SENS:DEM:FORM:BCON:AUTO

Burst Type (IEEE 802.11a, g (OFDM & Single Carrier), j & Turbo Mode only)

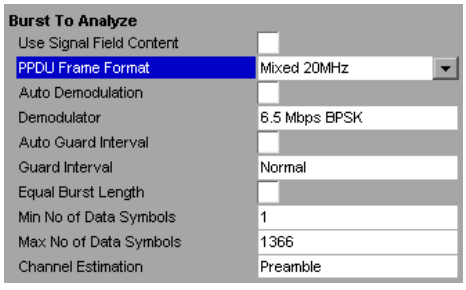


Burst Type specifies the type of burst that should be included in measurement analysis. Only one burst type can be selected for measurement results. The following burst types are supported:

Direct Link Burst	- IEEE 802.11a, j, n & Turbo Mode
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: `SENS:DEM:FORM:BAN:BTYP`

PPDU Frame Format (IEEE 802.11n (SISO) only)

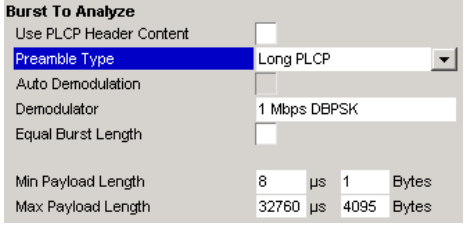


PPDU Frame Format specifies the type of PHY Protocol Data Unit (PPDU) which should be included in measurement analysis. The following PPDU formats are supported.

Mixed 20MHz
Green Field 20MHz
Mixed 40MHz
Green Field 40MHz

Remote: `SENS:DEM:FORM:BAN:BTYP`

Preamble Type (IEEE 802.11b only)

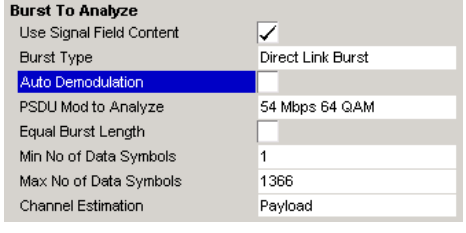


Preamble Type specifies the type of burst that should be included in measurement analysis. The following preamble types are supported:

Short PLCP
Long PLCP

Remote: `SENS:DEM:FORM:BAN:BTYP`

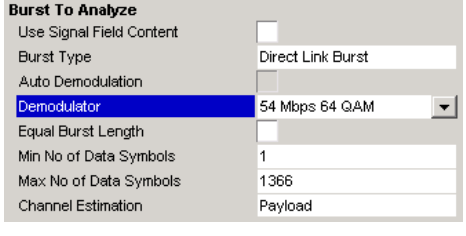
Auto Demodulation (IEEE 802.11a, b, g, j, n (SISO) & Turbo Mode only)



Auto Demodulation specifies whether or not the modulation to be applied to the measured data should be automatically detected.
When *Auto Demodulation* is set to ON, the modulation applied to the input data is determined from the modulation type of the first complete burst within the captured data.
Auto Demodulation uses the data held in the signal field of the burst and, thus, is available only when *Use Signal Symbol Field Content* is set to ON

Remote: `SENS:DEM:FORM:BCON:AUTO`

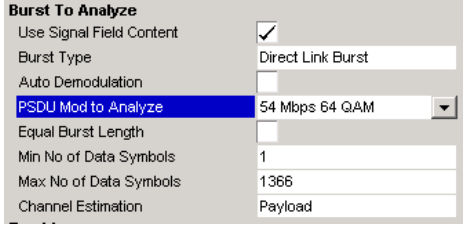
Demodulator (IEEE 802.11a, b, g, j & Turbo Mode only)



Demodulator is used to specify the modulation to be applied to the measured data. If the captured data uses a modulation scheme different from that specified by this parameter, the results will be of limited use.
Demodulator is available only when *Use Signal Symbol Field Content* is set to OFF.

Remote: `SENS:DEM:FORM:BAN`

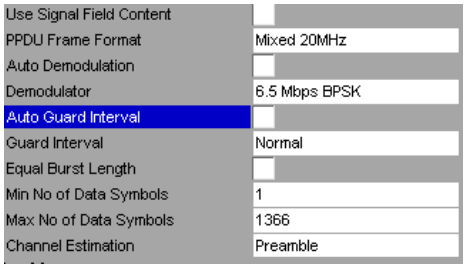
PSDU Mod to Analyze (IEEE 802.11n (SISO) only)



PSDU Mod to Analyze is used to specify the modulation of the bursts to be analyzed. Only bursts using the selected modulation are considered in measurement analysis.
PSDU Mod to Analyze is available only when *Use Signal Symbol Field Content* is set to ON

Remote: SENS:DEM:FORMat:BAN

Auto Guard Interval (IEEE 802.11n (SISO) only)



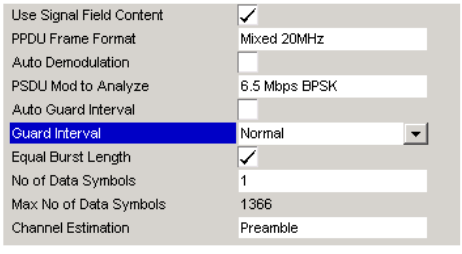
Auto Guard Interval specifies whether the Guard interval of the measured data should be automatically detected or not

When *Auto Guard Interval* is set to ON then the Guard Interval is detected from the input signal.

When *Use Auto Guard Interval* is set to OFF then guard interval of the input signal can be specified with the *Guard Interval* parameter.

Remote: `CONF:WLAN:GTIM:AUTO`

Guard Interval (IEEE 802.11n (SISO) only)

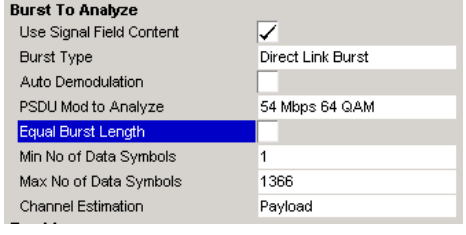


Guard interval is used to manually specify the guard interval of the input signal.

When *Auto Guard Interval* is set to ON then *Guard Interval* is read only and display the detected guard interval.

Remote: `CONF:WLAN:GTIM:SEL`

Equal Burst Length



Equal Burst Length allows bursts with a range of data symbols/bytes or bursts with a specific number of data symbols/bytes to be selected for measurement analysis.

IEEE 802.11a, j, n & Turbo Mode only

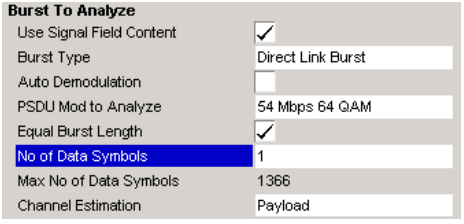
When *Equal Burst Length* is set to ON, the next parameter in the group becomes *No of Data Symbols* and only bursts with exactly the number of symbols specified in *No of Data Symbols* are considered for measurement analysis.
When *Equal Burst Length* is set to OFF, the next parameter in the group becomes *Min No of Data Symbols* and bursts with a number of data symbols within the range specified by the *Min No of Data Symbols* and *Max No of Data Symbols* parameters take part in measurement analysis.

IEEE 802.11b & g (Single Carrier and OFDM) only

When *Equal Burst Length* is set to ON, the next parameter in the group becomes *Payload Length* and only bursts with exactly the number of bytes or duration specified in *Payload Length* are considered for measurement analysis.
When *Equal Burst Length* is set to OFF, the next parameter in the group becomes *Min Payload Length* and bursts with a number of data bytes or duration within the range specified by the *Min Payload Length* and *Max Payload Length* parameters take part in measurement analysis.

Remote: `SENS:DEM:FORM:BAN:SYMB:EQU`
`SENS:DEM:FORM:BAN:DUR:EQU`
`SENS:DEM:FORM:BAN:DBYT`

No of Data Symbols (IEEE 802.11a, j, n & Turbo Mode only)

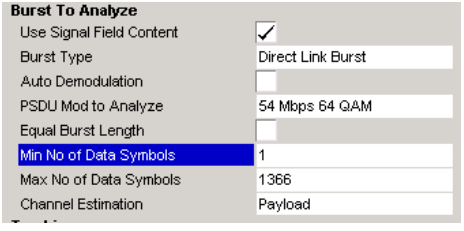


No of Data Symbols specifies the number of data symbols a burst must have for it to be considered in measurement analysis.

No of Data Symbols is only available when *Equal Burst Length* is set to ON.

Remote: `SENS:DEM:FORM:BAN:SYMB:MIN`

Min No of Data Symbols (IEEE 802.11a, j, n & Turbo Mode only)

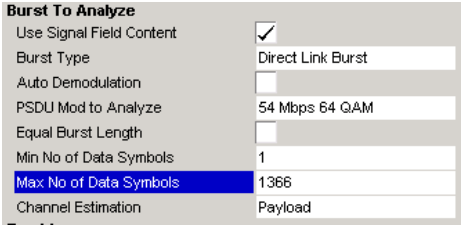


Min No of Data Symbols specifies the minimum number of data symbols a burst must have for it to be considered in measurement analysis.

Min No of Data Symbols is only available when *Equal Burst Length* is set to OFF.

Remote: `SENS:DEM:FORM:BAN:SYMB:MIN`

Max No of Data Symbols(IEEE 802.11a, j, n & Turbo Mode only)

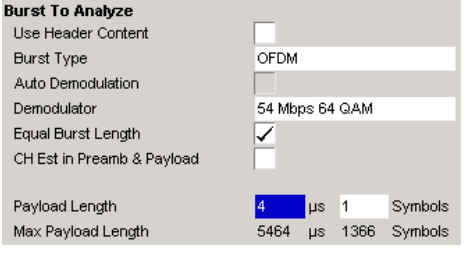


Max No of Data Symbols specifies the maximum number of data symbols a burst must have for it to be considered in measurement analysis.

Max No of Data Symbols is only available when *Equal Burst Length* is set to OFF.

Remote: `SENS:DEM:FORM:BAN:SYMB:MAX`

Payload Length (IEEE 802.11b & g only)

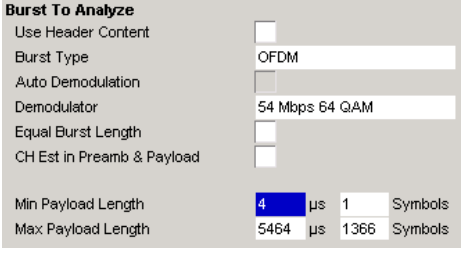


Payload Length specifies the number of symbols, bytes or duration a burst must have for it to be considered in measurement analysis.

Payload Length is only available when *Equal Burst Length* is set to ON.

Remote: `SENS:DEM:FORM:BAN:DUR:MIN`
`SENS:DEM:FORM:BAN:SYMB:MIN`

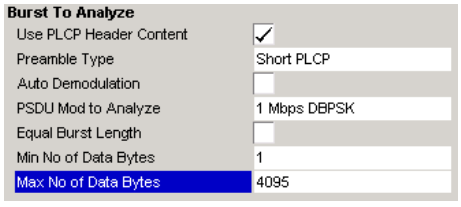
Min Payload Length (IEEE 802.11b & g only)



Min Payload Length specifies the minimum number of symbols, bytes or duration a burst must have for it to be considered in measurement analysis.
Min Payload Length is only available when *Equal Burst Length* is set to OFF.

Remote: `SENS:DEM:FORM:BAN:DUR:MIN`
`SENS:DEM:FORM:BAN:SYMB:MAX`

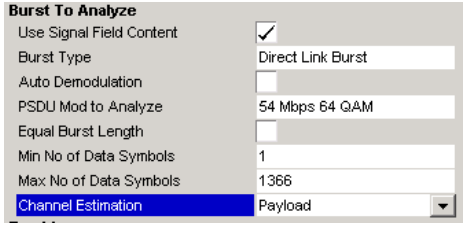
Max Payload Length(IEEE 802.11b & g (Single Carrier) only)



Max Payload Length specifies the maximum number of symbols, bytes or duration a burst must have for it to be considered in measurement analysis.
Max Payload Length is only available when *Equal Burst Length* is set to OFF.

Remote: `SENS:DEM:FORM:BAN:DUR:MAX`
`SENS:DEM:FORM:BAN:SYMB:MAX`

Channel Estimation (IEEE 802.11a, g (OFDM), j, n & Turbo Mode only)



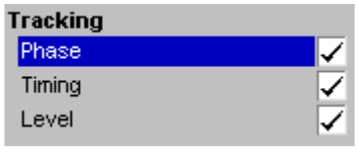
Channel Estimation specifies how accurately the EVM results should be calculated.
When *Channel Estimation* is set to Preamble, the EVM results are calculated in accordance with the selected standard. In this case, channel estimation is done in the preamble only.
When *Chan Channel Estimation* is set to Payload, the EVM results are calculated more accurately. In this case, channel estimation is done in the payload.

Remote: `SENS:DEM:CEST`

Tracking Settings

The tracking settings allow various errors in measurement results to be compensated for.

Phase



Phase is used to specify whether or not the measurement results should be compensated for phase error.
When *Phase* is set to ON, the measurement results will be compensated for phase error on a per-symbol basis.

Remote: `SENS:TRAC:PHAS`

Timing

Timing is used to specify whether or not the measurement results should be compensated for timing error.
When *Timing* is set to ON, the measurement results will be compensated for timing error on a per-symbol basis.

Remote: `SENS:TRAC:TIME`

Level

Level is used to specify whether or not the measurement results should be compensated for level error.

When *Level* is set to ON, the measurement results will be compensated for level error on a per-symbol basis.

Remote: `SENS:TRAC:LEV`

Synchronisation Settings (IEEE802.11n only)

The synchronsation settings allow adpting the synchronisation onto the channel conditions.

FFT Start Offset

FFT Start Offset defines the mode how the FFT start offset is determined. For 11n MIMO, this setting is located on the *Advanced Demod* settings panel.

Peak: The peak of the fine timing metric is used to determine the FFT start offset.
Guard Interval Center: The guard interval center is used as FFT start offset.
Auto: The measurement application determines the optimal FFT start offset.

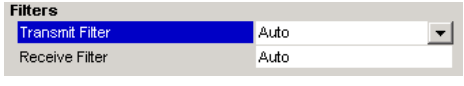
Remote: `SENS:DEM:FFT:OFFS`

Filter Settings (IEEE 802.11b & g only)

The filter settings specify the filters to be used.

Note: For all filter settings, the list of filter files can be found in D:\User\Filters. Additional filter files (*.vaf) files can be added to this directory, and the list of files for the filter settings will automatically be updated the next time the application is started. Additional filter files can be created from MatLab and converted into an *.vaf format with the Windows Software FILTWIZ downloadable from the R&S homepage together with a short manual "Introduction to "Filtwiz"".

Transmit Filter



Specifies the transmit filter to be used.
The settings provided by default are:

- Auto – Specifies the default filter
- DefRecieve – Default receive filter
- DefTransimt - Default transmit filter

See also chapter "Signal Processing of the IEEE802.11b application".

Remote: `SENS:DEM:FILT:CAT`

Recieve Filter

Specifies the recieve filter to be used.
The settings provided by default are:

- Auto – Specifies the default filter
- DefRecieve – Default receive filter
- DefTransimt - Default transmit filter

See also chapter "Signal Processing of the IEEE802.11b application".

Remote: `SENS:DEM:FILT:CAT`

Advanced Demod Settings (IEEE 802.11n (MIMO) only)

The *Advanced Demod* settings allow the user to specify the bursts to be analyzed. It provides also settings to adapt the synchronisation onto the channel conditions.

The *Advanced Demod* settings panel is selected by placing the focus on the *Demod Settings* tab and navigating with the arrow keys below the roll key to the right respective left.

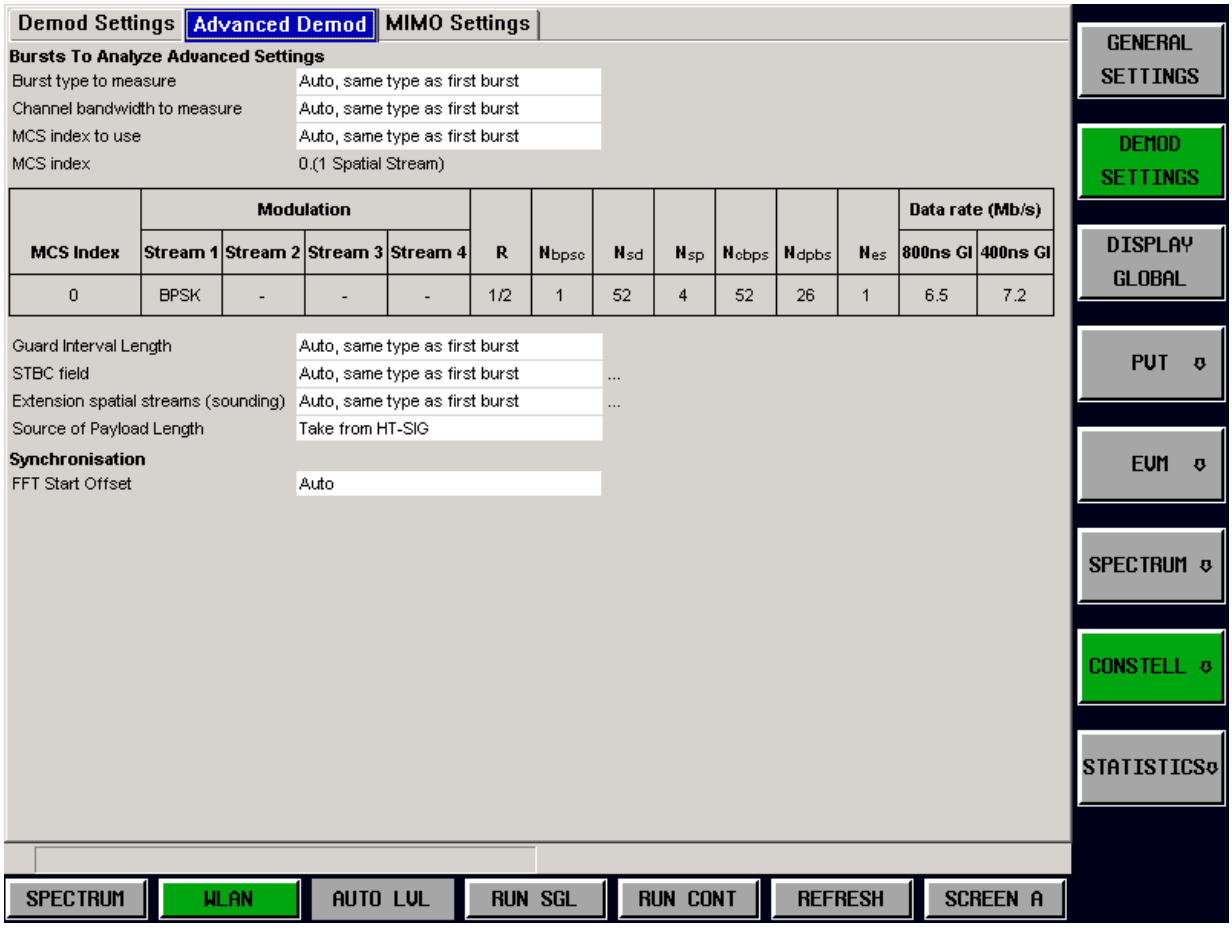
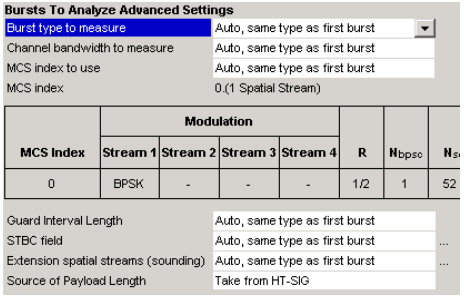


Fig. 67 Advanced Demod Settings IEEE 802.11n (MIMO) only.

Burst type to measure

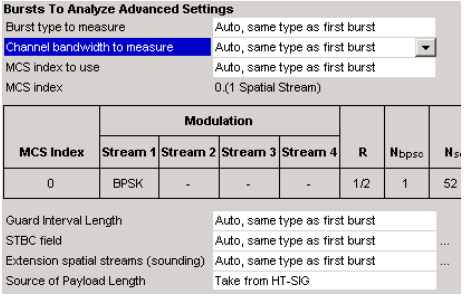


Burst type to measure defines the burst types taking part in the analysis.

Auto, same type as first burst: All bursts identical to the first recognized burst are analyzed.
Auto, individually for each burst: All bursts are analyzed.
Meas only Mixed Mode: Only mixed mode bursts are analyzed.
Meas only Greenfield: Only Greenfield mode bursts are analyzed.
Demod all as Mixed Mode: All bursts are analyzed as Mixed Mode bursts.
Demod all as Greenfield: All bursts are analyzed as Greenfield bursts.

Remote: `SENS:DEM:FORM:BAN:BTYP:AUTO:TYPE`

Channel Bandwidth to measure

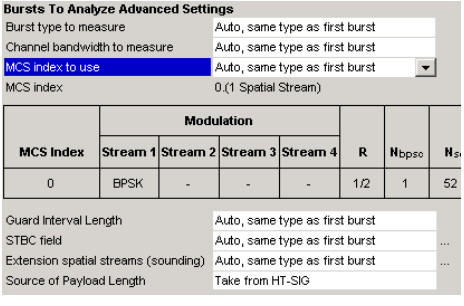


Channel bandwidth to measure defines the channel bandwidth of the bursts taking part in the analysis.

Auto, same type as first burst: All bursts using a channel bandwidth identical to the first recognized burst are analyzed.
Auto, individually for each burst: All bursts are analyzed.
Meas only 20MHz signal: Only bursts with 20MHz channel bandwidth are analyzed.
Meas only 40MHz signal: Only bursts with 20MHz channel bandwidth are analyzed.
Demod all as 20MHz signal: All bursts are analyzed as 20MHz channel bandwidth bursts.
Demod all as 40MHz signal: All bursts are analyzed as 40MHz channel bandwidth bursts.

Remote: `SENS:BAND:CHAN:AUTO:TYPE`

MCS Index to use

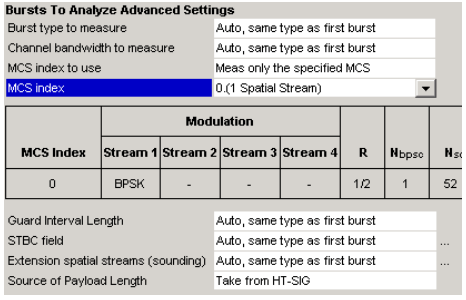


MCS index to use defines the Modulation and Coding Scheme (MCS) index of the bursts taking part in the analysis.

Auto, same type as first burst: All bursts using the MCS index identical to the first recognized burst are analyzed.
Auto, individually for each burst: All bursts are analyzed.
Meas only the specified MCS: Only bursts with the MCS index specified in the *MCS index* field are analyzed.
Demod all with specified MCS: The MCS index of the *MCS index* field is applied to all busrst.

Remote: `SENSe:DEM:FORM:MCS:MOD`

MCS Index

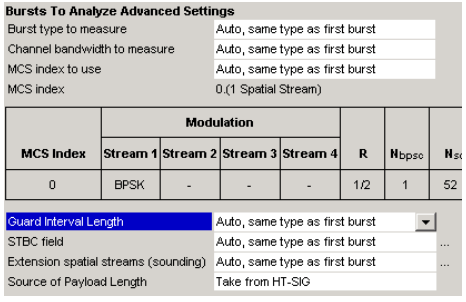


MCS index allows the user to define the Modulation and Coding Scheme (MCS) index, of the bursts taking part in the analysis, manually. This field is enabled for MCS index to use *Meas only the specified MCS* or *Demod all with specified MCS.*

MCS Index range 0,…,76

Remote: `SENSe:DEM:FORM:MCS`

Guard Interval Length

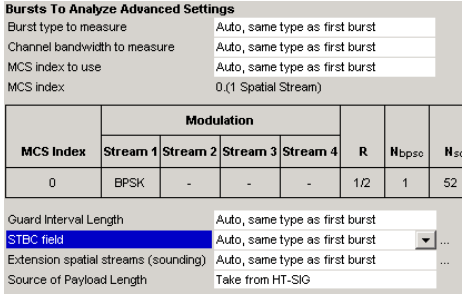


Guard Interval Length defines the guard interval length of the bursts taking part in the analysis.

Auto, same type as first burst: All bursts using the guard interval length identical to the first recognized burst are analyzed.
Auto, individually for each burst: All bursts are analyzed.
Meas only normal 8 (20MHz): In case of bursts with 20MHz channel bandwidth, the bursts with normal guard interval length are analyzed.
Meas only long 16 (20MHz): In case of bursts with 20MHz channel bandwidth, the bursts with long guard interval length are analyzed.
Meas only normal 16 (40MHz): In case of bursts with 40MHz channel bandwidth, the bursts with normal guard interval length are analyzed.
Meas only long 32 (40MHz): In case of bursts with 40MHz channel bandwidth, the bursts with long guard interval length are analyzed.
Demod all as normal 8 (20MHz): All bursts are analyzed assuming normal (20MHz) guard interval length.
Demod all as long 16 (20MHz): All bursts are analyzed assuming long (20MHz) guard interval length.
Demod all as normal 16 (40MHz): All bursts are analyzed assuming normal (40MHz) guard interval length.
Demod all as long 32 (40MHz): All bursts are analyzed assuming long (40MHz) guard interval length.

Remote: `CONF:WLAN:GTIM:AUTO:TYPE`

STBC field



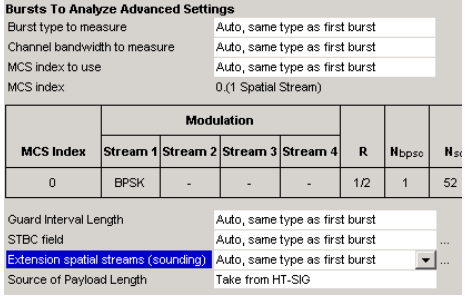
STBC field defines the Space-Time Block Coding (STBC) field content of the bursts taking part in the analysis.

Auto, same type as first burst: All bursts using a STBC field content identical to the first recognized burst are analyzed.
Auto, individually for each burst: All bursts are analyzed.
Meas only if STBC field = 0: Only bursts with the specified STBC field content are analyzed.
Meas only if STBC field = 1 (+1 Stream): Only bursts with the specified STBC field content are analyzed.
Meas only if STBC field = 2 (+2 Stream): Only bursts with the

specified STBC field content are analyzed.
Demod all as STBC field = 0: All bursts are analyzed assuming the specified STBC field content.
Demod all as STBC field = 1: All bursts are analyzed assuming the specified STBC field content.
Demod all as STBC field = 2: All bursts are analyzed assuming the specified STBC field content.

Remote: `CONF:WLAN:STBC:AUTO:TYPE`

Extension spatial streams (sounding)

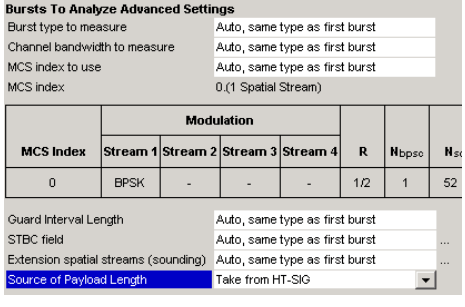


Extension spatial streams (sounding) defines the Ness field content of the bursts taking part in the analysis.

Auto, same type as first burst: All bursts using a Ness value identical to the first recognized burst are analyzed.
Auto, individually for each burst: All bursts are analyzed.
Meas only if Ness = 0: Only bursts with the specified Ness value are analyzed.
Meas only if Ness = 1: Only bursts with the specified Ness value are analyzed.
Meas only if Ness = 2: Only bursts with the specified Ness value are analyzed.
Meas only if Ness = 3: Only bursts with the specified Ness value are analyzed.
Demod all as Ness = 0: All bursts are analyzed assuming the specified Ness value.
Demod all as Ness = 1: All bursts are analyzed assuming the specified Ness value.
Demod all as Ness = 2: All bursts are analyzed assuming the specified Ness value.
Demod all as Ness = 3: All bursts are analyzed assuming the specified Ness value.

Remote: `CONF:WLAN:EXT:AUTO:TYPE`

Source of Payload Length



Source of Payload length defines how the payload length of the bursts to analyze is determined.

Estimate from Signal: The payload length is estimated by the measurement application from the signal.
Take from HT-SIG: The payload length information from the HT-Signal field is used.

Remote: `CONF:WLAN:PAYL:LENG:SRC`

MIMO Settings (IEEE 802.11n (MIMO) only)

The *MIMO Settings* allow the user to define the mapping between streams and antennas.

The *MIMO Settings* panel is selected by placing the focus on the *Demod Settings* tab and navigating with the arrow keys below the roll key to the right respective left.

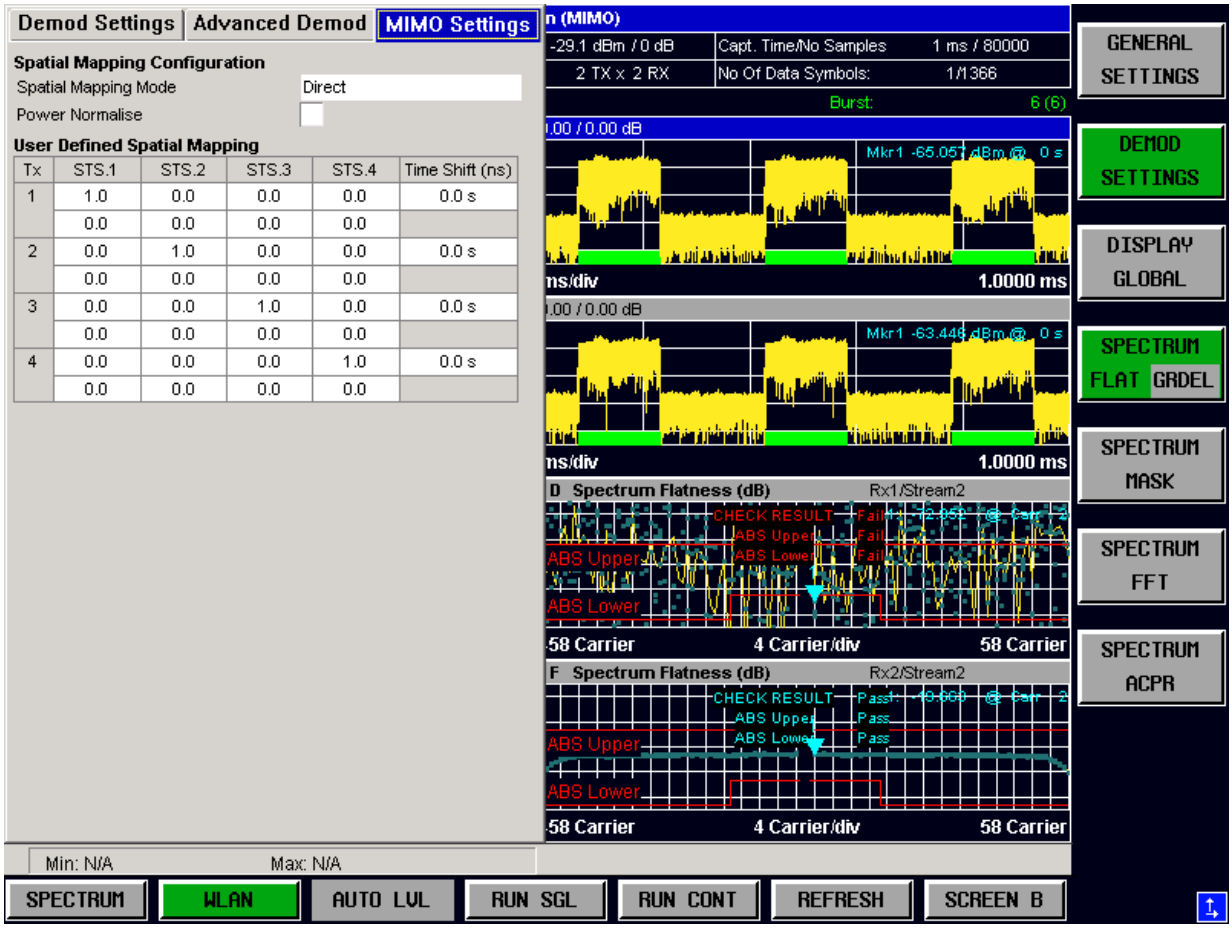
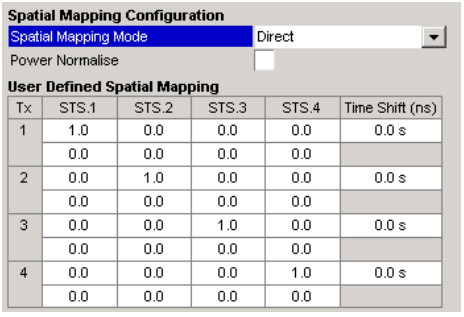


Fig. 68 MIMO Settings IEEE 802.11n (MIMO) only.

Spatial Mapping Mode

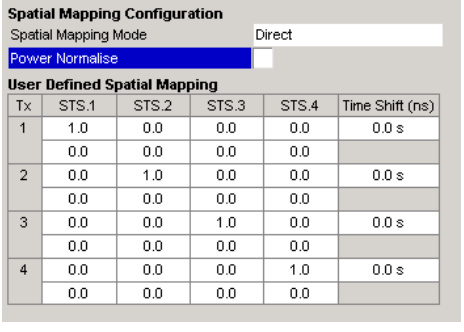


Spatial Mapping Mode defines the mapping between streams and antennas.

Direct: The mapping between streams and antennas is the identity matrix. See also section “20.3.11.10.1 Spatial Mapping” of the IEEE 802.11n WLAN standard.
Spatial Expansion: For this mode all streams contribute to all antennas. See also section “20.3.11.10.1 Spatial Mapping” of the IEEE 802.11n WLAN standard.
User defined: The mapping between streams and antennas is defined by the *User Defined Spatial Mapping* table.

Remote: `CONF:WLAN:SMAP:MODE`

Power Normalise

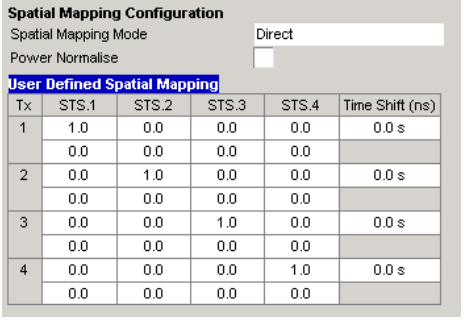


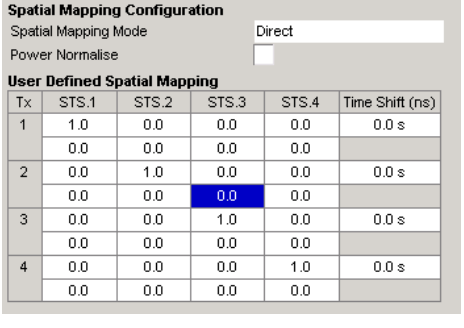
Power Normalise specifies whether an amplification of the signal power due to the spatial mapping is performed according to the matrix entries.

On: spatial mapping matrix is scaled by a constant factor to obtain a passive spatial mapping matrix which does not increase the total transmitted power.
Off: normalization step is omitted..

Remote: `CONF:WLAN:SMAP:NORM`

User Defined Spatial Mapping





User Defined Spatial Mapping allows the user to define his own spatial mapping between streams and antennas. Cyclic shift delay transmit diversity can also be set using *Time Shift*. To edit the table, move the focus on the table header. Press ENTER or push the roll key to enter the table.

Field Tx m, STS.n: complex element of the STS-Stream to Tx-Stream mapping matrix (precoding matrix Q). The upper subfield is the real part part of the complex element. The lower subfield is the imaginary part of the complex element.
Field: Tx m, Time Shift: Tx-Antenna wise definition of time shifts (in ns) for specification of user defined CSD (cyclic delay diversity) for the Spatial Mapping.

$$\begin{pmatrix} Tx_1 - Stream \\ . \\ . \\ Tx_4 - Stream \end{pmatrix} = \begin{pmatrix} Tx_1, STS.1 & . & . & Tx_1, STS.4 \\ . & & & . \\ . & & & . \\ Tx_4, STS.1 & . & . & Tx_4, STS.4 \end{pmatrix} \begin{pmatrix} STS - Stream_1 \\ . \\ . \\ STS - Stream_4 \end{pmatrix}$$

Remote: `CONF:WLAN:SMAP:TX<1..4>:STR<1..4>`
`CONF:WLAN:SMAP:TX<1..4>:TIM`

Gate Settings

This section of the user manual describes the Gate Settings. The gate settings allow the range of captured data used in results calculation to be specified.
When gating is switched on, vertical lines are displayed in the Magnitude Capture trace. The two lines mark the area of data to be used in the calculation of results

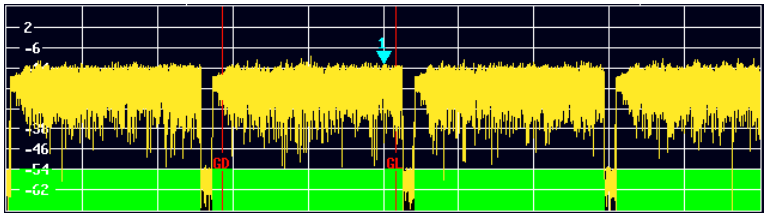


Fig. 69 Gate lines displayed in Magnitude Capture Buffer

The gate settings can be used to specify the region of input data to analyze for the following measurements:

- PVT
- Spectrum FFT
- CCDF
- Spectrum Mask
- Spectrum ACP

The softkeys for accessing the gate settings are accessed from each of the measurement softkey menus. Press the NEXT hardkey to access the gate setting menu.

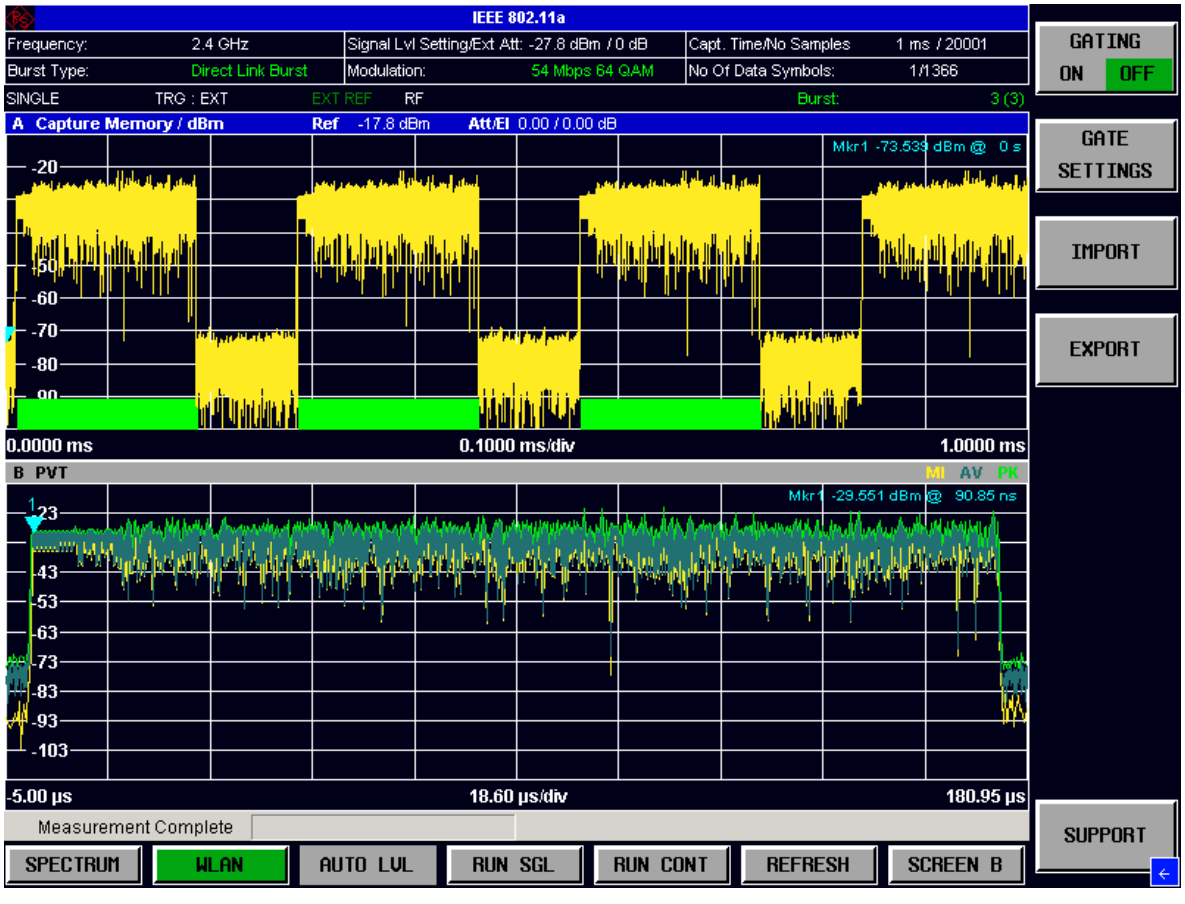
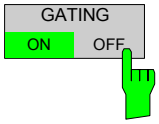


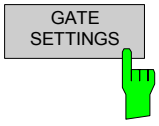
Fig. 70 Gate Settings menu view



The *GATING* softkey allows gating to be swiitched on or off.

Remote: `SENS:SWE:EGAT`

When gating is switched off, all captured data is used in results calculation.



The *GATE SETTINGS* softkey displays the Gate Settings pop-up dialog.

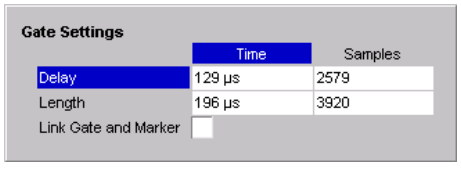
Remote:
```
SENS:SWE:EGAT:HOLD:SAMP
SENS:SWE:EGAT:HOLD:TIME
SENS:SWE:EGAT:LENG:SAMP
SENS:SWE:EGAT:LENG:TIME
SENS:SWE:EGAT:LINK
```

Fig. 71 Gate Settings pop-up dialog

Gate Settings

The gate settings specify the characteristics of the gate to be applied to the measurement. Note: If the gate settings dialog is displayed while a frequency sweep measurement is active (Spectrum Mask and Spectrum ACP), the measurement view automatically switches to the Magnitude Capture Buffer display in order to allow the gate to be set to the correct part of the sweep.

Delay



Delay specifies the starting point of captured data to be used in results calculation, i.e. the delay from the start of the captured data.

Delay can be specified in the following ways:

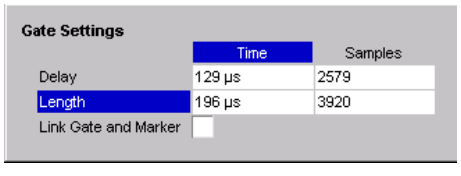
- Time
- Samples

When the delay is specified in one unit, the other unit field is updated accordingly.

When a value is supplied for the gate delay (in any unit), the gate delay line in the Magnitude Capture Buffer (marker with GD) is displayed in the new position.

Remote: `SENS:SWE:EGAT:HOLD:SAMP`
`SENS:SWE:EGAT:HOLD:TIME`

Length



Length specifies the amount of captured data to be used in results calculation.

Length can be specified in the following ways:

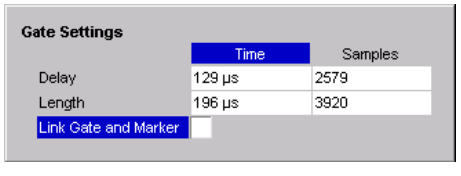
- Time
- Sample

When the length is specified in one unit, the other unit field is updated accordingly.

When a value is supplied for the gate length (in any unit), the gate length line in the Magnitude Capture Buffer (marker with GL) is displayed in the new position.

Remote: `SENS:SWE:EGAT:LENG:SAMP`
`SENS:SWE:EGAT:LENG:TIME`

Link Gate and Marker



Link Gate and Marker allows the position of the marker and the gate lines to be linked.

When *Link Gate and Marker* is switched ON, the marker is positioned half way between the gate start and the gate end. The marker position alters when the gate is modified, and the gate lines move with the marker when the marker position is altered.

Remote: `SENS:SWE:EGAT:LINK`

Import/Export of IQ Data

This section of the user manual describes the IQ Data Import/Export function, which allows the captured IQ data to be saved and recalled to and from an external file.

The softkeys for accessing the import/export IQ data settings are located in each of the measurement softkey menus. Press the NEXT hardkey to access the import/export softkeys.

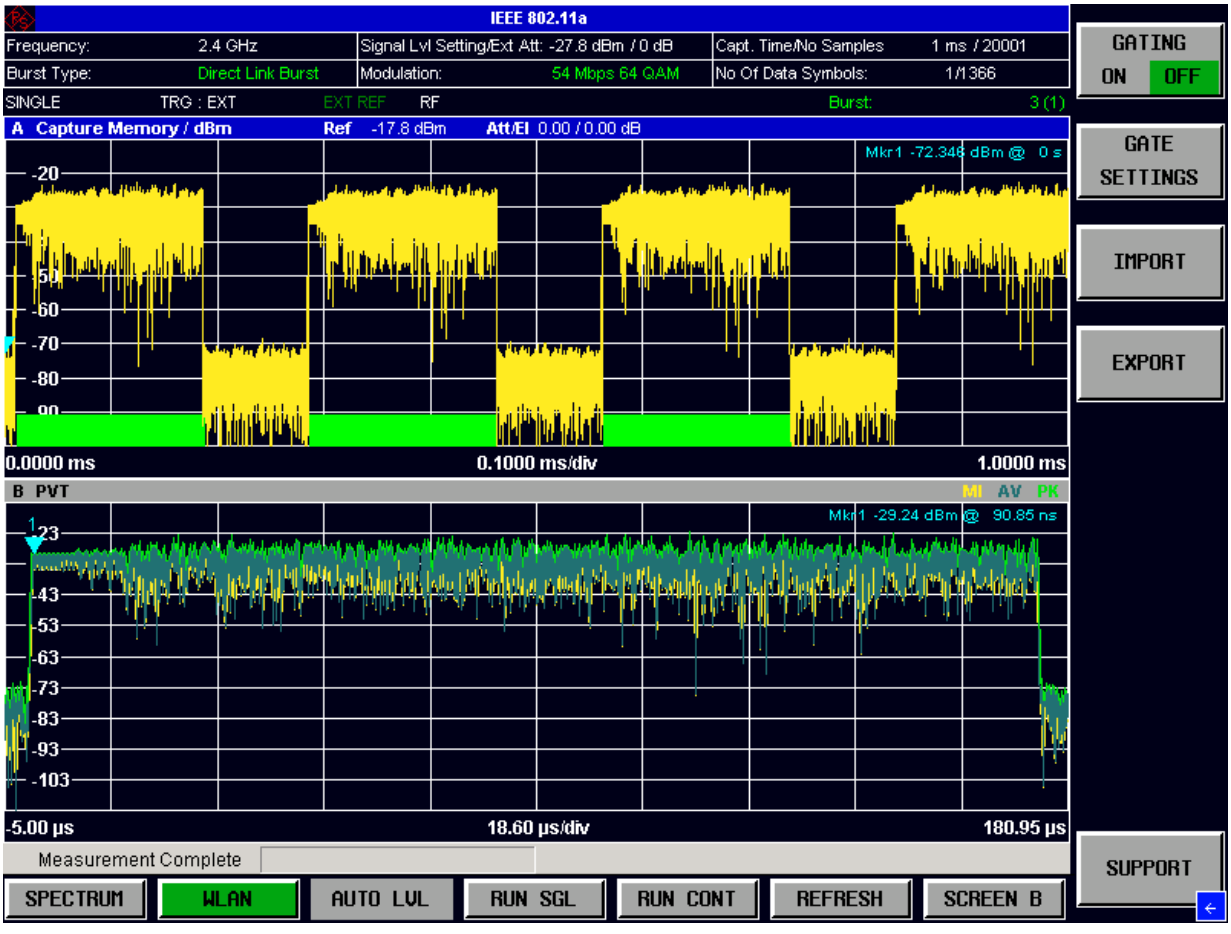
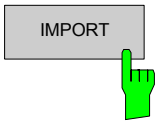


Fig. 72 Import/Export in the Gate Settings menu view



The *IMPORT* softkey displays the Import pop-up dialog.

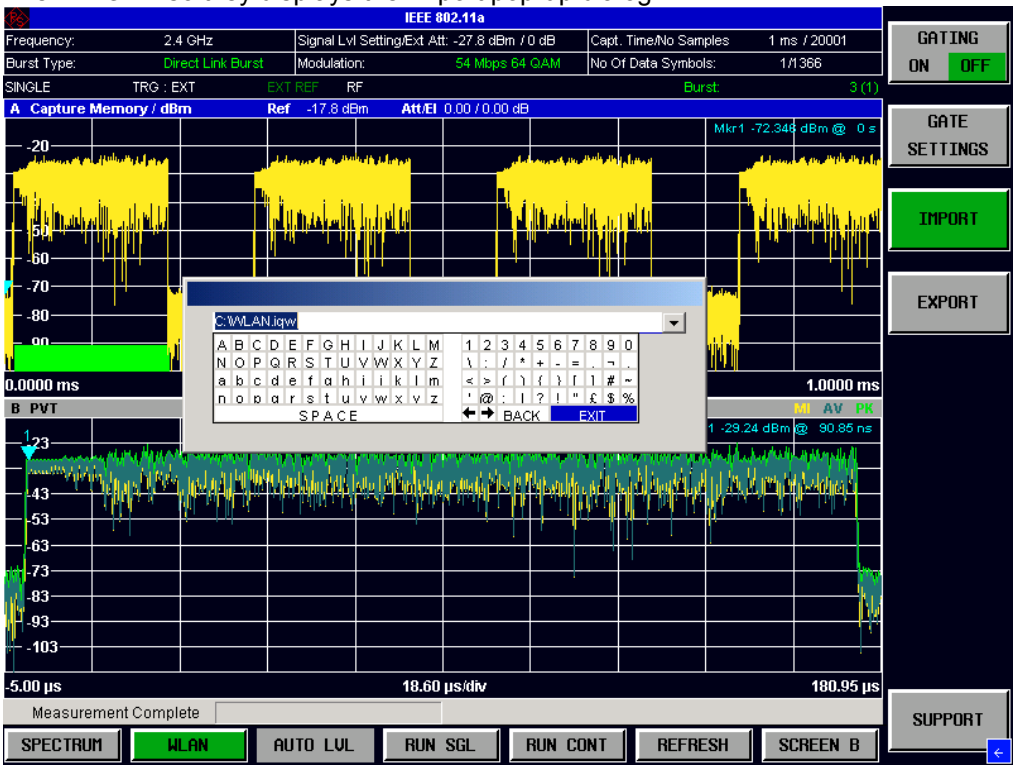
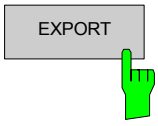


Fig. 73 Import pop-up dialog

The import pop-up dialog allows the full name and path of the IQ data file to be imported to be specified. Pressing ENTER causes the specified IQ data file to be loaded and the results displayed.
If the specified file cannot be found or is not a valid IQ data file, an error messge will be displayed indicating that the IQ data could not be imported.

Remote: `MMEM:LOAD:IQ:STAT`



The EXPORT softkey displays the Export pop-up dialog.

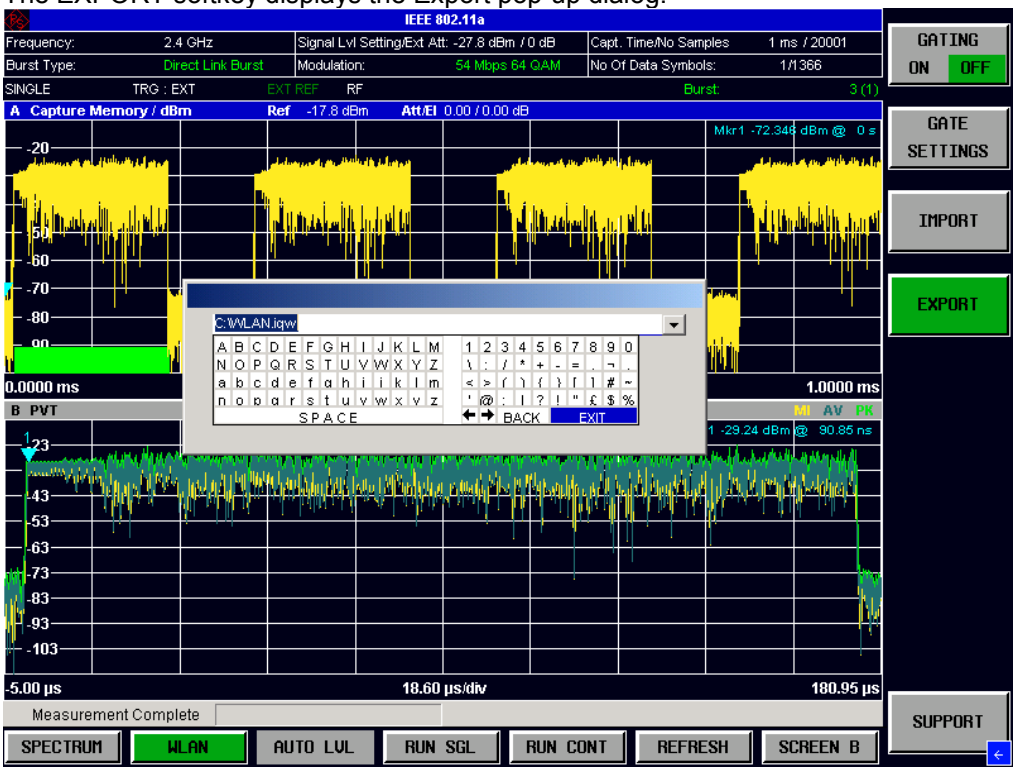


Fig. 74 Export pop-up dialog

The export pop-up dialog allows the full name and path of the IQ data file to be exported to be specified. Pressing ENTER causes the IQ data to be written to the specified file.
If the specified file cannot be created or if there is no valid IQ data to export (i.e. IQ measurement has not been executed), an error messge will be displayed indicating that the IQ data could not be exported.

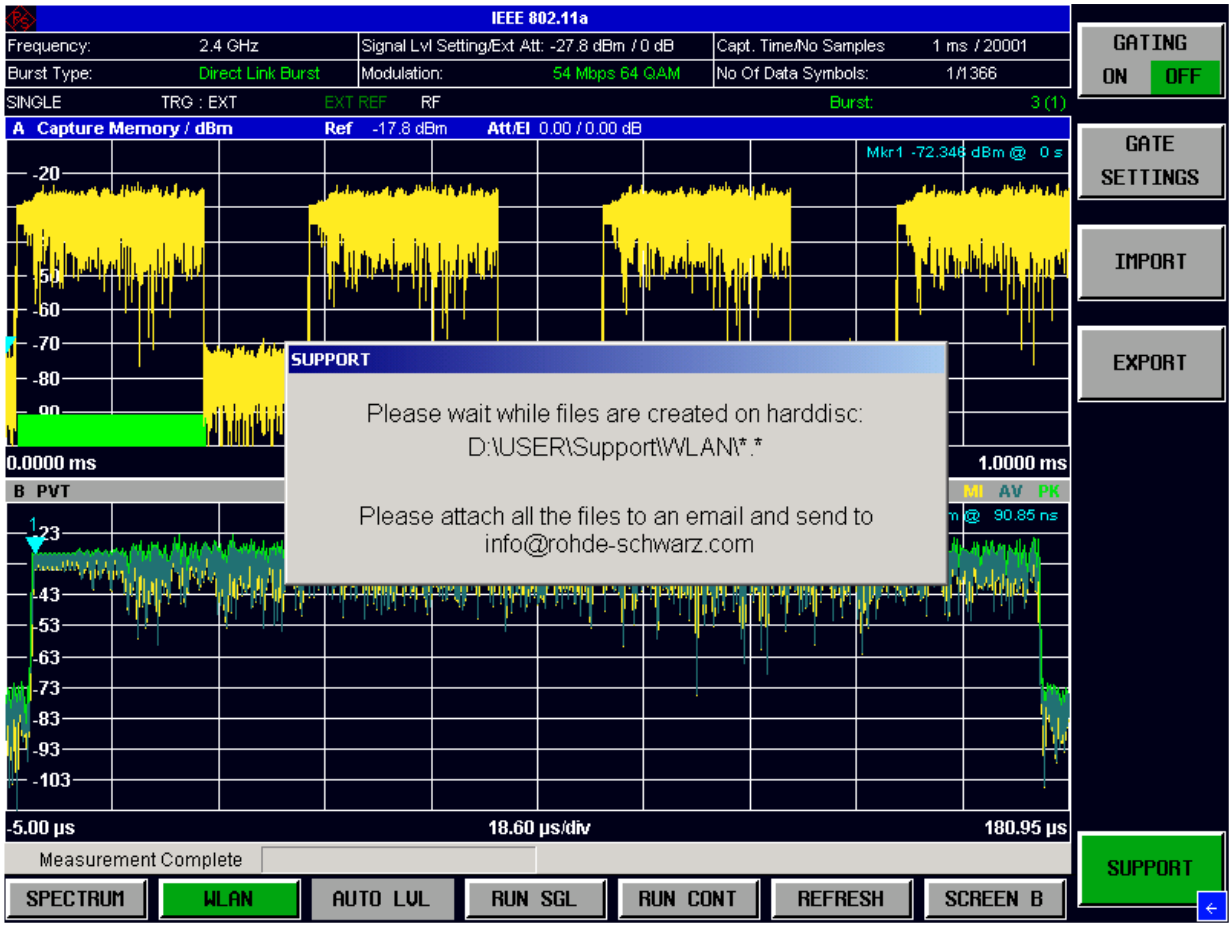
Remote: `MMEM:STOR:IQ:STAT`

Support

This section of the user manual describes the Support function, which stores necessary data files to be sent to Rohde & Schwarz support center.

The softkey to create and store the support files is located in each of the measurement softkey menus. Press the NEXT hardkey to access the *Support* softkey.

Note: The *Support* softkey is only available if no measurement is performed, i.e. RUN CONT must not be activated.



On pressing the *Support* softkey a popup dialog box is displayed and the following data is stored on the harddisk, D:\USER\SUPPORT*.*:

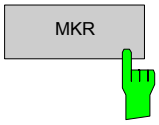
- *.bin file option settings
- *.iqw file IQ-data
- *.txt file option and version list
- *.bmp screenshot

Remote: `N/A`

Note: Attach all the files under D:\USER\SUPPORT*.* to an email and send to: info@rohde-schwarz.com.

Markers

This section of the user manual describes the Marker facility of the option.



The *MKR* hardkey brings up the marker softkey menu. Any setting views on display when the marker softkey menu is displayed will be closed.

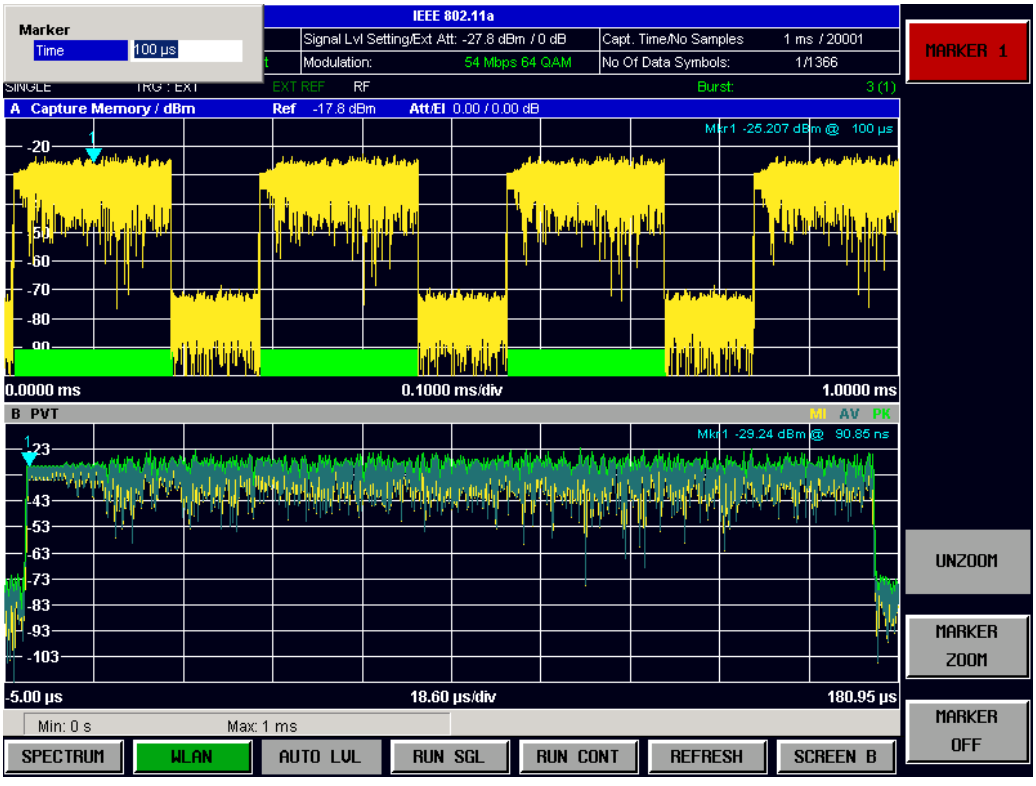
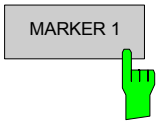


Fig. 75 Marker menu

From the marker menu, it is possible to adjust the marker position, use the marker to zoom in & out and switch the marker display off.

Adjusting Markers

The marker can be adjusted by pressing the marker softkey in the marker softkey menu.



The *MARKER* softkey displays the marker pop-up dialog. The contents of the marker pop-up depends on the type of graph to which the marker being adjusted belongs.

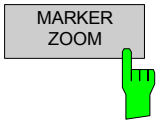
As soon as a field in the marker pop-up dialog is adjusted, the marker position in the trace will update, along with the results displayed for the marker.

Remote: `CALC:MARK:STAT`
`CALC:MARK:X`

Marker Zoom

A zoom facility is available for markers belonging to the following result traces:

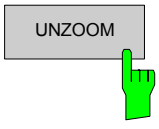
- Magnitude Capture
- PVT
- Constellation Vs Symbol
- Constellation Vs Carrier



The *MARKER ZOOM* softkey displays the Marker Zoom pop-up dialog which contains the magnification factor for the zoom.

The maximum magnification depends on the type of results trace.

Remote: `:CALC:MARK:FUNC:ZOOM`

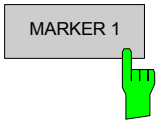


The *UNZOOM* softkey cancels the marker zoom.

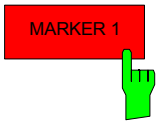
Remote: `:CALC:MARK:FUNC:ZOOM 1`

Toggle Marker Display

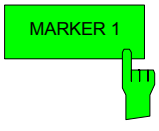
Markers can be toggled by pressing the marker softkey as follows:



Pressing the *MARKER* softkey when the marker is not displayed (softkey has grey background) causes the marker pop-up to be displayed and the marker to be switched on.



Pressing the *MARKER* softkey when the marker pop-up is displayed (softkey has red background) causes the marker to be switched off.



Pressing the *MARKER* softkey when the marker is displayed but the marker pop-up is not displayed (softkey has green background) causes the marker pop-up to be displayed.

All markers in the active screen can be switched off by pressing the *MARKER OFF* softkey.

Assigning Markers to Traces

In result graphs that have more than one trace (e.g. PVT), the marker can be assigned to any of the displayed traces.

MKR->

Pressing the *MKR->* hardkey displays the Marker Extension softkey menu.

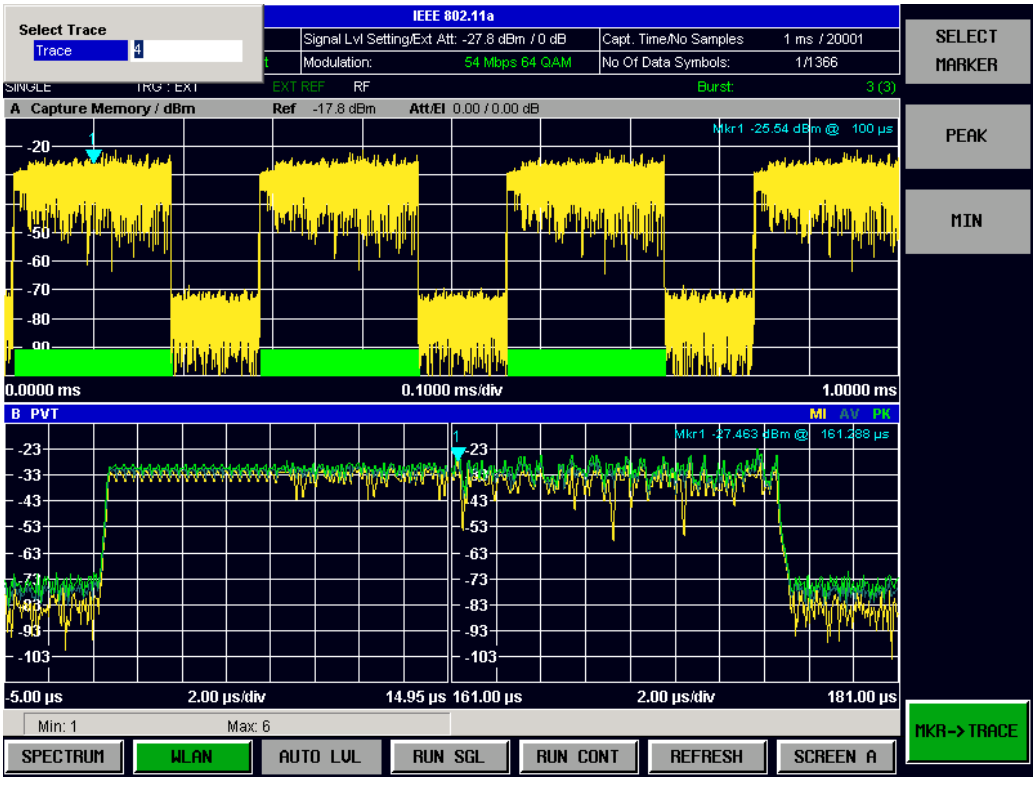


Fig. 76 Marker Extension softkey menu

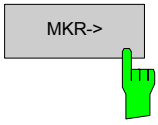
MKR->TRACE

Pressing the *MKR->TRACE* displays the Select Trace pop-up dialog. This allows the ID of the trace to which the marker is to be attached to be supplied.

Remote: `CALC:MARK:TRAC`

Assigning Markers to Peak/Min

In the Spectrum Flatness measurement results graph, the marker can be assigned to the peak or minimum value for the currently allocated trace.



Pressing the *MKR->* hardkey displays the Marker Extension softkey menu.

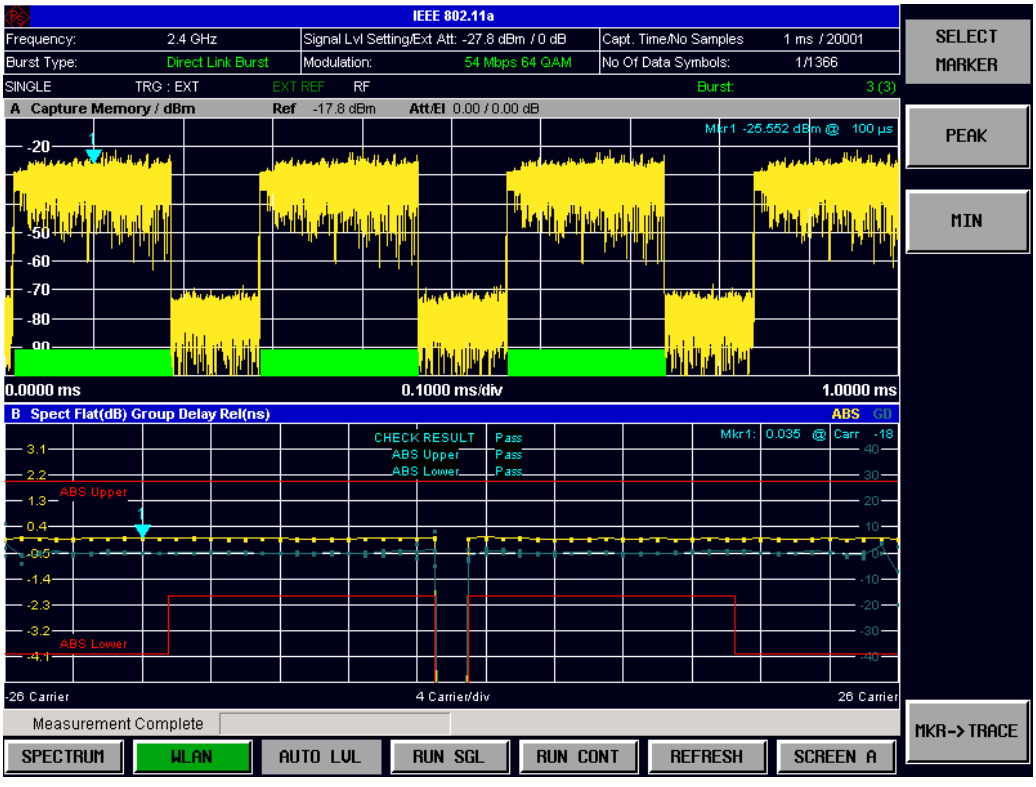
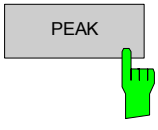
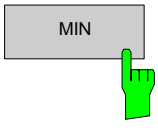


Fig. 77 Marker Extension Softkey Menu



Pressing the *PEAK* softkey sets the marker to the peak value for the allocated trace.

Remote: `CALC:MARK:MAX`

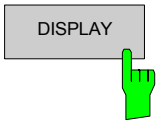


Pressing the *MIN* softkey sets the marker to the minimum value for the allocated trace.

Remote: `CALC:MARK:MIN`

Display Settings

The layout of the display can be controlled using the display menu.



The *DISPLAY* hardkey brings up the display menu. Any setting views on that are open when the display softkey menu is displayed will be closed.

Fig. 78 Display Menu

Remote: `DISP:FORM`

The display menu allows the display to be changed between split-screen and full-screen display for IQ measurement results. Note: For frequency sweep measurement results (Spectrum Mask and Spectrum ACPR), the display is always full screen.

The active screen can be selected by pressing the *SCREEN A/SCREEN B* hotkey. A screen needs to be made active in order to control the markers it displays.

In order to display a MIMO measurement window in Full Screen mode select the measurement window by browsing thtrough the measurement windows with the *SCREEN …* hotkey. After the required measurement winow has the focus (measurement window title bar is highlighted blue) press the *FULL SCREEN* softkey to display the window in full screen mode.

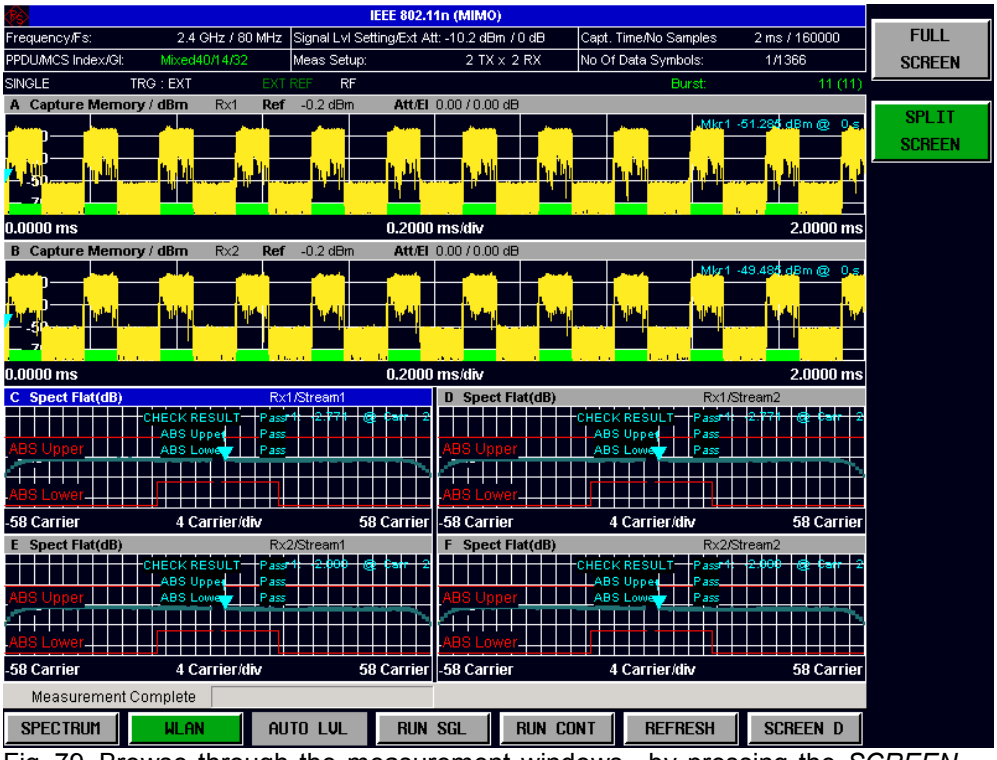


Fig. 79 Browse through the measurement windows –by pressing the *SCREEN …* hotkey- in order to select the window to be displayed in Full Screen mode.

Fig. 80 Press the *FULL SCREEN* softkey to display the required measurement window in full screen mode.

Remote: `DISP:FORM`

In full-screen mode, the *SCREEN A/SCREEN B* hotkey also toggles which screen is displayed.

3 Measurements in Detail

This section provides a more detailed explanation of the measurements provided by R&S FSQ-K90/K91/K91n and provides help for usingR&S FSQ-K90/K91/K91n to measure the characteristics of specific types of DUT.

Signal Processing of the IEEE802.11a application

Abbreviations

$a_{l,k}$	symbol at symbol l of subcarrier k
EVM_k	error vector magnitude of subcarrier k
EVM	error vector magnitude of current packet
g	signal gain
Δf	frequency deviation between TX and RX
l	symbol index $l = [1, nof\_Symbols]$
$nof\_symbols$	number of symbols of payload
H_k	channel transfer function of subcarrier k
k	channel index $k = [-31,32]$
K_{mod}	modulation-dependent normalization factor
ξ	relative clock error of reference oscillator
$r_{l,k}$	subcarrier k of symbol l

This description provides a high-level overview of IEEE802.11a application signal processing.

A diagram of the blocks of interest is shown in Fig. 81.First, the RF signal is downconverted 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 downconverter shifts the IF signal to the complex baseband. In the next step, the baseband signal is filtered by an 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; second, it attenuates the aliasing frequency bands caused by the subsequent downsampling. After filtering, the sequence is sampled down by the factor of 4. Thus, the sampling rate of the downsampled sequence $r(i)$ is the Nyquist rate of $f_{s3} = 20$ MHz. Up to this point, the digital part is implemented in an ASIC.

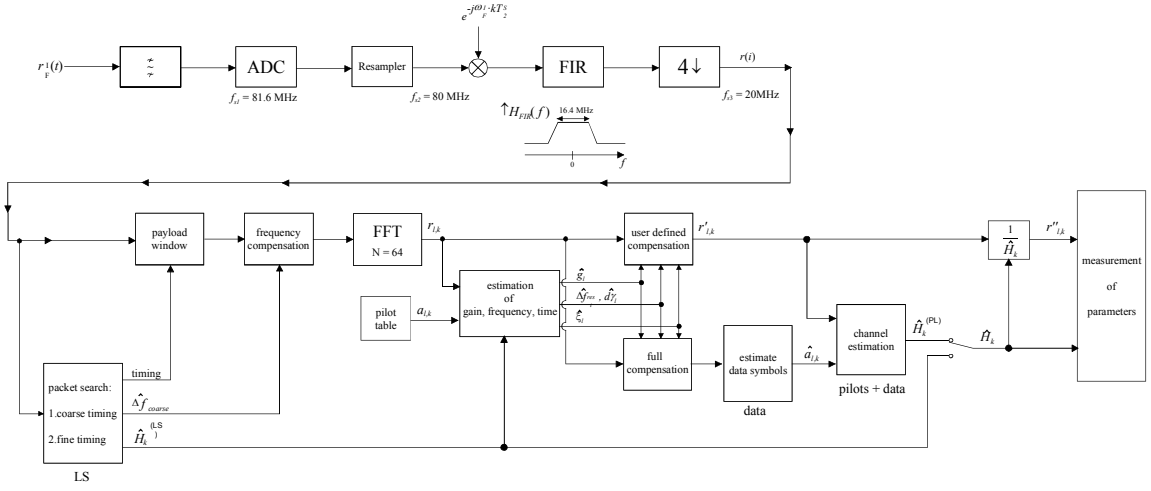


Fig. 81 Signal processing of the IEEE 802.11a application

The lower part of the figure shows the subsequent digital signal processing. In the first block, 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]-[3]. Furthermore, a coarse estimate $\Delta\hat{f}_{coarse}$ [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 subcarriers), 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 $\hat{H}_k^{(\mathrm{LS})}$, with $k = [-26, 26]$ denoting the channel index of the occupied subcarriers. First, the FFT of the LS is calculated. After the FFT calculation, the known symbol information of the LS subcarriers 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 trail time of the maximum energy is detected. This trial time is used to adjust the timing.

The position of the LS is now 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 $\Delta\hat{f}_{coarse}$. This is necessary because, otherwise, interchannel 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 $l = [\,1\,,\, nof\_symbols\,]$ and
- the channel index $k = [\,-31\,,\, 32\,]$.

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

$$r_{l,k} = K_{\mathrm{mod}} \cdot a_{l,k} \cdot g_l \cdot H_k \cdot e^{j\left(phase_l^{(\mathrm{commom})} + phase_{l,k}^{(\mathrm{timing})}\right)} + n_{l,k} \qquad (1)$$

[1] In this paper the hat generally describes an estimate. Example: $\hat{x}$ is the estimate of x.

with

- the modulation-dependent normalization factor K_{mod}
- the symbol $a_{l,k}$ of subcarrier 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 $phase_l^{(\mathrm{common})}$ of all subcarriers at symbol l (see below)
- the phase $phase_{l,k}^{(\mathrm{timing})}$ of subcarrier 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

$$phase_l^{(\mathrm{common})} = 2\pi \cdot N_s / N \cdot \Delta f_{rest} T \cdot l + d\gamma_l \qquad (2)$$

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 $\Delta \hat{f}_{coarse}$ (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 $\Delta f = \Delta \hat{f}_{coarse} + \Delta f_{rest}$. 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, 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 IEEE 802.11a measurement standard *Chapter 17.3.9.7 "Transmit modulation accuracy test"* [6], the common phase drift $phase_l^{(\mathrm{common})}$ 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 FSQ-K90/K91/K91n.

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

$$phase_{l,k}^{(\mathrm{timing})} = 2\pi \cdot N_s / N \cdot \xi \cdot k \cdot l \qquad (3)$$

with ξ being the relative clock deviation of the reference oscillator. Normally a symbol-wise timing jitter is negligible and thus not modelled 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 with [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), the resulting phase drift of the highest subcarrier $k = 26$ 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 IEEE 802.11a measurement standard [6], the timing drift $phase_{l,k}^{(\text{timing})}$ is not part of the requirements. Therefore, the "time tracking" (Tracking Time) is not activated as the default setting of the R&S FSQ-K90/K91/K91n.
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 $\hat{H}_k^{(\text{LS})}$ is calculated. This makes sense since the sequence $r'_{l,k}$ is compensated by the coarse channel transfer function $\hat{H}_k^{(\text{LS})}$ 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 is useful.
Referring to the IEEE 802.11a 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 FSQ-K90/K91/K91n.

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 function[2]

$$L_1(\Delta\tilde{f}_{rest}, \tilde{\xi}) \overset{\text{eq.(1)}}{=} \sum_{l=1}^{nof\_symbols} \sum_{k=-21,-7,7,21} \left| r_{l,k} - a_{l,k} \cdot \hat{H}_k^{(\text{LS})} \cdot e^{j\left(\tilde{p}hase_l^{(\text{common})} + \tilde{p}hase_{l,k}^{(\text{timing})}\right)} \right|^2$$

with

$$\tilde{p}hase_l^{(\text{common})} \overset{\text{eq.(2)}}{=} 2\pi \cdot N_s / N \cdot \Delta\tilde{f}_{rest} T \cdot l \qquad (4)$$

$$\tilde{p}hase_l^{(\text{timing})} \overset{\text{eq.(3)}}{=} 2\pi \cdot N_s / N \cdot \tilde{\xi} \cdot k \cdot l$$

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

$$L_2(\tilde{g}_l, d\tilde{\gamma}_l) \overset{\text{eq.(1)}}{=} \sum_{k=-21,-7,7,21} \left| r_{l,k} - a_{l,k} \cdot \tilde{g}_l \cdot \hat{H}_k^{(\text{LS})} \cdot e^{j\left(\tilde{p}hase_l^{(\text{common})} + \hat{p}hase_{l,k}^{(\text{timing})}\right)} \right|^2$$

with

$$\tilde{p}hase_l^{(\text{common})} \overset{\text{eq.(2)}}{=} 2\pi \cdot N_s / N \cdot \Delta\hat{f}_{rest} T \cdot l + d\tilde{\gamma}_l$$

$$\hat{p}hase_l^{(\text{timing})} \overset{\text{eq.(3)}}{=} 2\pi \cdot N_s / N \cdot \hat{\xi} \cdot k \cdot l$$

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

[2] In this paper, the tilde generally describes an estimate. Example: $\tilde{x}$ is the trial parameter of x.

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 $\hat{H}_k^{(\mathrm{LS})}$ calculated from the LS. Usually an error-free estimation of the data symbols can be assumed.

In the next block, a better channel estimate $\hat{H}_k^{(\mathrm{PL})}$ of the data and pilot subcarriers 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 IEEE 802.11a 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 FSQ-K90/K91/K91n 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

$$EVM_k = \sqrt{\frac{1}{nof\_Symbols} \cdot \sum_{l=1}^{nof\_Symbols} \left| r''_{l,k} - K_{\mathrm{mod}} \cdot a_{l,k} \right|^2} \qquad (5)$$

of the subcarrier k of the current packet. Furthermore the packet error vector magnitude

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

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

$$\overline{EVM} = \sqrt{\frac{1}{nof\_packets} \sum_{counter=1}^{nof\_packets} EVM^2(counter)} \qquad (7)$$

is calculated by averaging the packet EVM of all $nof\_packets$ detected packets. This parameter is equivalent to the "RMS average of all errors $Error_{RMS}$" of the IEEE 802.11a measurement standard (see [6], *Chapter 17.3.9.7*).

Literature

[1] Speth, Classen, Meyr: "Frame synchronisation 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., Dez. 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 IEEE 802.11b application

Abbreviations

ε	timing offset
Δf	frequency offset
$\Delta\phi$	phase offset
$\mathrm{ARG}\{\ldots\}$	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
$\hat{o}_I$	estimate of the IQ offset in the I branch
$\hat{o}_Q$	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
$\mathrm{REAL}\{\ldots\}$	calculation of the real part of a complex value
$\mathrm{IMAG}\{\ldots\}$	calculation of the imaginary part of a complex value

This description gives a rough overview of the signal processing concept of the IEEE 802.11b application.

A block diagram of the measurement application is shown in Fig. 82. The baseband signal of an IEEE 802.11b wireless LAN system transmitter is sampled with a sampling rate of 44 MHz.

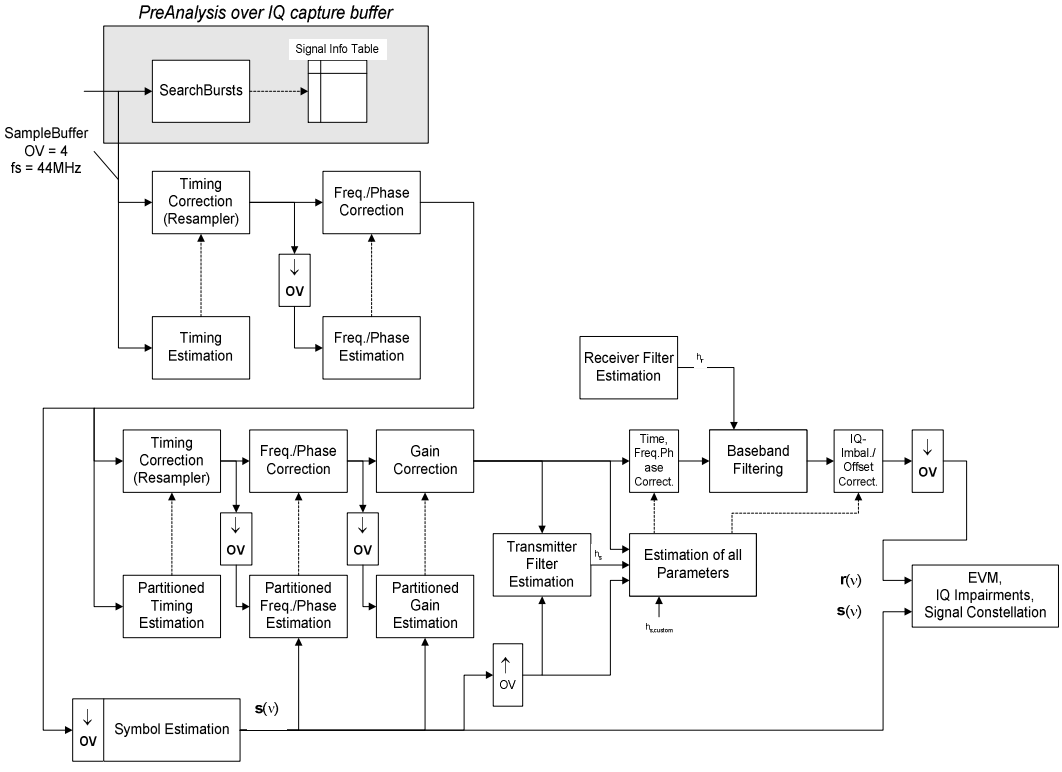


Fig. 82 Signal processing of the IEEE 802.11b application

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 begining of short and long bursts and can distinguish between them. The algorithm also detects the initial state of the scrambler. This is required if IEEE 802.11 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 are 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, 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 offset 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

$$L_1 = \sum_{v=0}^{N-1} \left| r(v) \cdot e^{-j2\pi\Delta\tilde{f}v} \cdot e^{-j\Delta\tilde{\phi}} - \sum_{i=-L}^{+L} \tilde{h}_s(i) \cdot \hat{s}_n(v-i) - \tilde{o}_I - j\tilde{o}_Q \right|^2 \qquad \text{Eq. 3.1}$$

of a maximum-likelihood-based estimator, where $r(v)$ is the oversampled measurement signal, $\hat{s}_n(v)$ the oversampled 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 offset, the phase offset , the IQ offset and the coefficients of the transmitter filter. The frequency offset, the phase offset

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 unkown signal parameters are estimated with a maximum-likelihood-based estimation, which minimizes the cost function

$$L_2 = \sum_{v=0}^{N-1} \left| r(v-\tilde{\varepsilon}) \cdot e^{-j2\pi\Delta\tilde{f}v} \cdot e^{-j\Delta\tilde{\phi}} - \tilde{g}_I \cdot s_I(v) - j\tilde{g}_Q \cdot s_Q(v) + \Delta\tilde{g}_Q \cdot s_Q(v) - \tilde{o}_I - j\tilde{o}_Q \right|^2 , \quad \text{Eq. 3.2}$$

where $\tilde{g}_I$ and $\tilde{g}_Q$ are the variation parameters of the gain used in the I and Q branches, respectively, $\Delta\tilde{g}_Q$ is the crosstalk factor of the Q branch into the I branch, and $s_I(v)$ and $s_Q(v)$ are the filtered reference signals of the I and Q branches, respectively. 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 quadrature mismatch and the normalized IQ offset are displayed by the measurement software. The IQ imbalance

$$\text{IQ - Imbalance} = \left| \frac{\hat{g}_Q + \Delta\hat{g}_Q}{\hat{g}_I} \right| \quad \text{Eq. 3.3}$$

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

$$\text{Quadrature} - \text{Mismatch} = \text{ARG}\left\{\hat{g}_Q + j \cdot \Delta\hat{g}_Q\right\} \quad \text{Eq. 3.4}$$

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

$$\text{IQ} - \text{Offset} = \frac{\sqrt{\hat{o}_I^2 + \hat{o}_Q^2}}{\sqrt{\frac{1}{2} \cdot \left[\hat{g}_I^2 + \hat{g}_Q^2\right]^2}} \quad \text{Eq. 3.5}$$

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

At this point in the signal processing, all unknown signal parameters such as timing offset, frequency offset, phase offset, 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)

$$EVM = \frac{\sqrt{\sum_{v=0}^{N-1} \left| r(v) - \hat{s}(v) \right|^2}}{\sqrt{\sum_{v=0}^{N-1} \left| \hat{s}(v) \right|^2}} \quad \text{Eq. 3.6}$$

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

$$EVM(v) = \frac{\left| r(v) - \hat{s}(v) \right|}{\sqrt{\sum_{v=0}^{N-1} \left| \hat{s}(v) \right|^2}} \quad \text{Eq. 3.7}$$

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

$$\hat{o}_I = \frac{1}{N}\sum_{v=0}^{N-1}\mathrm{REAL}\{r(v)\}$$

Eq. 3.8

and the IQ offset of the Q branch

$$\hat{o}_Q = \frac{1}{N}\sum_{v=0}^{N-1}\mathrm{IMAG}\{r(v)\}$$

Eq. 3.9

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

$$\hat{g}_I = \frac{1}{N}\sum_{v=0}^{N-1}\left|\mathrm{REAL}\{r(v) - \hat{o}_I\}\right|$$

Eq. 3.10

and the IQ imbalance of the Q branch

$$\hat{g}_Q = \frac{1}{N}\sum_{v=0}^{N-1}\left|\mathrm{IMAG}\{r(v) - \hat{o}_Q\}\right|$$

Eq. 3.11

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

$$V_{\mathrm{err}} = \frac{\sqrt{\frac{1}{2}\sum_{v=0}^{N-1}\left[\left|\mathrm{REAL}\{r(v)\} - \hat{o}_I\right| - \hat{g}_I\right]^2 + \frac{1}{2}\sum_{v=0}^{N-1}\left[\left|\mathrm{IMAG}\{r(v)\} - \hat{o}_Q\right| - \hat{g}_Q\right]^2}}{\sqrt{\frac{1}{2}\cdot\left[\hat{g}_I^2 + \hat{g}_Q^2\right]^2}}$$

Eq. 3.12

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

$$V_{\mathrm{err}}(v) = \frac{\sqrt{\frac{1}{2}\left[\left|\mathrm{REAL}\{r(v)\} - \hat{o}_I\right| - \hat{g}_I\right]^2 + \frac{1}{2}\left[\left|\mathrm{IMAG}\{r(v)\} - \hat{o}_Q\right| - \hat{g}_Q\right]^2}}{\sqrt{\frac{1}{2}\cdot\left[\hat{g}_I^2 + \hat{g}_Q^2\right]^2}}$$

Eq. 3.13

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. 3.14. If the EVM value is dominated by Gaussian noise, this method yields similar results to those of Eq. 3.15.

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

Measurement with Rohde & Schwarz 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. 83 is a screenshot of this measurement on the R&S FSQ. The delta marker directly shows the RF carrier suppression in dB (white circled value).

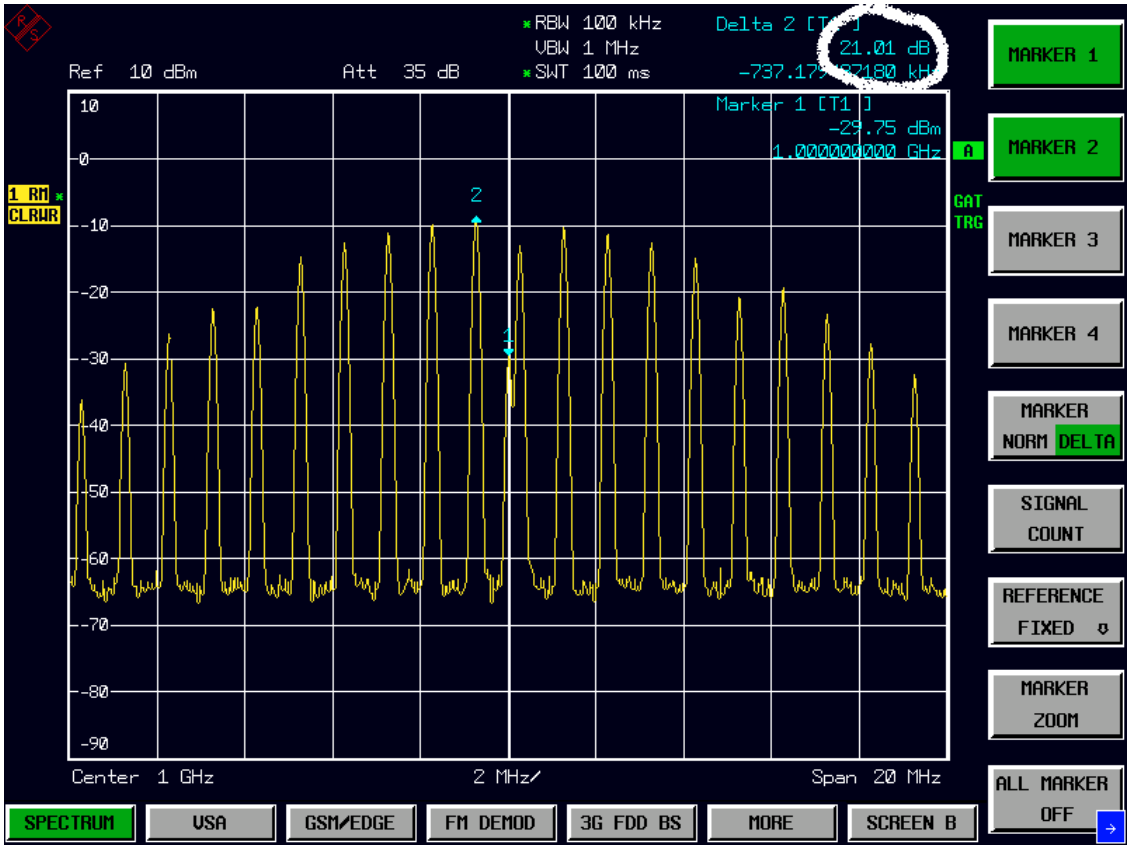


Fig. 83 RF carrier suppression measurement

Comparison to IQ offset measurement in R&S FSQ-K90/K91/K91n list mode

The IQ offset measurement in R&S FSQ-K90/K91/K91n returns the actual carrier feedthrough normalized to the mean power at the symbol timings. This measurement does not 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 R&S FSQ-K90/K91/K91n list mode. The difference (in dB) between the two values depends on the transmit filter shape and should be determined with one reference measurement.

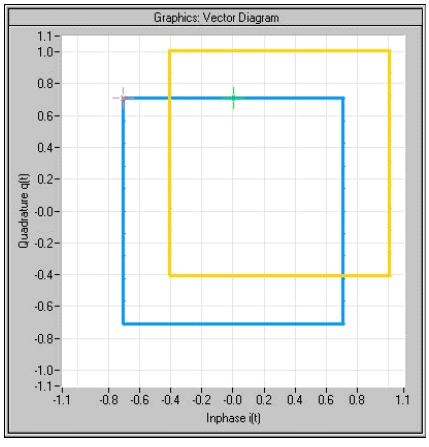
The following table lists the difference between the three transmit filter shapes $(\pm 0.5\ \mathrm{dB})$:

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

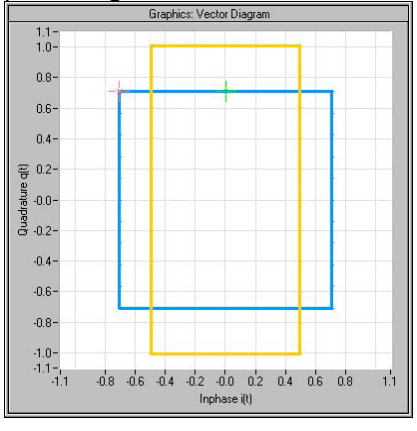
An IQ offset indicates a carrier offset with a fixed amplitude. This results in a constant shift of the IQ axes. The offset is normalized by the mean symbol power and displayed in dB.



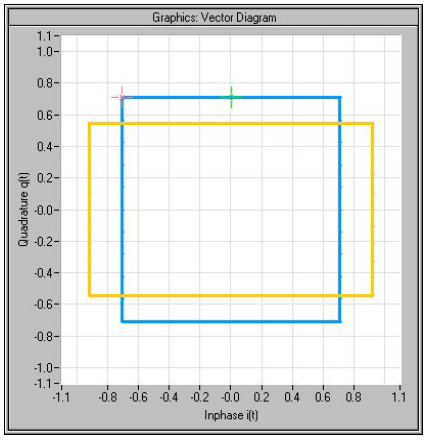
Gain Imbalance

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:
Imbalance [dB] = 20log (| $Gain_Q$ | / | $Gain_I$ |)

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



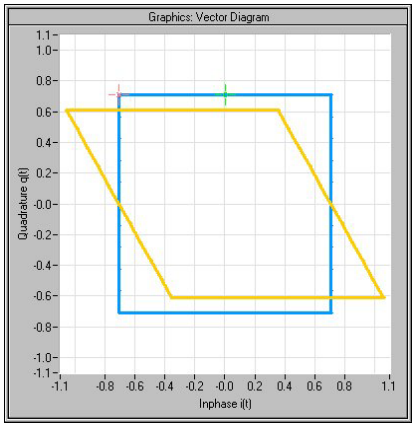
Negative values mean that the I vector is amplified more than the Q vector by the corresponding percentage:



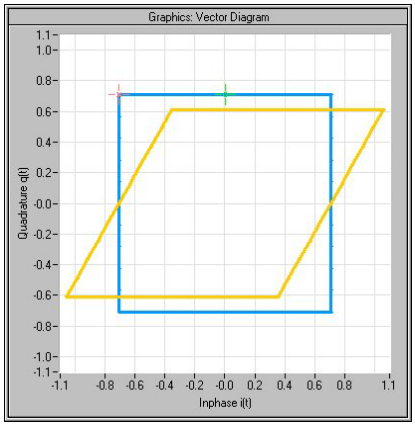
Quadrature Error

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, and 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 of less than 90 degrees:



Peak EVM (IEEE)

Peak EVM (IEEE) evaluates the EVM as defined in section 18.4.7.8 “Transmit modulation accuracy” of the IEEE 802.11b standard. The measurement signal is corrected in respect of frequency error and clock deviation before EVM calculation. Additionally the specified calculation removes the dc offset of the measurement signal.
The standard does not specify a normalization factor for the error vector magnitude. To get a level independent EVM value, the R&S FSQ-K91 normalizes the EVM values, so that an EVM of 100% indicates that the error power on the I- or Q-channels equals the mean power on the I- or Q-channels respectively.

The Peak EVM is the maximum EVM over all chips of one burst. If more than one burst is evaluated (several analyzed bursts in the capture buffer or with the help of Overall Burst Count), the Min / Mean / Max columns show the minimum, mean or maximum Peak EVM of all analyzed bursts.

The IEEE 802.11b standard allows a Peak EVM of less than 35%. In contrary to the specification, the R&S FSQ-K91 does not limit the measurement to 1000 chips length, but searches the maximum over the whole burst.

Burst EVM (Direct)

Burst EVM (Direct) evaluates the root mean square EVM over one burst. That is the square root of the averaged error power normalized by the averaged reference power:

$$\mathrm{EVM} = \sqrt{\frac{\sum_{n=0}^{N-1} \left| x_{\mathrm{meas}}(n) - x_{\mathrm{ref}}(n) \right|^2}{\sum_{n=0}^{N-1} \left| x_{\mathrm{ref}}(n) \right|^2}} = \sqrt{\frac{\sum_{n=0}^{N-1} \left| e(n) \right|^2}{\sum_{n=0}^{N-1} \left| x_{\mathrm{ref}}(n) \right|^2}} .$$

Before calculation of the EVM, the measurement signal is corrected in respect of frequency error, clock deviation and IQ impairments.

If more than one burst is evaluated (several analyzed bursts in the capture buffer or with the help of Overall Burst Count), the Min / Mean / Max columns show the minimum, mean or maximum Burst EVM of all analyzed bursts.

Burst EVM is not part of the IEEE standard and no limit check is specified. Nevertheless this commonly used EVM calculation can give some insight in modulation quality and allows comparisons to other modulation standards.

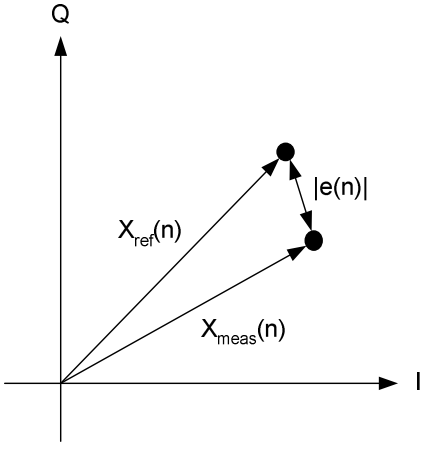


Fig. 84 IQ diagram for EVM calculation

4 Remote Control

Description of commands

This section specifies all the remote control commands specific to the R&S FSQ-K90/K91/K91n option. Only those commands provided for this option are specified. For details of remote control commands provided by the host analyzer, refer to the analyzer user manual.

Notation

In the following sections, all commands implemented in the instrument are first listed in tables 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 descriptions of the commands.

Table of Commands

Command: In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).

Parameter: The parameter column indicates the requested parameters together with their specified range.

Unit: The unit column indicates the basic unit of the physical parameters.

Comment: The comment column indicates the following:

- whether the command does not have a query form
- whether the command has only one query form
- whether the command is implemented only with a certain option of the instrument

Indentations The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level, the further the indentation to the right. Please note that the complete notation of the command always includes the higher levels as well.

Example: `SENSe:FREQuency:CENTer` is represented in the table as follows:

`SENSe`	first level
`:FREQuency`	second level
`:CENTer`	third level

Individual description The individual description contains the complete notation of the command. An example of each command, the *RST value and the SCPI information are included as well.

Upper-/lowercase notation Upper-/lowercase letters are used to mark the long or short form of the key words of a command in the description (see Section 3.5.2). The instrument itself does not distinguish between uppercase and lowercase 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 following two commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1kHz:

```
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

```
DISPlay:FORMat FULL | SPLit
```

If parameter FULL is selected, full screen is displayed; in the case of SPLit, split screen is displayed.

[ ] Keywords in square brackets can be omitted when composing the header (see Section 3.5.2, Optional Keywords). 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 always consists 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 Section 3.5.5, "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 with the numeric value 0 or 1.

<numeric_value>

<num> These keywords mark parameters that may be entered as numeric values or be set using specific keywords (character data).The following keywords are permitted:

MINimum This keyword sets the parameter to the smallest possible value.

MAXimum This keyword sets the parameter to the largest 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 with 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 the result.

<arbitrary block program data>

This keyword is provided for commands whose parameters consist of a binary data block.

ABORt Subsystem

The ABORt subsystem provides a mechanism by which running measurements can be aborted

COMMAND	PARAMETERS	UNIT	COMMENT
ABORt			

ABORt

This causes the measurement currently in progress to be aborted.

Example: "ABOR" - The R&S FSQ-K90/K91/K91n option will attempt to abort the currently active measurement.

Characteristics: *RST value: --
SCPI: In compliance

CALCulate Subsystem

CALCulate:BURSt Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:BURSt [:IMMediate]	-	-	

CALCulate<1|2>:BURSt[:IMMediate]

This command forces the IQ measurement results to be recalculated according to the current settings.

Example: "CALC:BURS" Forces an update of the IQ results

Characteristics: *RST value: -
SCPI: device specific

CALCulate LIMit Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
:CALCulate<1|2>			
:LIMit<1 to 8>			
:BURSt			
:ALL	<numeric_value>,…		
:RESult?	--	--	query only
:TRISe			
[:AVERage]	<numeric_value>	S	
:RESult?	--		query only – 802.11b
:MAXimum	<numeric_value>	S	
:RESult?	--		query only – 802.11b
:TFALl			
[:AVERage]	<numeric_value>	S	
:RESult?	--		query only – 802.11b
:MAXimum	<numeric_value>	S	
:RESult?	--		query only – 802.11b
:FERRor			
[:AVERage]	<numeric_value>	HZ	
:RESult?	--		query only
:MAXimum	<numeric_value>	HZ	
:RESult?	--		query only
:SYMBolerror			
[:AVERage]	<numeric_value>	PPM | PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	PPM | PCT	
:RESult?	--		query only
:IQOFfset			
[:AVERage]	<numeric_value>	DB	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB	
:RESult?	--		query only
:EVM			
[:AVERage]	<numeric_value>	PCT	
:RESult?	--		query only – 802.11b
:MAXimum	<numeric_value>	PCT	
:RESult?	--		query only – 802.11b
:ALL			
[:AVERage]	<numeric_value>	DB|PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB|PCT	
:RESult?	--		query only
:DATA			
[:AVERage]	<numeric_value>	DB|PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB|PCT	
:RESult?	--		query only
:PILot			
[:AVERage]	<numeric_value>	DB|PCT	
:RESult?	--		query only
:MAXimum	<numeric_value>	DB|PCT	
:RESult?	--		query only

COMMAND	PARAMETERS	UNIT	COMMENT
:ACPower			
:ACHannel?	--	DB	query only
:RESult?	--		query only
:ALTernate?	--	DB	query only
:RESult?	--		query only
:CONTrol			
[:DATA]?	--		query only
:SPECtrum			
:Mask			
:CHECk			
:X?	--	HZ	query only
:Y?	--	DBM	query only
:UPPer			
[:DATA]?	--		query only
FAIL?	--		query only

CALCulate<1\|2>:LIMit<1>:BURSt:ALL <numeric value>,...

This command sets or returns all the limit values. 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 that 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

CALCulate<1|2>:LIMit<1>:BURSt:ALL:RESult?

This command returns all the limit results (PASSED | FAILED). The results are output as a list of result strings 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 that the units for the EVM results are specified with the UNITS:EVM command.

Example: "CALC:LIM:BURS:ALL:RES?" All limit values are returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERage] <numeric value>

This command sets the average rise time limit in seconds

Example: "CALC:LIM:BURS:TRIS 0.000001" The average frequency error rise time limit is set to 1 µs.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TRISe[:AVERage]:RESult?

This command returns the average rise time limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:TRIS:RES?" Average rise time limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum <numeric value>

This command sets the maximum rise time limit in seconds

Example: "CALC:LIM:BURS:TRIS:MAX?" Maximum rise time limit is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TRISe:MAXimum:RESult?

This command returns the maximum rise time limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:TRIS:MAX:RES?" Maximum rise time limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TFALl[:AVERage] <numeric value>

This command sets the average fall time limit in seconds

Example: "CALC:LIM:BURS:TFAL 0.000001" The average fall time limit is set to 1 µs

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TFALl[:AVERage]:RESult?

This command returns the average fall time limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:TFAL:RES?" Average fall time limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TFALl:MAXimum <numeric value>

This command sets the maximum fall time limit in seconds

Example: "CALC:LIM:BURS:TFALl:MAX 0.000001" The maximum fall time limit set to 1 µs

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:TFALl:MAXimum:RESult?

This command returns the maximum fall time limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:TRIS:MAX:RES?" Maximum fall time limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage] <numeric value>

This command sets the average frequency error limit in Hz

Example: "CALC:LIM:BURS:FERR 10000" The average frequency error limit is set to 10 kHz

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:FERRor[:AVERage]:RESult?

This command returns the average frequency error limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:FERR:RES?" Average frequency error limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum <numeric value>

This command sets the maximum frequency error limit in Hz

Example: "CALC:LIM:BURS:FERR:MAX?" Maximum frequency error limit is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:FERRor:MAXimum:RESult?

This command returns the maximum frequency error limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:FERR:MAX:RES?" Maximum frequency error limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage] <numeric value>

This command sets the average symbol error limit in Hz

Example: "CALC:LIM:BURS:SYMB 10000" The average symbol error limit is set to 10 kHz

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror[:AVERage]:RESult?

This command returns the average symbol error limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:SYMB:RES?" Average symbol error limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt: SYMBolerror:MAXimum <numeric value>

This command sets the maximum symbol error limit in Hz

Example: "CALC:LIM:BURS:SYMB:MAX?" Maximum symbol error limit is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:SYMBolerror:MAXimum:RESult?

This command returns the maximum symbol error limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:SYMB:MAX:RES? "Maximum symbol error limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage] <numeric value>

This command sets the average IQ Offset error limit 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

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset[:AVERage]:RESult?

This command returns the average IQ Offset error limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:IQOF:RES?" Average IQ Offset error limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum <numeric value>

This command sets the maximum IQ Offset error limit 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

CALCulate<1|2>:LIMit<1>:BURSt:IQOFfset:MAXimum:RESult?

This command returns the maximum IQ Offset error limit result (PASSED | FAILED)

Example: "CALC:LIM:BURS:IQOF:MAX:RES:? "Maximum IQ Offset error limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM[:AVERage] <numeric value>

This command sets the average Error Vector Magnitude Limit in dB for the IEEE 802.11b standard.

Example: "CALC:LIM:BURS:EVM –25.0" Average EVM limit is set to -25 dB

Characteristics: *RST value: -
SCPI: device specific

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.

Example: "CALC:LIM:BURS:EVM:RES?" Average EVM limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:MAXimum <numeric value>

This command sets the maximum Error Vector Magnitude Limit in dB for the IEEE 802.11b standard.

Example: "CALC:LIM:BURS:EVM:MAX?" Maximum EVM limit is returned

Characteristics: *RST value: -
SCPI: device specific

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.

Example: "CALC:LIM:BURS:EVM:MAX:RES?" Maximum EVM limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL[:AVERage] <numeric value>

This command sets the average Error Vector Magnitude Limit in dB. This is a combined figure that represents the pilot, data and the free carrier.

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

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.

Example: "CALC:LIM:BURS:EVM:ALL:RES?" Average EVM for all carrier limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:ALL:MAXimum <numeric value>

This command sets the maximum Error Vector Magnitude Limit in dB. This is a combined figure that represents the pilot, data and the free carrier.

Example: "CALC:LIM:BURS:EVM:ALL:MAX?" Maximum EVM for all carrier limit is returned

Characteristics: *RST value: -
SCPI: device specific

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.

Example: "CALC:LIM:BURS:EVM:ALL:MAX:RES?" Maximum EVM for all carrier limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA[:AVERage] <numeric value>

This command sets the average Error Vector Magnitude limit summary for the data carrier 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

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 in dB.

Example: "CALC:LIM:BURS:EVM:DATA:RES?" Average EVM for data carrier limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:DATA:MAXimum <numeric value>

This command sets the maximum Error Vector Magnitude limit summary for the data carrier in dB.

Example: "CALC:LIM:BURS:EVM:DATA:MAX?" Maximum EVM for data burst limit is returned

Characteristics: *RST value: -
SCPI: device specific

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 in dB.

Example: "CALC:LIM:BURS:EVM:DATA:MAX:RES?" Maximum EVM for data carrier limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot[:AVERage] <numeric value>

This command sets the average Error Vector Magnitude limit summary for the pilot carriers 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

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 in dB.

Example: "CALC:LIM:BURS:EVM:PIL:RES?" Average EVM for pilot carrier limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:BURSt:EVM:PILot:MAXimum <numeric value>

This command sets the maximum Error Vector Magnitude limit summary for the pilot carriers in dB.

Example: "CALC:LIM:BURS:EVM:PIL:MAX?" Maximum EVM for pilot carrier limit is returned

Characteristics: *RST value: -
SCPI: device specific

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 in dB.

Example: "CALC:LIM:BURS:EVM:PIL:MAX:RES?" Maximum EVM for pilot carrier limit result is returned

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:ACPower:ACHannel?

This command returns the ACP adjacent channel limit for IEEE 802.11j if defined.

Example: "CALC:LIM:ACP:ACH?" Returns the IEEE 802.11j ACP adjacent channel limit.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:ACPower:ACHannel:RESult?

This command returns the ACP adjacent channel limit for IEEE 802.11j result summary (PASSED | FAILED) for both the lower and upper adjacent channels.

Example: "CALC:LIM:ACP:ALT:RES?" limit result for IEEE 802.11j adjacent channel is returned.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:ACPower:ALTernate?

This command returns the ACP alternate channel limit for IEEE 802.11j if defined.

Example: "CALC:LIM:ACP:ALT?" Returns the IEEE 802.11j ACalternate channel limit.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:ACPower:ALTernate:RESult?

This command returns the ACP alternate channel limit result (PASSED | FAILED) for IEEE 802.11j for both the lower and upper alternate channels.

Example: "CALC:LIM:ACP:ALT:RES?" limit result for IEEE 802.11j alternate channel is returned.

Characteristics: *RST value: -
SCPI: device specific

CALCulate:LIMit<1 to 6>:CONTrol[:DATA] <numeric value>,<numeric value>

This command defines the X-axis values (frequencies) of the upper or lower limit lines.

The number of values for the CONTrol axis and for the corresponding UPPer limit line has to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

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: -
SCPI: conforming

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:X?

This command returns the X-value at the maximum overstepping of the spectrum mask limits.

Example: "CALC:LIM:SPEC:MASK:CHEC:X?" Returns the frequency at the maximum overstepping.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:LIMit<1>:SPECtrum:MASK:CHECk:Y?

This command returns the Y-value at the maximum overstepping of the spectrum mask limits.

Example: "CALC:LIM:SPEC:MASK:CHEC:Y?" Returns the power at the maximum overstepping.

Characteristics: *RST value: -
SCPI: device specific

CALCulate:LIMit<1 to 6>:UPPer[:DATA] <numeric_value>,<numeric_value>...

This command defines the values for the upper limit lines independently of the measurement window.

The number of values for the CONTrol axis and for the corresponding UPPer limit line has to be identical. Otherwise default values are entered for missing values or unnecessary values are deleted.

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: -
SCPI: conforming

CALCulate<1|2>:LIMit<1>:FAIL?

This command queries the result of the limit check of the limit line indicated in the selected measurement window. It should be noted that a complete sweep must have been performed for obtaining a valid result. A synchronization with *OPC, *OPC? or *WAI should therefore be provided. The result of the limit check responds with 0 for PASS and 1 for FAIL. Note that no limit lines are displayed in screen A and, thus, all CALCulate1:LIMit:FAIL? commands will return 0. 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

Example: `""INIT;*WAI"` Starts a new sweep and waits for its end.

`"CALC2:LIM3:FAIL?"` Queries the result of the check for limit line 3 in screen B.

Characteristics: *RST value: -
SCPI: device specific

CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the R&S FSQ-K90/K91/K91n option.

CALCulate 1: Screen A
CALCulate 2: Screen B

Note: *Currently, only 1 marker is available per screen.*

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>:			
MARKer<1>			
:MAXimum			no query
:MINimum			no query
:TRACe	<numeric_value>		
:X	<numeric_value>	HZ | S | DB	
:Y	<numeric_value>	PCT | DB	
:SYMBol	<numeric_value>		
:CARRier	<numeric_value>		
:BSYMbol	<numeric_value>, <numeric_value>		802.11b only
: AOFF			
[:STATe]	<Boolean>		

CALCulate<1|2>:MARKer<1>:MAXimum

This command sets the selected marker to the maximum peak value in the current trace.

This command is only available for the following result displays:

- Spectrum Flatness

Example: "`CALC2:MARK:TRAC:MAX`" Set marker 1 in screen B to maximum value in trace

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:MINimum

This command sets the selected marker to the minimum peak value in the current trace.

This command is only available for the following result displays:

- Spectrum Flatness

Example: "`CALC2:MARK:TRAC:MIN`" Set marker 1 in screen B to minimum value in trace

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:TRACe <numeric value>

This command assigns the selected marker to the indicated measurement curve in the selected measurement window.

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 - When Max Hold trace is displayed
- Spectrum ACP/ACPR - When Max Hold trace is displayed

Example: "CALC2:MARK:TRAC 2" Assigns marker 1 in screen B to trace 2.

Characteristics: *RST value: 1
SCPI: device specific

CALCulate<1|2>:MARKer<1>:X <numeric value>

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), subcarrier (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

Example: "CALC:MARK:X 2ms" Positions marker 1 in screen A to time 2 ms.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:Y <numeric value>

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

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

CALCulate<1|2>:MARKer<1>:SYMBol <numeric value>

This command positions the selected marker to the indicated symbol (constellation vs symbol and constellation Vs carrier).
This command is valid only for the following result displays:

- constellation Vs symbol
- constellation Vs carrier

Example: "CALC2:MARK:SYMB 2" Positions marker 1 in screen B to symbol 2.
"CALC2:MARK:SYMB?" Outputs the symbol value of marker 1 in screen B.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:CARRier <numeric value>

This command positions the selected marker to the indicated carrier (constellation vs symbol and constellation Vs carrier).
This command is valid only for the following result displays:

- constellation Vs symbol
- constellation Vs carrier

Example: "CALC2:MARK:CARR -7" Positions marker 1 in screen B to carrier -7.
"CALC2:MARK:CARR?" Outputs the carrier value of marker 1 in screen B.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:BSYMbol <numeric value>,<numeric value>

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 is only valid for the following IEEE 802.11b measurements: Constellation vs Symbol, EVM vs Symbol.

Example: "CALC2:MARK1:BSYM 2,10" Positions marker 1 in screen B to symbol 10 of burst 2.
"CALC2:MARK1:BSYM?" Outputs the burst and symbol values of marker 1 in screen B.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:AOFF

This command switches off all active markers in the specified measurement window. The window will either be "screen a" or "screen b" and will be determined by the numeric value that follows the "CALCulate" keyword.

Example: "CALC1:MARK:AOFF" Switches off all markers in the screen A window.
"CALC2:MARK:AOFF" Switches off all markers in the screen B window.

Characteristics: *RST value: -
SCPI: device specific

CALCulate<1|2>:MARKer<1>:STATe <boolean>

This command switches the specified marker in the specified screen on or off.

Example: "CALC1:MARK1:STATE ON" Switches the screen A marker 1 ON.
"CALC2:MARK1:STATE OFF" Switches the screen B marker 1 OFF.

Characteristics: *RST value: 1
SCPI: device specific

CALCulate:MARKer:FUNCtion Subsystem

The measurement window is selected by CALCulate 1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1>			
:FUNCtion			
:ZOOM	<numeric_value>		
:POWer			
:RESult			
[:CURRent]		DB	Query only
:MAXHold		DB	Query onlly

CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM <numeric value>

This command defines the ratio to be zoomed around the marker 1 in the selected measurement window. The default value is 1, where the full trace is shown.
This command is only available for the following result displays:

- Constellation versus Carrier
- Constellation versus Symbol
- PVT Full Burst
- PVT Rising / Falling
- Magnitude Capture Buffer

Example: "CALC:MARK:FUNC:ZOOM 2" Zooms 50% in screen A.

"CALC:MARK:FUNC:ZOOM 4" Zooms 25% in screen A.

"CALC:MARK:FUNC:ZOOM 1" Deactivates zooming in screen A.

Characteristics: *RST value: 1
SCPI: device specific

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 ratio) measurement must have previously been run in order for summary data to be available.
Results are output separated by commas in the following order:

1. Power of main channel
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2

Adjacent channel power values are output in dB.

Example: "CALC2:MARK:FUNC:POW:RES?"

Characteristics: *RST value: -
SCPI: device specific

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 ratio) measurement must have previously been run with more than one sweep in order for maximum summary data to be available.
Results are output separated by commas in the following order:

1. Power of main channel
2. Power of lower adjacent channel
3. Power of upper adjacent channel
4. Power of lower alternate adjacent channel 1
5. Power of upper alternate adjacent channel 1
6. Power of lower alternate adjacent channel 2
7. Power of upper alternate adjacent channel 2

Adjacent channel power values are output in dB.

Example: "CALC2:MARK:FUNC:POW:RES:MAXH?"

Characteristics: *RST value: -
SCPI: device specific

CONFigure Subsystem

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 of the measurements are queried.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:POWer			
:EXPected			
:RF	<numeric_value>	DBM	
:IQ	<numeric_value>	V	
:AUTO	<boolean> | ONCE		
:SWEep			
:TIME	<numeric_value>	S	
:CHANnel	<numeric_value>		
:STANdard	<numeric_value>		
:BURSt			
:PVT			
:AVERage	<numeric_value>		802.11b & g (single carrier) only
:RPOWer	MEAN | MAXimum		
:SELect	EDGE | FULL | RISE | FALL		802.11b & g (single carrier) only
[:IMMediate]			
:EVM			
:ECARrier			
[:IMMediate]			
:ESYMbol			802.11a, j & n
[:IMMediate]			
:SPECtrum			
:MASK			
:SELect	IEEE | ETSI		
[:IMMediate]			
:FLATness			802.11a & n
:SELect	FLATness | GRDelay		
:CSELect	EFFective | PHYsical		
[:IMMediate]			802.11a, j & n
:FFT			
[:IMMediate]			
:ACPR			
[:IMMediate]			
:CONStellation			
:CCARrier			
[:IMMediate]			
:CSYMbol			
[:IMMediate]			802.11a, j & n
:CARRier			
:SELect	-26 to 26 | ALL | PILOTS		8802.11a, j & n
:STATistics			
:CCDF			
[:IMMediate]			
:BSTReam			
[:IMMediate]			
:SFIeld			
[:IMMediate]			
:PREamble			
:SELect	FREQuency | PHASe		
[:IMMediate]			

COMMAND	PARAMETERS	UNIT	COMMENT
:WLAN			
:ANTMatrix			
:STATe<1 to 4>	<boolean>		802.11n MIMO
:ADDRess<1 to 4>	<String>		802.11n MIMO
:ANTenna<1 to 4>	ANTenna1 | ANTenna2		802.11n MIMO
:DUTConfig	TX1 | TX2		802.11n MIMO
:EXTension			
:AUTO	FBURst | ALL | DES0 | DES1 | DES2 | DES3 | MES0 | MES1 | MES2 | MES3		802.11n MIMO
:GTIMe			
:AUTO	<boolean>		802.11n
:TYPE	FBURst | ALL | DN8 | DL16 | DN16 | DL32 |MN8 |ML16 | MN16 | ML32		802.11n MIMO
:SELect	SHORt | NORMal		802.11n
:SMAPping			
:MODE	DIRect | SEXPansion | USER		802.11n MIMO
:NORMalise	<boolean>		802.11n MIMO
:TX<1 to 4>	<numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>		802.11n MIMO
:STReam<1 to 4>	<numeric_value>, <numeric_value>		802.11n MIMO
:TIMeshift	<numeric_value>		802.11n MIMO
:STBC			
:AUTO:			
:TYPE	FBURst | ALL | DSS0 | DSS1 | DSS2 | MSS0 | MSS1 | MSS2		802.11n MIMO
:PAYload			
:LENgth			
:SRC	ESTimate | HTSignal		802.11n MIMO
:PVERror			
:MRANge	ALL | PSDU		802.11n MIMO

CONFigure:POWer:EXPected:RF <numeric value>

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.

Example: "`CONF:POW:EXP:RF 9`" The R&S FSQ-K90/K91/K91n option assumes an input signal strength of 9 dBm

Characteristics: *RST value: -
SCPI: device specific

CONFigure:POWer:EXPected:IQ <numeric value>

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.

Example: "`CONF:POW:EXP:IQ 1`" The R&S FSQ-K90/K91/K91n option assumes an input signal strength of 1 Volt

Characteristics: *RST value: -
SCPI: device specific

CONFigure:POWer:AUTO ON | OFF | ONCE

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. If this

command is issued with the ONCE parameter, the auto level routine is immediately performed one time regardless of the current state of this parameter (ON or OFF).

Example: "CONF:POW:AUTO 1" The R&S FSQ-K90/K91/K91n option will automatically detect the input power level.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:POWer:AUTO:SWEep:TIME <numeric value>

This remote control command is used to specify the seep time for the automatic power level detection.

Example: "CONF:POW:AUTO:SWE:TIME 200MS" The auto power detect measurement will use a sweep time of 200 ms

Characteristics: *RST value: 100ms
SCPI: device specific

CONFigure:CHANnel <numeric value>

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.

Example: "CONF:CHAN 9" The R&S FSQ-K90/K91/K91n option will perform measurements at the frequency represented by channel 9.

Characteristics: *RST value: 0
SCPI: device specific

CONFigure:STANdard <numeric value>

This remote control command specifies which wireless LAN standard the option is configured to measure. The values are as follows:

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 = Turbo
6 = IEEE 802.11n
7 = IEEE 802.11n MIMO

Example: "CONF:STAN 0" - TheR&S FSQ-K90/K91/K91n option will perform measurements in compliance with IEEE 802.11a.

Characteristics: *RST value: 0
SCPI: device specific

CONFigure:BURSt:PVT:AVERage <numeric value>

This remote control command configures the R&S FSQ-K90/K91/K91n 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.

Example: "CONF:BURS:PVT:AVER 31" The R&S FSQ-K90/K91/K91n option is configured to use burst power average length of 31.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:PVT:RPOWer MEAN | MAXimum

This remote control command configures R&S FSQ-K90/K91/K91n to use either mean or maximum burst power as the reference power for the 802.11b PVT measurement

Example: "CONF:BURS:PVT:RPOW MEAN" R&S FSQ-K90/K91/K91n option is configured to use mean burst power as the reference power

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:PVT:SELect EDGE | FULL | RISE | FALL

This remote control configures how R&S FSQ-K90/K91/K91n will interpret the power versus time measurement results.

The supplied string can be one of the following:

IEEE 802.11a, j, n

'EDGE' - configures the measurement to be rising and falling edge.

'FULL' - configures the measurement to be full burst.

IEEE 802.11b

'RISE - configures the measurement to be rising edge only.

'FALL - configures the measurement to be falling edge only.

'EDGE' - configures the measurement to be rising and falling edge

Example: "CONF:BURS:PVT:SEL FULL" The R&S FSQ-K90/K91/K91n option will interpret the measurement results as full burst.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:PVT[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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" TheR&S FSQ-K90/K91/K91n option is configured to run a Power Versus Time measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:EVM:ECARrier[:IMMediate]

This remote control command configures theR&S FSQ-K90/K91/K91n 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" R&S FSQ-K90/K91/K91n option is configured to run an EVM versus carrier measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:EVM:ESYMbol[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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" R&S FSQ-K90/K91/K91n option is configured to run an EVM versus symbol measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:SPECtrum:MASK:SELect IEEE | ETSI

This remote control configures how R&S FSQ-K90/K91/K91n will interpret the Spectrum MASK measurement results. This is either performed using the IEEE or ETSI standard. This command is only available for IEEE 802.11a.

Example: "CONF:BURS:SPECT:MASK:SEL ETSI" R&S FSQ-K90/K91/K91n option is will interpret the measurement results using the ETSI standard.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:SPECtrum:MASK[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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" R&S FSQ-K90/K91/K91n option is configured to run a Spectrum Mask measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:SPECtrum:FLATness:SELect

This remote control command configures the Spectrum Flatness measurement type. This command is only valid for 11n and 11n MIMO.

The supplied enumeration can be one of the following:

FLATness - Spectrum Flatness results

GRDelay - Spectrum Flatness Group Delay results

Example: "CONF:BURS:SPEC:FLAT:SEL GRD" Flatness measurement type is configured as Spectrum Flatness Group Delay

Characteristics: *RST value: –
SCPI: device-specific

CONFigure:BURSt:SPECtrum:FLATness:CSELect

This remote control command configures the Spectrum Flatness channel selection to either Effective or Physical. This command is only valid for 11n and 11n MIMO.

The supplied emumeration can be one of the following:

Effective - Effective channel

Physical - Physical channel

Example: `"CONF:BURS:SPEC:FLAT:SEL PHY"` Flatness measurement channel is configured as Physical

Characteristics: *RST value: –
SCPI: device-specific

CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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"` R&S FSQ-K90/K91/K91n option is configured to run a Spectrum Flatness measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:SPECtrum:FFT[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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"` R&S FSQ-K90/K91/K91n option is configured to run an FFT measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:SPECtrum:ACPR[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n measurement type to be ACPR (adjacent channel power ratio). 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"` R&S FSQ-K90/K91/K91n option is configured to run an ACPR measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:CONStellation:CCARrier[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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"` R&S FSQ-K90/K91/K91n option is configured to run a Constellation versus Carrier measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:CONStellation:CSYMbol[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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" R&S FSQ-K90/K91/K91n option is configured to run a Constellation versus Symbol measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:CONStellation:CARRier:SELect -26 to 26 | ALL | PILOTS

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. (11n supports 57 data carriers +/-28 in HT mode. The default is 53 data carriers +/-26, a SCPI error is raised if setting this parameters value outside the permitted standards data carrier index

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

CONFigure:BURSt:STATistics:CCDF[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n measurement type to be CCDF (Complementary 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" R&S FSQ-K90/K91/K91n option is configured to run a CCDF measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:STATistics:BSTReam[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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" R&S FSQ-K90/K91/K91n option is configured to run a bit stream measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:STATistics:SFIeld[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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:SFI" R&S FSQ-K90/K91/K91n option is configured to run a bit stream measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:PREamble:SELect FREQuency | PHASe

This remote control command specifies whether Frequency or Phase results are displayed when the measurement type is set to Error Vs Preamble.

Example: "CONF:BURS:PRE:SEL:FREQ" R&S FSQ-K90/K91/K91n option shows the frequency result of the configured to run a bit a Preamble measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:BURSt:PREamble[:IMMediate]

This remote control command configures the R&S FSQ-K90/K91/K91n 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" R&S FSQ-K90/K91/K91n option is configured to run a Preamble measurement.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:WLAN:ANTMatrix:ADDRess<1..2>

This remote control command specifies the TCP/IP address in IPV4 format.

Note, it is not possible to set the IP address of ANTMatrix1 (Master)

Example: "CONF:WLAN:ANTM:ADDR2 '192.168.114.157'"
Characteristics: *RST value: -
SCPI: Device-specific

CONFigure:WLAN:ANTMatrix:STATe<1..2>

This remote control command specifies the ON/OFF state of the receive path.

Note, it is not possible to set the state of ANTMatrix1 (Master)

Example: "CONF:WLAN:ANTM:STAT2 ON"
Characteristics: *RST value: 0
SCPI: device-specific

CONFigure:WLAN:ANTMatrix:ANTenna<1..2>

This remote control command specifies the antenna assignment of the receive path.

Note, it is not possible to set the antenna of ANTMatrix1 (Master)

ANTenna1 assigns Antenna 1

ANTenna2 assigns Antenna 2

Example: "CONF:WLAN:ANTM:ANT2 ANTENNA1"

Characteristics: *RST value: -
SCPI: device-specific

CONFigure:WLAN:DUTConfig

This remote control command specifies the number of antennas used for MIMO measurement.
TX1 one antenna
TX2 two antennas

Example: "CONF:WLAN:DUTC TX1"

Characteristics: *RST value: TX1
SCPI: Device Specific

CONFigure:WLAN:EXT:AUTO

This remote control command specifies which bursts are analyzed according to extension spatial streams

FBURst The first burst is analyzed and subsequent bursts are analyzed only if they match

ALL all bursts are analyzed

M0 Measure only if Ness0

M1 Measure only if Ness1

M2 Measure only if Ness2

M3 Measure only if Ness3

D0 Demod all as Ness0

D1 Demod all as Ness1

D2 Demod all as Ness2

D3 Demod all as Ness3

Example: "CONF:WLAN:EXT:AUTO?"

Characteristics: *RST value: FBURst
SCPI: device-specific

CONFigure:WLAN:GTIMe:AUTO <boolean>

This remote control command specifies wether the guard time of the IEEE 802.11n input signal is automatically detected or specified manually. This command is only valid in SISO

Example: "CONF:WLAN:AUTO ON" R&S FSQ-K90/K91/K91n option is set to automatically detect the guard time of the input signal.

Characteristics: *RST value: -
SCPI: device specific

CONFigure:WLAN:GTIMe:AUTO:TYPE

This remote control command specifies how bursts are analyzed according to guard length.

FBURst	The guard length of the first burst is detected and subsequent bursts are analyzed only if they match
ALL	all bursts are analyzed regardless of guard length
MN8	Measrure Normal 8, 20MHz Bandwidth guard interval
ML16	Measrure Long 16, 20MHz Bandwidth guard interval
MN16	Normal 16, 40MHz Bandwidth guard interval
ML32	Measrure Long 32, 40MHz Bandwidth guard interval
DN8	Demodulate according to Normal 8, 20MHz Bandwidth guard interval

DL16	Demodulate according to Long 16, 20MHz Bandwidth guard interval
DN16	Demodulate according to Normal 16, 40MHz Bandwidth guard interval
DL32	Demodulate according to Long 32, 40MHz Bandwidth guard interval

Example: `"CONF:WLAN:GTIM:AUTO:TYPE FBUR"`

Characteristics: *RST value: FBURst
SCPI: device-specific

CONFigure:WLAN:GTIMe:SELect SHORt | NORMal

This remote control command specifies the guard time of the IEEE 802.11n input signal. If the guard time is specified to be detected from the input signal using the CONFigure:WLAN:GTIMe:AUTO command then this command is query only and allows the detected guard time to be obtained.

Example: `"CONF:WLAN:GTIM SHOR"` R&S FSQ-K90/K91/K91n option is configured to measure signals with short guard times

Characteristics: *RST value: -
SCPI: device specific

CONFigure:WLAN:SMAPping:MODE

This remote control command specifies the special mapping mode.

DIRect	direct
SEXPansion	expansion
USER	user defined

Example: `"CONF:WLAN:SMAP:MODE DIR"`

Characteristics: *RST value: DIR
SCPI: device-specific

CONFigure:WLAN:SMAPping:NORMalise

This remote control command specifies whether an amplification of the signal power due to the spatial mapping is performed according to the matrix entries. If this command it set to ON then the spatial mapping matrix is scaled by a constant factor to obtain a passive spatial mapping matrix which does not increase the total transmitted power. If this command is set to OFF the normalization step is omitted.

Example: `"CONF:WLAN:SMAP:NORM OFF"`

Characteristics: *RST value: OFF
SCPI: device-specific

CONFigure:WLAN:SMAPping:TX<1..4>

This remote control command specifies the mapping for all streams (real & imaginary data pairs) and timeshift for a specified antenna.

Example:
```
"CONF:WLAN:SMAP:TX1
1.0,1.0, 2.0,2.0, 3.0,3.0, 4.0,4.0, 0"
```

Characteristics: *RST value: -
SCPI: device-specific

CONFigure:WLAN:SMAPping:TX<1..4>:STReam<1..4>

This remote control command specifies the mapping for a specific stream and antenna (real & imaginary data pair).

Example: `"CONF:WLAN:SMAP:TX1:STR1 1.0, 1.0`

Characteristics: *RST value: 0
SCPI: device-specific

CONFigure:WLAN:SMAPping:TX<1..4>:TIMeshift

This remote control command specifies the timeshift for a specific antenna.

Example: `"CONF:WLAN:SMAP:TX1:TIM 0"`

Characteristics: *RST value: 0
SCPI: device-specific

CONFigure:WLAN:STBC:AUTO:TYPE

This remote control command specifies which bursts are analyzed according to STBC streams.

FBURst	first burst is analyzed and subsequent bursts are analyzed only if they match
ALL	all bursts are analyzed
M0	Measure only if STBC field = 0
M1	Measure only if STBC field = 1
M2	Measure only if STBC field = 2
D0	Demod all as STBC field = 0
D1	Demod all as STBC field = 1
D2	Demod all as STBC field = 2

Example: "CONF:WLAN:STBC?"

Characteristics: *RST value: -
SCPI: device-specific

CONFigure:WLAN:PAYload:LENgth:SRC

This remote control command configures the FS-K90 11n MIMO to determine if the payload length

Should be taken from the signal field decoding result or from the signal

Example: "CONF:WLAN:PAY:LEN:SRC EST" use signal

Characteristics: *RST value: HTSignal-
SCPI: Device Specific

CONFigure:WLAN:PVERror:MRANge

This remote control command specifies the Peak Vector Error results are calculated over the complete burst or just over the PSDU. The values which can be specified are as follows:

ALL	Peak Error Vector results are calculated over the complete burst
PSDU	Peak Error Vector results are calculated over the PSDU only

This command is supported for 802.11b and 802.11g only

Example: "CONF:WLAN:PVER:MRANge PSDU" FS-K91 option is configured to measure Peak Error Vector only over the PSDU

Characteristics: *RST value: ALL-
SCPI: Device Specific

DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information aswell as of measurement data on the display.

COMMAND	PARAMETERS	UNIT	COMMENT
:DISPlay			
:FORMat	SPLit | SINGle		
[:WINDow<1|2>]			
:SELect			
:SSELect			
:TABLe	<boolean>		
:TRACe<1…3>			
:Y			
:SCALe			
:AUTO	<boolean>		
:PDIVision	<numeric_value>		
:RLEVel		DB	
[:RF]	<numeric_value>	DB	
:IQ	<numeric_value>		
:OFFSet	<numeric_value>		

DISPlay:FORMat SPLit | SINGle

This command sets the visible screen display type to full or split screen.

Example: "DISP:FORM SING" Sets the R&S FSQ-K90/K91/K91n display to full screen.

Characteristics: *RST value: SPL
SCPI: device specific

DISPlay[:WINDow<1|2>]:SELect

This command selects whether screen A or screen B is active

Example: "DISP:WIND1:SEL" Sets the R&S FSQ-K90/K91/K91n screen A active.

Characteristics: *RST value: -
SCPI: device specific

DISPlay[:WINDow<1|2>]:SSELect

This is an alias for DISPlay:WINDow[1|2]:SELect. SSELect means Screen SELect.

Example: "DISP:WIND1:SSEL" Sets the R&S FSQ-K90/K91/K91n screen A active.

Characteristics: *RST value: 1
SCPI: device specific

DISPlay[:WINDow<1|2>]:TABLe <boolean>

This command selects whether the results table is displayed

Example: "DISP:WIND1:TABL 0" Hides the results table

Characteristics: *RST value: 0
SCPI: device specific

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:AUTO <boolean>

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 3> must be 1

Example: "DISP:WIND2:TRAC:Y:SCAL:AUTO ON" switches on automatic scaling of the Y-axis for the active trace

Characteristics: *RST value: ON

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:PDIVision <numeric value>

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 3> must be 1.

Example: "DISP:WIND2:TRAC:Y:SCAL:DPIV 2" Sets the Y scale division to size to 2.

Characteristics: *RST value: 3

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel <numeric value>

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 3> are irrelevant.

Example: " DISP:TRAC:Y:RLEV?" Returns the current reference level in use

Characteristics: *RST value: -

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel[:RF] <numeric value>

This remote control command can be used to retrieve or set the current internal instrument reference level for RF input used when performing measurements. The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example:	"DISP:TRAC:Y:RLEV?"	returns the current RF reference level in use
	"DISP:TRAC:Y:RLEV: -20"	sets the instrument reference level to -20
Characteristics:	*RST value: -5 dB SCPI: conforming	

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:IQ <numeric value>

This remote control command can be used to retrieve or set the current internal instrument reference level for baseband input used when performing measurements. The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example:	"DISP:TRAC:Y:RLEV:IQ"	returns the current baseband reference level in use
	"DISP:TRAC:Y:RLEV:IQ 1"	sets the instrument reference level to 1
Characteristics:	*RST value: 1V SCPI: conforming	

DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet <numeric value>

This remote control command specifies the external attenuation/gain applied to measurements. The value corresponds to the reference level offset in the spectrum analyzer mode. The numeric suffix at WINDow<1|2> and TRACe<1 to 3> are irrelevant.

Example:	"DISP:TRAC:Y:RLEV:OFFS 10"	External attenuation (level offset) of the analyzer is 10 dB
	"DISP:TRAC:Y:RLEV:OFFS -10"	External attenuation of the analyzer is -10 dB. i.e. a gain of 10 dB
Characteristics:	*RST value: 0 dB SCPI: in compliance	

FETCh Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks. This subsystem is closely linked to the CONFigure and SENSe subsystems.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			
:BURSt			
:ALL?		--	query only
:COUNt?		--	query only
:ALL?		--	query only
:PREamble?		DBM	query only
:PAYLoad?		DBM	query only
:RMS			
[:AVERage]?		DB	query only
:MINimum?		DB	query only
:MAXimum?		DB	query only
:PEAK?		DB	query only
:CRESt			
[:AVERage]?		DBM	query only
:MINimum?		DBM	query only
:MAXimum?		DBM	query only
:TRISe			
:AVERage?		S	query only – 802.11b
:MINimum?		S	query only – 802.11b
:MAXimum?		S	query only – 802.11b
:TFALl			
:AVERage?		S	query only – 802.11b
:MINimum?		S	query only – 802.11b
:MAXimum?		S	query only – 802.11b
:FERRor			
:AVERage?		HZ	query only
:MINimum?		HZ	query only
:MAXimum?		HZ	query only
:SYMBolerror			
:AVERage?			
:MINimum?			
:MAXimum?			
:IQOFfset			
:AVERage?		DB	query only
:MINimum?		DB	query only
:MAXimum?		DB	query only
:GIMBalance			
:AVERage?		DB	query only
:MINimum?		DB	query only
:MAXimum?		DB	query only
:QUADoffset			
:AVERage?		DEG	query only – 802.11a, j & n
:MINimum?		DEG	query only – 802.11a, j & n
:MAXimum?		DEG	query only – 802.11a, j & n
:BERPilot			
:AVERage?		DB	query only – 802.11n MIMO
:MINimum?		DB	query only – 802.11n MIMO
:MAXimum?		DB	query only – 802.11n MIMO

COMMAND	PARAMETERS	UNIT	COMMENT
:EVM			
[:IEEE]			
:AVERage?		PCT	query only – 802.11b
:MINimum?		PCT	query only – 802.11b
:MAXimum?		PCT	query only – 802.11b
:DIRect			
:AVERage?		PCT	query only – 802.11b
:MINimum?		PCT	query only – 802.11b
:MAXimum?		PCT	query only – 802.11b
:ALL			
:AVERage?		DB	query only
:MINimum?		DB	query only
:MAXimum?		DB	query only
:DATA			
:AVERage?		DB	query only
:MINimum?		DB	query only
:MAXimum?		DB	query only
:PILot			
:AVERage?		DB	query only
:MINimum?		DB	query only
:MAXimum?		DB	query only
:SYMBol			
:COUNt?		--	query only

FETCh:BURSt:ALL?

This command returns all the results. The results are output as a list of result strings separated by ',' in the following (ASCII) format:

IEEE 802.11a, j, n

<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 >

IEEE 802.11b

<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 >

Note that 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

FETCh:BURSt:COUNt?

This command returns the analyzed number of bursts from the current sweep. Where multiple sweeps are required for the current measurement because the bursts to analyze is greater than the number of bursts that can be captured in one sweep then this command only returns the number of captured bursts in the current sweep.

Example: "FETC:BURS:COUN?" The analyzed number of bursts are returned

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:COUNt:ALL?

This command returns the total analyzed number of bursts. This count will be the total number of bursts analyzed for the current measurement. Where multiple sweeps are required for the current measurement because the bursts to analyze is greater than the number of bursts that can be captured in one sweep then this command returns the total number of captured bursts in the current measurement over all measured sweeps..

Example: "FETC:BURS:COUN:ALL?" The number of analyzed bursts analyzed in all sweeps.

Characteristics: *RST value: –

SCPI: device-specific

FETCh:BURSt:PREamble?

This command returns the measured power in the burst preamble.

Example: "FETC:BURS:PRE?" The burst preamble power is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:PAYLoad?

This command returns the measured power in the payload of the burst.

Example: "FETC:BURS:PAYL?" The burst payload power is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:RMS[:AVERage]?
FETCh:BURSt:RMS:MAXimum?
FETCh:BURSt:RMS:MINimum?

The commands return the average, minimum or maximum RMS burst power in dBm measured during the measurement.

Example: "FETC:BURS:RMS:MAX?" The maximum calculated RSM burst power from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

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

FETCh:BURSt:CRESt[:AVERage]?
FETCh:BURSt:CRESt:MAXimum?
FETCh:BURSt:CRESt:MINimum?

This command returns the average, minimum or maximum determined CREST factor (= ratio of peak power to average power) in dB.

Example: "FETC:BURS:CRES:MAX?" The maximum calculated crest factor from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:TRISe:AVERage?
FETCh:BURSt:TRISe:MAXimum?
FETCh:BURSt:TRISe:MINimum?

This command returns the average, minimum or maximum burst rise time in seconds.

Example: "FETC:BURS:TRIS:MAX?" The maximum calculated rise time from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:TFALl:AVERage?
FETCh:BURSt:TFALl:MAXimum?
FETCh:BURSt:TFALl:MINimum?

This command returns the average, minimum or maximum burst fall time in seconds.

Example: "FETC:BURS:TFAL:MAX?" The maximum calculated fall time from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:FERRor:AVERage?
FETCh:BURSt:FERRor:MAXimum?
FETCh:BURSt:FERRor:MINimum?

This command returns the measured average, minimum or maximum frequency errors in Hz.

Example: "FETC:BURS:FERR:MAX?" The maximum frequency error from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:SYMBolerror:AVERage?
FETCh:BURSt:SYMBolerror:MAXimum?
FETCh:BURSt:SYMBolerror:MINimum?

This command returns the percentage of symbols that were outside the permissible demodulation 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

FETCh:BURSt:IQOFfset:AVERage?
FETCh:BURSt:IQOFfset:MAXimum?
FETCh:BURSt:IQOFfset:MINimum?

This command returns the measured average, minimum or maximum IQ offset errors in dB.

Example: "FETC:BURS:IQOF:MAX?" The maximum IQ offset error from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:GIMBalance:AVERage?
FETCh:BURSt:GIMBalance:MAXimum?
FETCh:BURSt:GIMBalance:MINimum?

This command returns the measured average, minimum or maximum IQ imbalance errors in dB.

Example: "FETC:BURS:GIMB:MAX?" The maximum IQ imbalance error from the most recent measurement is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:QUADoffset:AVERage?
FETCh:BURSt:QUADoffset:MAXimum?
FETCh:BURSt:QUADoffset:MINimum?

This command returns the accuracy in terms of the phase error of symbols within a burst.

Example: "FETC:BURS:QUAD:MAX?" The maximum angle error recorded for a symbol during the measurement.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:EVM:[:IEEE]:AVERage ?
FETCh:BURSt:EVM:[:IEEE]:MAXimum?
FETCh:BURSt:EVM:[:IEEE]:MINimum?

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.

Example: "FETC:BURS:EVM:MAX?" The maximum EVM recorded before filtering.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:BERPilot:AVERage
FETCh:BURSt:BERPilot:MAXimum
FETCh:BURSt:BERPilot:MINimum

This command returns the Burst Error Rate for PILots (average, minimum or maximum value) in % for the 802.11n MIMO standard

Example: " FETCh:BURSt:BERPilot:AVERage?

Characteristics: *RST value: -
SCPI: device-specific

FETCh:BURSt:EVM:DIRect:AVERage?
FETCh:BURSt:EVM:DIRect:MAXimum?
FETCh:BURSt:EVM:DIRect:MINimum?

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.

Example: "FETC:BURS:EVM:DIR:MAX?" The maximum EVM recorded after filtering.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:EVM:ALL :AVERage?
FETCh:BURSt:EVM:ALL:MAXimum?
FETCh:BURSt:EVM:ALL:MINimum?

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.

Example: "FETC:BURS:EVM:ALL:MAX?" The maximum EVM recorded for all measurement carrier is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:EVM:DATA:AVERage?
FETCh:BURSt:EVM:DATA:MAXimum?
FETCh:BURSt:EVM:DATA:MINimum?

This command returns the error vector magnitude measurement results summary for the data carrier (average, minimum or maximum value) in dB.

Example: "FETC:BURS:EVM:DATA:MAX?" The maximum EVM recorded for the data carrier is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh:BURSt:EVM:PILot:AVERage?
FETCh:BURSt:EVM:PILot:MAXimum?
FETCh:BURSt:EVM:PILot:MINimum?

This command returns the error vector magnitude measurement results summary for the EVM pilot carrier (average, minimum or maximum value) in dB.

Example: "FETC:BURS:EVM:PIL:MAX?" The maximum EVM recorded for the EVM pilot carrier is returned.

Characteristics: *RST value: -
SCPI: device specific

FETCh: SYMBol:COUNt?

This command returns the number of symbols for each analyzed burst as a comma separated list

Example: "FETC:SYMB:COUN?" The analyzed number of symbols for each burst are returned

Characteristics: *RST value: -
SCPI: device specific

FORMat Subsystem

The FORMat subsystem specifies the data format of the data transmitted from and to the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
FORMat [:DATA]	ASCii|REAL|UINT[,<numeric_value>]	-	

FORMat[:DATA] ASCii|REAL|UINT[,<numeric_value>]

This command specifies the data format for the data transmitted from the instrument to the control PC. It controls whether the bit stream data is sent as ASCII or UINT8 binary format.

Example: "FORM UINT,8" The R&S FSQ-K90/K91/K91n option will send bit stream data requested by the TRACE:DATA? command as unsigned integers in binary format.

Characteristics: *RST value: ASCii
SCPI: In compliance

INITiate Subsystem

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 steps to set up the instrument for the measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
INITiate [:IMMediate] :CONTinuous	 <boolean>		 no query

INITiate[:IMMediate]

This remote control command requests the R&S FSQ-K90/K91/K91n option to start a new measurement sequence. If a measurement sequence is already in progress, the command will be ignored.

Example: "INIT" The R&S FSQ-K90/K91/K91n option will attempt to start a new measurement.

Characteristics: *RST value: -
SCPI: In compliance

INITiate:CONTinuous <boolean>

This command determines whether the trigger system is continuously initiated (continuous) or performs single measurements (single).

Example: "INIT:CONT OFF" The R&S FSQ-K90/K91/K91n option will attempt a non-continuous measurement when initiated.

Characteristics: *RST value: 0
SCPI: In compliance

INPut Subsystem

The INPut subsystem controls the input characteristics of the RF inputs of the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
:INPut			
:ATTenuation	<numeric_value>	DB	
:DIQ			
:RANGe			
[:UPPer]	<numeric_value>	V	B17 option only
:SRATe	<numeric_value>	HZ	B17 option only
:EATT	<numeric_value>	DB	
:AUTO	<Boolean>		
:STATe	<Boolean>		
:FILTer			
:YIG			
[:STATe]	<Boolean>		
:AUTO	<Boolean>		
:SELect	AIQ | RF | DIQ		
:IQ			
:BALanced			
[:STATe]	<Boolean>		B71 option only
:IMPedance	LOW | HIGH		B71 option only
:TYPE	IQ | I | Q		B71 option only

INPut:ATTenuation <numeric value>

This command specifies the current input mechanical attenuator. To protect the input mixer against damage from overloads, the setting 0 dB can only be obtained by entering numerals, not by using the command DEC. The step width is 10 dB without the electronic attenuator option, and the range is 0 dB to 70 dB.

The input attenuation can be set in 5 dB steps between 0 dB and 75 dB with the electronic attenuator option.

Example: `"INP:ATT?"` Returns the current mechanical attenuator setting in use

Characteristics: *RST value: -

INPut<1|2>:DIQ:RANGe[:UPPer] <numeric value>

This remote control command specifies the upper range of the digital base band input. Note that this command requires option B17.

Example: `"INP:DIQ:RANG?"` Returns the upper range of the digital baseband input

Characteristics: *RST value: 10 dB
SCPI: conforming

INPut<1|2>:DIQ:SRATe <numeric value>

This remote control command specifies the sampling rate for the digital base band input. Note that this command requires option B17.

Example: `"INP:DIQ:SRAT"`

Characteristics: *RST value: 10 dB
SCPI: conforming

INPut:EATT <numeric value>

This command specifies the attenuation of the current input electronic input attenuator. The attenuation setting can only be varied in 5 dB steps from 0 to 30 dB. Other entries are rounded to the next lower integer value. The electronic attenuator is switched off in the default state.

Example: "INP:EATT?" Returns the current electronic attenuator setting in use

Characteristics: *RST value: -

The command is only available with the electronic attenuator option (B25).

INPut:EATT:AUTO <boolean>

This command automatically couples the electronic input attenuation to the reference level and the attenuation of the mechanical attenuator (state ON) or switches the input attenuation to manual entry (state OFF).

Example: "INP:EATT:AUTO ON" Couples the attenuation of the electronic attenuator to the reference level.

Characteristics: *RST value: ON
SCPI: device specific

The command is only available with the electronic attenuator option (B25).

INPut:EATT:STATe <boolean>

This command switches the electronic input attenuation into the signal path (state ON) or removes it from the signal path (state OFF).

Example: "INP:EATT:STAT ON" Switches the electronic attenuator into the signal path.

Characteristics: *RST value: OFF
SCPI: device specific

The command is only available with the electronic attenuator option (B25).

INPut:FILTer:YIG[:STATe] <boolean>

This command switches the YIG filter for image frequency suppression into the signal path (condition ON) and/or removes it from the signal path (condition OFF).

Example: "INP:FILT:YIG OFF" Switches the YIG filter off

Characteristics: *RST value: ON
SCPI: device specific

INPut:SELect AIQ | RF | DIQ

This remote control command specifies whether the Analog baseband Inputs, Digital Baseband input or RF input are the currently selected signal input. Note that Analog baseband input requires option B71. Digital Baseband Input requires option B17.

Example: "INP:SEL AIQ" Select baseband input

Characteristics: *RST value: RF
SCPI: in compliance

INPut:IQ:BALanced[:STATe] <boolean>

This remote control command specifies whether the IQ inputs are symmetrical (balanced) or asymmetrical (unbalanced). Note that this command requires option B71.

Example: "INP:IQ:BAL 1" Specifies symmetrical (balanced) IQ inputs.

Characteristics: *RST value: ON
SCPI: device specific

INPut:IQ:IMPedance LOW | HIGH

This remote control command specifies the input impedance for the IQ inputs.

Note that this command requires option B71.

Example: "INP:IQ:IMP LOW" Specifies low input impedance for IQ inputs.

Characteristics: *RST value: LOW
SCPI: device specific

INPut:IQ:TYPE IQ | I | Q

This remote control command specifies the input path for the Baseband input. The values which can be specified are as follows:

:INPut:IQ:TYPE IQ I + j*Q (=default)

:INPut:IQ:TYPE I I Only

:INPut:IQ:TYPE Q Q Only

Note that this command requires option B71.

Example: "INP:IQ:TYPE I" Specifies only the I input is used for the Baseband path.

Characteristics: *RST value: IQ
SCPI: conforming

INSTrument Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
INSTrument			
:SELect	WLAN		
:NSElect	<numeric_value>		

INSTrument:SELect WLAN

This remote control command selects active operation of the R&S FSQ-K90/K91/K91n option by specifying its name.

Example: "INST:SEL WLAN" The R&S FSQ-K90/K91/K91n option will be selected as the active option.

Characteristics: *RST value: SANalyzer
SCPI: device specific

INSTrument:NSELect <numeric value>

This remote control command selects active operation of the R&S FSQ-K90/K91/K91n option by specifying its associated option number.

Example: "INST:NSEL 6" The R&S FSQ-K90/K91/K91n option will be selected as the active option.

Characteristics: *RST value: 1
SCPI: device specific

MMEMory Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
:MMEMory			
:LOAD			
:IQ			
:STATe	1,<file_name>		
:SEM			
:STATe	1,<file_name>		
:STORe			
:IQ			
:STATe	1,<file_name>		

MMEMory:LOAD:IQ:STATe 1,<file_name>

The remote control command is used to load IQ data from the specified .iqw file.

Example: "MMEM:LOAD:IQ:STAT 1,'D:\USER\DATA.iqw'" Loads IQ data from the specified file

Characteristics: *RST value: -
SCPI: device specific

MMEMory:LOAD:SEM:STATe 1,<file_name>

The remote control command is used to load a R&S FSQ-K90/K91/K91n spectrum emission mask setup from an xml file

Example: "MMEM:LOAD:SEM:STAT 1,'D:\USER\ETSI_SEM.xml'"

Characteristics: *RST value: -
SCPI: device specific

MMEMory:STORe:IQ:STATe 1,<file_name>

The remote control command is used to save IQ data to the specified .iqw file.

Example: "MMEM:STOR:IQ:STAT 1,'D:\USER\DATA.iqw'" Stores IQ data to the specified file

Characteristics: *RST value: -
SCPI: device specific

SENSe Subsystem

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.

e.g. `SENS:FREQ 10GHZ` – sets the frequency to 10 GHz
`SENS:FREQ?` - response 10 GHZ - returns the current frequency

COMMAND	PARAMETERS	UNIT	COMMENT
[:SENSe]			
:FREQuency			
:CENTer	<numeric_value>	Hz	
:IQ			
:DITHer			
[:STATe]	<Boolean>		
:LPASs			
[:STATe]	<Boolean>		
:SWEep			
:TIME	<numeric_value>	S	
:COUNt	<numeric_value>		
:EGATE	<Boolean>		
:HOLDoff			
[:TIMe]	<numeric_value>	S	
:SAMPle	<numeric_value>		
:LENgth			
[:TIMe]	<numeric_value>	S	
:SAMPle	<numeric_value>		
:LINK	<Boolean>		
:DEMod			
:CESTimation	<Boolean>		IEEE 802.11a, j & n
:FFT			
:OFFSet	AUTO | GICenter		
:FILTer			query only
:CATalog?	<String>,<String>		
:MODulation			
:FORMat			
:SIGSymbol	<Boolean>		
[:BCONtent]			
:AUTo	<Boolean>		IEEE 802.11b
:BTRate	10 | 20 | 55 | 110		
:BANalyze	<String>		
:BTYPe	<String>		
:AUTO			
:TYPE	FBURst | ALL |MMIX | MGRF | DMIX | DGRF		802.11n MIMO
:SYMBols			
:EQUal	<Boolean>		IEEE 802.11a, j & n
:MIN	<numeric_value>		IEEE 802.11a, j & n
:MAX	<numeric_value>		IEEE 802.11a, j & n
:DBYTes			
:EQUal	<Boolean>		IEEE 802.11b
:MIN	<numeric_value>		IEEE 802.11b
:MAX	<numeric_value>		IEEE 802.11b
:DURation			
:EQUal	<Boolean>		802.11b/g
:MIN	<numeric_value>		802.11b/g
:MAX	<numeric_value>		802.11b/g
:MCSIndex	<numeric_value>		
:MODE	FBURST | ALL | MEASure | DEMod		802.11n MIMO

COMMAND	PARAMETERS	UNIT	COMMENT
:BURSt			
:COUNt			
:STATe	<numeric_value>		
:SWAPiq	<Boolean>		
:TRACking	<Boolean>		
:LEVel			
:PHASe	<Boolean>		
:TIME	<Boolean>		
:POWer	<Boolean>		
:ACHannel			IEEE 802.11j
:MODE			
:SEM	ABS | REL		
:CLASs	USER|IEEE|ETSI		
:BANDwidth	<numeric_value>		
:CHANnel			
:AUTO	<String>		
:TYPE	<Boolean>		
[:RESolution]	FBURst | ALL | MB20 | MB40 | DB20 | DB40		
:FILTer			
[:STATe]	<Boolean>		

[SENSe:]FREQuency:CENTer <numeric value>

The remote control command is used to specify the frequency that the analyzer will use to make measurements against the input signal.

Example: "SENS:FREQ:CENT 5GHZ" The R&S FSQ-K90/K91/K91n option uses the specified frequency value to set the analyzer detection frequency.

Characteristics: *RST value: f_{max} / 2
SCPI: in compliance

[SENSe:]IQ:DITHer[:STATe] <boolean>

This instruction links a 2 MHz-wide dither signal with 42.67 MHz into the signal path of the baseband inputs. Note that this command requires option B71.

Example: "SENS:IQ:DITH 1" Switches on the 2 MHz broad dither signal

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]IQ:LPASs[:STATe] <boolean>

This instruction switches a 36 MHz filter into the I and Q branch of the baseband inputs. Note that this command requires option B71

Example: "SENS:IQ:LPAS 1" Switches on the lowpass filter for the IQ inputs.

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]SWEep:TIME <numeric value>

The remote control command is used to specify the sweep acquisition period (capture time) for which the input signal is to be measured.

Example: "SENS:SWEep:TIME 20ms" The R&S FSQ-K90/K91/K91n option uses the specified sweep acquisition period.

Characteristics: *RST value: 1 ms
SCPI: in compliance

[SENSe:]SWEep:COUNt <numeric value>

The remote control command is used to specify the number of sweeps for Spectrum Mask and Spectrum ACPR measurements.

Example: "SENS:SWEep:COUN 64" Sets the number of sweeps to 64.

Characteristics: *RST value: 1
SCPI: in compliance

[SENSe:]SWEep:EGATe <boolean>

This command switches the gating on/off.

Example: "SENS:SWE:EGAT ON" Switches gating on.

Characteristics: *RST value: OFF
SCPI: device specific

[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] <numeric value>

This command defines the gate delay in the capture buffer in time units. The range of this value is dependent on the measurement that was last run.

Example: "SENS:SWE:EGAT:HOLD 125µs" The R&S FSQ-K90/K91/K91n option will enforce a delay of 125 µs in the capture buffer

Characteristics: *RST value: 100µs
SCPI: device specific

[SENSe:]SWEep:EGATe:HOLDoff:SAMPle <numeric value>

This command defines the gate delay in the capture buffer as a number of samples. The range of this value is dependent on the measurement that was last run.

Example: "SENS:SWE:EGAT:HOLD:SAMP 2500" The R&S FSQ-K90/K91/K91n option will enforce a delay of 2500 samples in the capture buffer.

Characteristics: *RST value: 2000
SCPI: device specific

[SENSe:]SWEep:EGATe:LENGth[:TIMe] <numeric value>

This command defines the gate time in the capture buffer in time units. The range of this value is dependent on the measurement that was last run.

Example: "SENS:SWE:EGAT:LENG 20ms" The R&S FSQ-K90/K91/K91n option will enforce a gate length of 20 ms between sweeps.

Characteristics: *RST value: 400µs
SCPI: device specific

[SENSe:]SWEep:EGATe:LENGth:SAMPle <numeric value>

This command defines the gate time in the capture buffer as a number of samples. The range of this value is dependent on the measurement that was last run.

Example: "SENS:SWE:EGAT:LENG:SAMP 200000" The R&S FSQ-K90/K91/K91n option will enforce a gate length of 200000 samples in the capture buffer.

Characteristics: *RST value: 8000
SCPI: device specific

[SENSe:]SWEep:EGATe:LINK <boolean>

This command links together the movement of the gating lines and the capture buffer marker.

Example: "SENS:SWE:EGAT:LINK ON" Links the gating lines with marker 1.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]DEMod:CESTimation <boolean>

This command defines whether channel estimation will be done in the payload (if set to 1) or in the 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.

Example: "SENS:DEM:CEST 1" Specifies that the IQ measurement results will use channel estimation payload.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]DEMod:FFT:OFFSet PEAK | AUTO | GICenter

This command specifies the FFT start offset. The values which can be specified are as follows:

PEAK -The peak of the fine timing metric is used to determine the FFT start offset.

AUTO -The FFT start offset is automatically chosen to minimize the intersymbol interference.

GICenter -Guard Interval Center: The FFT start offset is placed to the center of the guard interval

Example: "SENS:DEM:FFT:OFFS?" Reads the fft start offset value
Characteristics: *RST value: AUTO
SCPI: device specific

[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

Example: "SENS:DEM:FILT:CAT?" Reads all filter names

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]DEMod:FILTer:MODulation <string>, <string>

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.

Example: "SENS: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

[SENSe:]DEMod:FORMat:SIGSymbol <boolean>

When this command is set to ON, the signal symbol field of the burst is analyzed to determine the details of the burst. When this field is set to ON, only bursts that 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.

Example: "SENS:DEM:FORM:SIGS ON" Specifies that the signal symbol field should be decoded.

Characteristics: *RST value:
SCPI: device specific

[SENSe:]DEMod:FORMat[:BCONtent]:AUTo <boolean>

When this command is set to ON, 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 that match the modulation scheme are considered in results analysis.

Example: "SENS:DEM:FORM:AUT ON" Specifies that the signal symbol field should be decoded.

Characteristics: *RST value:
SCPI: device specific

[SENSe:]DEMod:FORMat:BTRate 10 | 20 | 55 | 110

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:
10 - 1Mbit/s
20 - 2Mbit/s
55 - 5.5Mbit/s
110 - 11Mbit/s

Example: "SENS:DEM:FORM:BTR 20" The R&S FSQ-K90/K91/K91n option will demodulate 2 Mbit/s signals.

Characteristics: *RST value: 10 (= 1mbit)
SCPI: device specific

[SENSe:]DEMod:FORMat:BANalyze <string>

The remote control command sets the analysis modulation format that will be assumed when the measurement is performed. If the [SENSe:]DEMod:FORMat:SIGSymbol parametrer has been set to ON, this command can be used to measure only certain burst types within a measurement sequence. The supplied string can be one of the following:

'BPSK' Alias for BI-Phase shift keying at higher data rate for selected standard
'BPSK3' IEEE 802.11j (10 MHz) - BI-Phase shift keying at 3 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
'BPSK45'	IEEE 802.11j (10 MHz) - BI-Phase shift keying at 4.5 Mbps
'BPSK65'	IEEE 802.11n - BI-Phase shift keying at 6.5 Mbps
'BPSK72'	IEEE 802.11n - BI-Phase shift keying at 7.2 Mbps
'CCK11'	IEEE 802.11b & g (Single Carrier) – Complementary Code Keying at 11 Mbps
'CCK55'	IEEE 802.11b & g (Single Carrier) - Complementary Code Keying at 5.5 Mbps
'DBPSK1'	IEEE 802.11b & g (Single Carrier) - Differential BI-Phase shift keying
'DQPSK2'	IEEE 802.11b & g (Single Carrier) – Differential Quadrature phase shift keying
'PBCC11'	IEEE 802.11b & g (Single Carrier) – PBCC at 11 Mbps
'PBCC22'	IEEE 802.11g (Single Carrier) – PBCC at 11 Mbps
'PBCC55'	IEEE 802.11b & g (Single Carrier) - PBCC at 5.5 Mbps
'QAM16'	Alias for Quadrature Amplitude Modulation at higher data rate for selected standard
'QAM64'	Alias for Quadrature Amplitude Modulation 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
'QAM1626'	IEEE 802.11n Quadrature Amplitude Modulation at 26 Mbps
'QAM1636'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo - Quadrature Amplitude Modulation at 36 Mbps
'QAM1639'	IEEE 802.11n Quadrature Amplitude Modulation at 39 Mbps
'QAM16289'	IEEE 802.11n Quadrature Amplitude Modulation at 28.9 Mbps
'QAM16433'	IEEE 802.11n Quadrature Amplitude Modulation at 43.3 Mbps
'QAM6424'	EEE 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
'QAM6452'	IEEE 802.11n Quadrature Amplitude Modulation at 52 Mbps
'QAM6454'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo - Quadrature Amplitude Modulation at 54 Mbps
'QAM6465'	IEEE 802.11n Quadrature Amplitude Modulation at 65 Mbps
'QAM16289'	IEEE 802.11n Quadrature Amplitude Modulation at 28.9 Mbps
'QAM16433'	IEEE 802.11n Quadrature Amplitude Modulation at 43.3 Mbps
'QAM64578'	IEEE 802.11n Quadrature Amplitude Modulation at 57.8 Mbps
'QAM64585'	IEEE 802.11n Quadrature Amplitude Modulation at 58.5 Mbps
'QAM64722'	IEEE 802.11n Quadrature Amplitude Modulation at 72.2 Mbps
'QPSK'	Alias for Quadrature 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
'QPSK13'	IEEE 802.11n Quadrature phase shift keying at 13 Mbps
'QPSK18'	IEEE 802.11a, g (OFDM), j (20 MHz) & Turbo - Quadrature phase shift keying at 18 Mbps
'QPSK144'	IEEE 802.11n Quadrature phase shift keying at 14.4 Mbps
'QPSK195'	IEEE 802.11n Quadrature phase shift keying at 19.5 Mbps
'QPSK217'	IEEE 802.11n Quadrature phase shift keying at 21.7 Mbps

For 802.11n this command is only supported for SISO. For MIMO use:

:SENSe:DEMod:FORMat:MCSindex

Example: "`SENS:DEM:FORM:BAN 'QAM16'`" The R&S FSQ-K90/K91/K91n option will only analyze bursts that are of the QAM16 modulation format

Characteristics: *RST value: 'QAM64'
SCPI: device specific

[SENSe:]DEMod:FORMat:BANalyze:BTYPe <string>

This remote control command specifies the type of burst to be analyzed. Only bursts of the specified type take part in measurement analysis. The supplied string can be one of the following:

'DIRECT'	IEEE 802.11a, IEEE 802.11j (10 MHz), IEEE 802.11j (20 MHz), 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
'MM20'	IEEE 802.11n, Mixed Mode, 20 MHz sampling rate
'GFM20'	IEEE 802.11n, Green Field Mode, 20 MHz sampling rate

Example: "SENS:DEM:FORM:BAN:BTYP 'DIRECT'" The R&S FSQ-K90/K91/K91n option will only analyze DIRECT bursts

Characteristics: *RST value: 'DIRECT'
SCPI: device specific

[SENSe:]DEMod:FORMat:BANAlyze:BTYPe:AUTO:TYPE

This remote control command specifies whether how signals are analyzed.

FBURSt	The first burst is detected and subsequent bursts are analyzed only if they match the first burst
ALL	All valid bursts are analyzed
MMIX	Only mixed mode bursts are analyzed
MGRF	Only Greenfield bursts are analyzed
DMIX	All bursts are analyzed as mixed mode regardless of whether they are mixed mode or greenfiled
DGRF	All bursts are analyzed as Greenfield regardless of whether they are mixed mode or greenfiled

Example: "SENS:DEM:FOR:BTYP:AUTO:TYPE FBUR"

Characteristics: *RST value: FBURSt
SCPI: device-specific

[SENSe:]DEMod:FORMat:BANalyze:SYMbols:EQUal <boolean>

When this command is set to ON, 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

Example: "SENS:DEM:FORM:BAN:SYM:EQU 1" Only bursts of equal length will take part in analysis.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]DEMod:FORMat:BANalyze:SYMbols:MIN <numeric value>

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, 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.

Example: "SENS:DEM:FORM:BAN:SYM:MIN 16" The R&S FSQ-K90/K91/K91n option will only analyze bursts that contain a symbol count of 16.

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]DEMod:FORMat:BANalyze:SYMbols:MAX <numeric value>

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 will take part in measurement analysis.

Example: "SENS:DEM:FORM:BAN:SYM:MAX 1300" The R&S FSQ-K90/K91/K91n option will only analyze bursts that contain a maximum symbol count of 1300.

Characteristics: *RST value: 64
SCPI: device specific

[SENSe:]DEMod:FORMat:BANalyze:DBYTes:EQUal <boolean>

When this command is set to ON, 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.

Example: "SENS:DEM:FORM:BAN:DBYT:EQU ON" Only bursts of equal length will take part in the measurement analysis.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]DEMod:FORMat:BAN:DBYT:MIN <numeric value>

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, 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.

Example: "SENS:DEM:FORM:BAN:DBYT:MIN 16" The R&S FSQ-K90/K91/K91n option will only analyze bursts that contain 16 data bytes.

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]DEM:FORMat:BAN:DBYT:MAX <numeric value>

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 willl take part in measurement analysis.

Example: "SENS:DEM:FORM:BAN:DBYTes:MAX 1300" The R&S FSQ-K90/K91/K91n option will only analyze bursts that contain a maximum of 1300 data bytes.

Characteristics: *RST value: 64
SCPI: device specific

[SENSe:]DEMod:BANalyze:DURation:EQUal <boolean>

When this command is set to ON, 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 required burst duration in order for a burst to take part in measurement analysis.

Example: "SENS:DEM:BAN:DUR:EQU ON" Only bursts of equal length will take part in the measurement analysis.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]DEMod:BANalyze:DURation:MIN <numeric value>

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, 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.

Example: "SENS:DEM:BAN:DBYT:MIN 45" The R&S FSQ-K90/K91/K91n option will only analyze bursts that last 48 microseconds.

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]DEMod:BANalyze:DURation:MAX <numeric value>

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 will take part in measurement analysis

Example: "SENS:DEM:BAN:DUR:MAX 1300" The R&S FSQ-K90/K91/K91n option will only analyze bursts that have a maximum duration of 1300 microseconds.

Characteristics: *RST value: 5464
SCPI: device specific

[SENSe:]DEMod:FORMat:MCSIndex

This command accesses the MCS-Index which controls the rate and modulation and streams. It is used as the offset into the available options as shown on control –or
MCS parameter tables (see document: IEEE P802.11n/D11.0 June 2009".

Example: "SENS:DEM:FORM:MCSI 1" this selects MCS-Index 1 (BPSK 1 spatial stream)

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]DEMod:FORMat:MCSIndex:MODE

This remote control command specifies how bursts are analyzed acoording to the MCS index

FBURst	The MCS index of the first burst is detected and subsequent bursts are analyzed only if they have the same MCS index
ALL	All valid bursts are analyzed according to their individual MCS indexes
MEASure	Only bursts with an MCS index which matches that supplied by *SENSe:]DEMod:FORMat:MCSIndex* will be analyzed
DEMod	All bursts will be anayzed according to the MCS index specified by *[SENSe:]DEMod:FORMat:MCSIndex*

Example: "SENS:DEM:FORM:MCSI:AUTO:TYPE FBUR

Characteristics: *RST value: FBURst
SCPI: device-specific

[SENSe:]BURSt:COUNt <numeric value>

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.

Example: "BURS:COUN 16" Sets the number of bursts to 16.

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]BURSt:COUNt:STATe <boolean>

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.

Example: "BURS:COUN:STAT 1" Sets the burst count state to ON.

Characteristics: *RST value: OFF
SCPI: device specific

[SENSe:]SWAPiq <boolean>

This command defines whether or not the recorded IQ pairs should be swapped (I<->Q) before being processed.

Example: "SWAP 1" Specifies that IQ values should be swapped.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]TRACking:LEVel <boolean>

This command defines whether or not the measurement results should be compensated for level.

Example: "TRAC:LEV 1" Specifies that the measurement results should be compensated for level.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]TRACking:PHASe <boolean>

This command defines whether or not the measurement results should be compensated for phase.

Example: "TRAC:PHAS 1" Specifies that the measurement results should be compensated for phase.

Characteristics: *RST value: 1
SCPI: device specific

[SENSe:]TRACking:TIME <boolean>

This command defines whether or not the measurement results should be compensated for time.

Example: "TRAC:TIME 1" Specifies that the measurement results should be compensated for time.

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]POWer:ACHannel:MODE ABS | REL

This command sets the ACP measurement mode for the IEEE 802.11j standard to either absolute or relative. The mode can be specified as follows:

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

[SENSe:]POWer:SEM: USER | IEEE | ETSI

This command sets the Spectrum Emission Mask (SEM) measurement type. This is either IEEE, ETSI Spectrum mask or a user defined file.

Example: "POW:SEM:ETSI" Sets the SEM ETSI measurement type

Characteristics: *RST value: IEEE
SCPI: device specific

[SENSe:]POWer:SEM:CLASs <numeric value>

This command sets the Spectrum Emission Mask (SEM) power class index. The index represents the power classes to be applied. The index is directly related to the entries displayed in the power class drop down combo box, within the SEM settings configuration page.

Example: "POW:SEM:CLAS 0" Sets the SEM power class to automatic

Characteristics: *RST value: 0
SCPI: device specific

[SENSe:]BANDwidth:CHANnel::AUTO:TYPE

This remote control command specifies how bursts are analyzed according to channel bandwidth.

FBURst	The channel bandwidth of the first valid bursts is detected and subsequent bursts are analyzed only if they have the same channe bandwidth
ALL	All bursts are analyzed regardless of their channel bandwidth
MB20	Only burst with a channel bandwidth of 20MHzare analyzed
MB40	Only burst with a channel bandwidth of 40MHzare analyzed
DB20	All bursts are analyzed according to a channel bandwidth of 20MHz
DB40	All bursts are analyzed according to a channel bandwidth of 40MHz

Example: `"SENS:BAND:CHAN?`

Characteristics: *RST value: OFF
SCPI: device-specific

[SENSe:]BANDwidth:[RESolution]:FILTer

This remote control command enables or disables use of the RBW filter ON OFF

Example: `"SENS:BAND:RES:FILT OFF`

Characteristics: *RST value: OFF
SCPI: device-specific

STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (see section Status reporting registers). *RST does not influence the status registers.

COMMAND	PARAMETERS	UNIT	COMMENT
STATus:			
:QUEStionable			
:LIMit<1|2>			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:ACPLimit			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:POWer			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:SYNC			
[:EVENt]?	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	

STATus:QUEStionable:LIMit<1|2>[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit register for screen A and B. Readout deletes the contents of the EVENt section.

Example: "`STAT:QUES:LIM?`"

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:LIMit<1|2>:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register for screen A and B. Readout does not delete the contents of the CONDition section.

Example: "`STAT:QUES:LIM:COND?`"

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:LIMit<1|2>:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:LIMit register for screen A and B. The ENABle register selectively enables the individual events of the associated EVENt section for the summary bit.

Example: "STAT:QUES:LIM:ENAB 65535" All events bits will be represented in the LIMit summary bit.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:LIMit<1|2>:PTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit 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.

Example: "STAT:QUES:LIMit:PTR 65535" All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:LIMit<1|2>:NTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:LIMit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:LIMit 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.

Example: "STAT:QUES:LIM:NTR 65535" All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: device specific

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

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: In compliance

STATus:QUEStionable:ACPLimit:ENABle 0 to 65535

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.

Example: "STAT:QUES:ACPL:ENAB 65535" All events bits will be represented in the LIMit summary bit.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:ACPLimit:PTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:ACPLimit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:ACPLimit 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.

Example: "STAT:QUES:ACPL:PTR 65535" All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:ACPLimit:NTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:ACPLimit Condition register of screen A or B will set the corresponding bit in the STATus:QUEStionable:ACPLimit 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.

Example: "STAT:QUES:ACPL:NTR 65535" All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: device specific

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:POW?"

Characteristics: *RST value: -
SCPI: device specific

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:POW:COND"

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:POWer:ENABle 0 to 65535

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.

Example: "STAT:QUES:POW:ENAB 65535" All events bits will be represented in the POWer summary bit.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:POWer:PTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:POWer Condition register will set the corresponding bit in the STATus:QUEStionable:POWer 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.

Example: "STAT:QUES:POWer:PTR 65535" All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:POWer:NTRansition 0 to 65535

This command determines what bits in the STATus:QUEStionable:POWer Condition will set the corresponding bit in the STATus:QUEStionable:POWer 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.

Example: "STAT:QUES:POW:NTR 65535" All condition bits will be summarized in the Event register when a positive transition occurs.

Characteristics: *RST value: -
SCPI: device specific

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

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: In compliance

STATus:QUEStionable:SYNC:ENABle 0 to 65535

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.

Example: "STAT:QUES:SYNC:ENAB 65535" All events bits will be represented in the SYNC summary bit.

Characteristics: *RST value: -
SCPI: device specific

STATus:QUEStionable:SYNC:PTRansition 0 to 65535

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.

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

STATus:QUEStionable:SYNC:NTRansition 0 to 65535

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.

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

TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe			
[:DATA]	TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6 | LIST		Query only
:IQ			
:DATA:			
:MEMory?	<numeric_value>,<numeric_value>		Query only
:SRATe	<numeric_value>	Hz	IEEE 802.11a
:FILTer			
:FLATness	NORMal | WIDE		

TRACE[:DATA] TRACE1 | TRACE2 | TRACE3 | TRACE 4 | TRACE5 | TRACE 6 | LIST

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 is particular to the currently selected measurement type and is specified below. DISPlay:FORMat is not supported with this command.

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 a measurement belonging to the IQ group has been 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, j and n, 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 these measurement results.

IEEE 802.11a, j /n only
IIf "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

IEEE 802.11n only

20 MHz Channel Bandwidth
If "All Carriers" is selected, it will return 56 pairs of I and Q data per symbol.
If "Pilots Only" is selected, it will return 4 pairs 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 pair of I and Q data per symbol.

40 MHz Channel Bandwidth
If "All Carriers" is selected, it will return 116 pairs of I and Q data per symbol.
If "Pilots Only" is selected, it will return 6 pairs of I and Q per symbol in the following order: Carrier –53, Carrier –25, Carrier –11, Carrier 11, Carrier 25, Carrier 53.
If a single carrier is selected, it will return 1 pair 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 carriers (57 within the n standard) including DC, until all the data is exhausted. The IEEE 80211n Standard has 57 carrier for 20MHz channel bandwidth including DC and 117 carriers for 40MHz channel bandwidth including 3 DC.
Each I and Q point will be returned in floating point format. TRACE1 is used for these measurement results.
Supported data formats (FORMat:DATA): ASCii|REAL

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 complete bursts within the capture time are analyzed in 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, 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, 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 If the graphic type selected is RISing or FALLing, 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.

Supported data formats (FORMat:DATA): ASCii|REAL

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.
For example, the return data will either be one single group of 53 carriers (or 57 within the n standard) if the average trace is selected or a repeating group of 53 (or 57 within the n standard) 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.

Supported data formats (FORMat:DATA): ASCii|REAL

Spectrum Flatness 11n
There are two separate traces that are available with this measurement. Trace data for a particular trace will only be returnable by querying the appropriate trace.
The graph shows the absolute power value graph (ABS), which is plotted on a per carrier basis. All 56 carriers are drawn, in addition to the unused 0 carrier. The absolute power groups will allow all the data points to be returned as one trace and an average of all the channels as the other trace.
For example, the return data will either be one single group of 57 carriers if the average trace is selected or a repeating group of 57 carriers if all the data is requested.

TRACE1 – ABS (all analyzed trains)

TRACE2 – ABS (average trace)

Absolute power results are returned in dB.

Supported data formats (FORMat:DATA): ASCii|REAL

Spectrum Group Delay 11n
There are two separate traces that are available with this measurement. Trace data for a particular trace will only be returnable by querying the appropriate trace.
The graph shows the relative group delay graph, which is plotted on a per carrier basis. All 56 carriers are drawn, in addition to the unused 0 carrier. The 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.
For example, the return data will either be one single group of 57 carriers if the average trace is selected or a repeating group of 57 carriers if all the data is requested.

TRACE1 – Group Delay (all analyzed trains)

TRACE2 – Group Delay (average trace)

Group delay results are returned in ns.

Supported data formats (FORMat:DATA): ASCii|REAL

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.
For example, if there were 20000 samples, 32768 FFT points would be returned.
Data will be returned in floating point format in dBm. TRACE1 is used for these measurement results.

Statistics bit stream data

IEEE 802.11a, j & n only Data will be returned in repeating groups of 52 data channels (or 56/114 channels within the n standard) 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 these 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 represent the PLCP Preamble for Short and Long burst types, respectively. The next 6 bytes represent the PLCP Header. The remaining bytes represent the PSDU. Data will be returned in ASCII printable hexadecimal character format. TRACE1 is used for these measurement results.

Supported data formats (FORMat:DATA): ASCii|UINT

Statistics CCDF - Complementary cumulative distribution function
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 a 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.

Supported data formats (FORMat:DATA): ASCii|REAL

Statistics Signal Field data

IEEE 802.11a, j & n only Data will be returned as an array of hexidecimal values, with each hexidecimal value representing the 24 bit long signal field for a single burst.

IEEE 802.11b only Data will be returned as an array of hexidecimal values, with each hexidecimal 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 (or 57/117 within th n standard) carriers 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

Supported data formats (FORMat:DATA): ASCii|UINT

EVM vs Symbol
Three trace 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 & n 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

Supported data formats (FORMat:DATA): ASCii|REAL

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.

Supported data formats (FORMat:DATA): ASCii|REAL

Frequency Sweep Measurements
No data will be returned for this type of measurement, should it be requested, until a measurement has been 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 – Clear write values

TRACE2 – Max hold values

LIST – Spectrum Emission Mask (SEM) summary results.

SEM summary results format:
1st Value -Index into table of results (1 – 50)
2nd Value -Start frequency band (Hz)
3rd Value -Stop frequency band (Hz)
4th Value -RBW (Hz)
5th Value -limit fail frequency (Hz)
6th Value -Power absolute (dBm)
7th Value -Power relative (dBc)
8th Value -Limit distance (dB)
9th Value -Failure flag (1 = fail, 0 = pass)
Supported data formats (FORMat:DATA): ASCii|REAL

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 these measurement results.

Supported data formats (FORMat:DATA): ASCii|REAL

Example: "`TRAC? TRACE2`" The measurement data for the selected graph is returned.

Characteristics: *RST value: -
SCPI: conforming

TRACe:IQ:DATA:MEMory? <numeric value>,<numeric value>

Returns all the IQ data associated with the measurement acquisition time.
The result values are scaled linear in unit *Volt* and correspond to the voltage at the RF input of the instrument. The command returns a comma-separated list of the measured voltage values in floating point format (Comma Separated Values = CSV). The number of values returned is 2 * number of samples, the first half being the I values, the second half the Q values.

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

<# of samples> Number of measurement values to be read.
Value range: 1 to <# of samples> - <offset samples>

Example: "`TRAC:IQ:DATA:MEM? 0,2000`" Requests first 2000 samples.

Characteristics: *RST value: -
SCPI: device specific.

TRACe:IQ:SRATe <numeric value>

This command allows the sample rate for IQ measurements to be specified

Example: "`TRAC:IQ:SRAT 20000`" Specifies a sample rate of 20 MHz.

Characteristics: *RST value: -
SCPI: device specific

TRACE:IQ:FILTer:FLATness NORMal | WIDE

This command determines whether the wideband detector filters are too be used in preference to the wideband detector board, (B72 option), for a specified sample rate. The use of the wideband filters is restricted to the 20.4MHz to 40.8MHz range. These filters are only switchable if the B72 option is available in the test instrument. An FSQ which does not have the B72 option will automatically use the wideband filters where the sample rate is in the 20.4MHz to 40.8MHz range.

Example: "`TRACE:IQ:FILT:FLAT WIDE`" Specifies the use of wideband detector filters

Characteristics: *RST value: NORMal
SCPI: device specific

TRIGger Subsystem

The trigger subsystem is used to synchronize device action(s) with events.

COMMAND	PARAMETERS	UNIT	COMMENT
:TRIGger			
[:SEQUence]			
:MODE	IMMediate | EXTernal | POWer		
:LEVel			
[:EXTernal]	<numeric_value>	V	
:Power	<numeric_value>	DBM | V	
:AUTO	<Boolean>		
:HOLDoff	<numeric_value>	S	

TRIGger[:SEQuence]:MODE IMMediate | EXTernal | POWer

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 — The next measurement is triggered by the detection of a signal with sufficient power.

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

TRIGger[:SEQuence]:LEVel[:EXTernal] <numeric value>

This command accepts the level of the external trigger input for which triggering will occur.

Example: "TRIG:LEV 1 V"

Characteristics:
*RST value: 1.4 V
SCPI: device specific

TRIGger[:SEQuence]:LEVel:POWer <numeric value>

This command accepts the level of the input signal for which triggering will occur. The value is specified in dBm for RF input and V for baseband inputs.

Example:
"TRIG:LEV:POW 10 DBM" Set to 10 dBm for RF measurement.
"TRIG:LEV:POW 1 V" Set to 1 V for baseband measurement.

Characteristics:
*RST value: 0 DBM
SCPI: device specific

TRIGger[:SEQuence]:LEVel:POWer:AUTO <boolean>

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 TRIGger[:SEQuence]:MODE is not POWer.

Example: "TRIG:LEV:POW:AUTO 1" Specifies that an automatic power trigger level calculation should be performed before the start of each main measurement.

Characteristics: *RST value: 0
SCPI: device specific

TRIGger[:SEQuence]:HOLDoff <numeric value>

This command defines the length of the trigger delay. A negative delay time (pretrigger) can be set.

Example: "TRIG:HOLD 500us" The R&S FSQ-K90/K91/K91n option use a holdoff period of 500 µs after the trigger condition has been met.

Characteristics: *RST value: -10µs
SCPI: In compliance

UNIT Subsystem

The unit subsystem specifies the units for specific result types.

COMMAND	PARAMETERS	UNIT	COMMENT
:UNIT			
:EVM	DB | PCT		
:GIMBalance	DB | PCT		
:PREamble	HZ | PCT		

UNIT:EVM DB | PCT

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

UNIT:GIMBalance DB | PCT

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

UNIT:PREamble HZ | PCT

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

Status reporting registers

The status reporting system (see Fig. 4-1) stores all information about the present operating state of the instrument, e.g. that the instrument is presently carrying out a calibration, and about errors that 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 the IEC bus.

The information has 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 about 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 and thus is represented in Fig. 4-1.

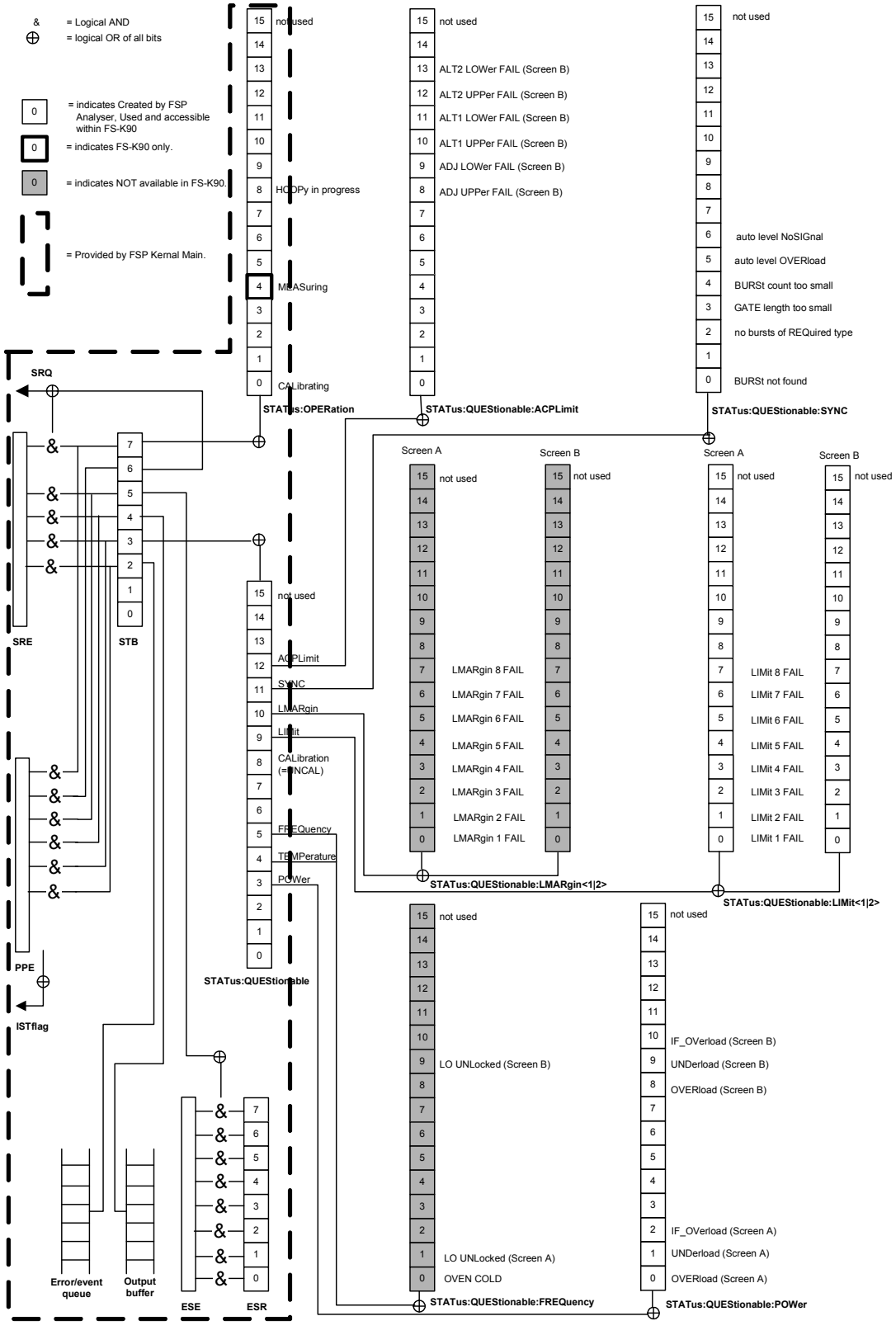


Fig. 4-1 Overview of the status registers

Description of the Status Registers

All the status registers shown in Fig. 4-1 are the same as those provided by the base system, with the exception of the following:

STATus:OPERation – Although this register is provided by R&S FSP Kernel main,R&S FSQ-K90/K91/K91n makes use of bits 4 & 7 in this register which are not used within R&S FSP Kernel main.
STATus:QUEStionable:ACPLimit – This register is provided by the analyzer and is not available from the R&S FSQ-K90/K91/K91n command tree.
STATus:QUEStionable:LIMit2 – This register is provided by the analyzer and is not available from the R&S FSQ-K90/K91/K91n command tree.
STATus:QUEStionable:LMARgin<1|2> – These registers are provided by the analyzer and are not available from the R&S FSQ-K90/K91/K91n command tree.
STATus:QUESTionable:FREQuency – This register is provided by the analyser and is not available from the R&S FSQ-K91 command tree

The deviations from the status register structure of the base system are detailed below.

STATus:OPERation Register

In the CONDition part, this register contains information about which actions the instrument is executing or, in the EVENt part, information about which actions the instrument has executed since the last reading. It can be read using commands "`STATus:OPERation:CONDition`?" or "`STATus:OPERation[:EVENt]?`".

Bit No	Meaning
0	CALibrating This bit is set as long as the instrument is performing a calibration.
1 to 3	These bits are not used
4	MEASuring A '1' in this bit position indicates that a measurement is in progress. **R&S FSQ-K91 only**
5 to 7	These bits are not used
8	HardCOPy in progress This bit is set while the instrument is printing a hardcopy.
9 to 14	These bits are not used
15	This bit is always 0

STATus:QUEStionable Register

This register contains information about indefinite states that may occur if the unit is operated without meeting the specifications. It can be queried by commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENt]?`.

Bit No	Meaning
0 to 2	These bits are not used
3	POWer This bit is set if a questionable power occurs (cf. also 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 (cf. section "STATus:QUEStionable:FREQuency Register").
6 to 7	These bits are not used
8	CALibration The bit is set if a measurement is performed uncalibrated (= ^ label "UNCAL")
9	**LIMit** (device-specific) This bit is set if a limit value is violated (see also section STATus:QUEStionable:LIMit Register). Note: Limit register is associated with limit lines for the Spectrum Mask measurement only.
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 WLAN mode, synchronization fails, no signal is detected or no burst is found. This bit is also set if input settings conflict with the measurement setup (see also "STATus:QUEStionable:SYNC Register").
12	**ACPLimit** 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	These bits are not used
15	This bit is always 0

STATus:QUEStionable:LIMit Register

This register contains information about the observance of limit lines in the corresponding measurement window (LIMit 1 corresponds to Screen A, LIMit 2 to Screen B). It can be queried with commands `STATus:QUEStionable:LIMit<1|2>:CONDition?` and `STATus:QUEStionable:LIMit<1|2>[:EVENt]?`.
Note that no limit lines are displayed in screen A. Thus, all bits in the LIMit1 register will always be set to 0.

Bit No	Meaning
0 to 1	These bits are not used
2	LIMit FAIL This bit is set if the ETSI Spectrum Mask limit line is violated
3	LIMit FAIL This bit is set if the Spectrum Flatness (Upper) limit line is violated
4	LIMit FAIL This bit is set if the Spectrum Flatness (Lower) limit line is violated
5	LIMit FAIL This bit is set if the IEEE Spectrum Mask limit line is violated.
6	LIMit FAIL This bit is set if the PVT Rising Edge max limit is violated.
7	LIMit FAIL This bit is set if the PVT Rising Edge mean limit is violated.
8	LIMit FAIL This bit is set if the PVT Falling Edge max limit is violated.
9	LIMit FAIL This bit is set if the PVT Falling Edge mean limit is violated.
10-14	These bits are 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 queried with commands '`STATus:QUEStionable:ACPLimit :CONDition?`' and '`STATus:QUEStionable:ACPLimit[:EVENt]?`'

Bit No	Meaning
0 to 7	These bits are not used
8	**ADJ UPPer FAIL (Screen B)** This bit is set if the limit is exceeded in the upper adjacent channel in screen B.
9	**ADJ LOWer FAIL (Screen B)** This bit is set if the limit is exceeded in the lower adjacent channel in screen B.
10	**ALT1 UPPer FAIL (Screen B)** This bit is set if the limit is exceeded in the upper 1st alternate channel in screen B.
11	ALT1 LOWer FAIL (Screen B) This bit is set if the limit is exceeded in the lower 1st alternate channel in screen B.
12	ALT2 UPPer FAIL (Screen B) This bit is set if the limit is exceeded in the upper 2nd alternate channel in screen B.
13	ALT2 LOWer FAIL (Screen B) This bit is set if the limit is exceeded in the lower 2nd alternate channel in screen B.
13-14	These bits are not used
15	This bit is always 0

STATus:QUEStionable:SYNC Register

This register contains information about sync and bursts that are 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 R&S FSQ-K90/K91/K91n 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.

Softkeys with assignment of IEC/IEEE bus commands

Key MEAS or Hotkey WLAN

GENERAL SETTINGS

```
:CONFigure:STANdard
:[SENSe:]FREQuency:CENTer
:CONFigure:CHANnel
:CONFigure:POWer:AUTO
:DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet
:CONFigure:POWer:EXPected:RF
:CONFigure:POWer:EXPected:IQ
:[SENSe:]SWEep:TIME
:[SENSe:]SWEep:COUNt
:[SENSe:]BURSt:COUNt:STATe
:[SENSe:]BURSt:COUNt
:TRIGger[:SEQuence]:MODE
:TRIGger[:SEQuence]:HOLDoff
:TRIGger[:SEQuence]:LEVel:POWer
:TRIGger[:SEQuence]:LEVel:POWer:AUTO
:[SENSe:]SWAPiq
:INPut:SELect
:INPut:IQ:IMPedance
:INPut:IQ:BALanced[:STATe]
:[SENSe:]IQ:LPASs[:STATe]
:[SENSe:]IQ:DITHer[:STATe]
```

DEMOD SETTINGS

```
:[SENSe:]DEMod:FORMat:SIGSymbol
:[SENSe:]DEMod:FORMat:BANalyze:BTYPe
:[SENSe:]DEMod:FORMat:AUTo
:[SENSe:]DEMod:FORMat:BANalyze
:[SENSe:]DEMod:BANalyze:SYMbols:EQUal
:[SENSe:]DEMod:BANalyze:SYMbols:MIN
:[SENSe:]DEMod:BANalyze:SYMbols:MAX
:[SENSe:]DEMod:CESTimation
:[SENSe:]TRACKing:PHASe
:[SENSe:]TRACKing:TIME
:[SENSe:]TRACKing:LEVel
```

DISPLAY LIST GRAPH

```
:DISPlay[:WINDow<1|2>]:TABLe
Result query:
:FETCh:BURSt:ALL?
:FETCh:BURSt:PREamble?
:FETCh:BURSt:PAYLoad?
:FETCh:BURSt:RMS?
:FETCh:BURSt:PEAK?
:FETCh:BURSt:CRESt?
:FETCh:BURSt:FERRor?
:FETCh:BURSt:SYMBolerror?
:FETCh:BURSt:IQOFfset?
:FETCh:BURSt:GIMBalance?
:FETCh:BURSt:QUADoffset?
:FETCh:BURSt:EVM:ALL?
:FETCh:BURSt:EVM:DATA?
:FETCh:BURSt:EVM:PILot?
```

PVT	:CONFigure:BURSt:PVT[:IMMediate]
GENERAL SETTINGS	:CONFigure:STANdard :[SENSe:]FREQuency:CENTer :CONFigure:CHANnel :CONFigure:POWer:AUTO :DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet :CONFigure:POWer:EXPected:RF :CONFigure:POWer:EXPected:IQ :[SENSe:]SWEep:TIME :[SENSe:]SWEep:COUNt :[SENSe:]BURSt:COUNt:STATe :[SENSe:]BURSt:COUNt :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SELect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe]
DEMOD SETTINGS	:[SENSe:]DEMod:FORMat:SIGSymbol :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :[SENSe:]DEMod:FORMat:AUTo :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMbols:EQUal :[SENSe:]DEMod:BANalyze:SYMbols:MIN :[SENSe:]DEMod:BANalyze:SYMbols:MAX :[SENSe:]DEMod:CESTimation :[SENSe:]TRACKing:PHASe :[SENSe:]TRACKing:TIME :[SENSe:]TRACKing:LEVel
DISPLAY LIST GRAPH	:DISPlay[:WINDow<1|2>]:TABLe
FULL BURST	:CONFigure:BURSt:PVT:SELect FULL
UP RAMP ON OFF	:CONFigure:BURSt:PVT:SELect RISE (query only - 802.11b)
RISING FALLING	:CONFigure:BURSt:PVT:SELect EDGE
DOWN RAMP ON OFF	:CONFigure:BURSt:PVT:SELect FALL (query only - 802.11b)
REF MEAS MAX MEAN	:CONFigure:BURSt:PVT:RPOWer MAX | MEAN
AVERAGE LENGTH	:CONFigure:BURSt:PVT:AVERage
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIMe] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

EVM	---
GENERAL SETTINGS	:CONFigure:STANdard :[SENSe:]FREQuency:CENTer :CONFigure:CHANnel :CONFigure:POWer:AUTO :DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet :CONFigure:POWer:EXPected:RF :CONFigure:POWer:EXPected:IQ :[SENSe:]SWEep:TIME :[SENSe:]SWEep:COUNt :[SENSe:]BURSt:COUNt:STATe :[SENSe:]BURSt:COUNt :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SELect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe]
DEMOD SETTINGS	:[SENSe:]DEMod:FORMat:SIGSymbol :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :[SENSe:]DEMod:FORMat:AUTo :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMbols:EQUal :[SENSe:]DEMod:BANalyze:SYMbols:MIN :[SENSe:]DEMod:BANalyze:SYMbols:MAX :[SENSe:]DEMod:CESTimation :[SENSe:]TRACKing:PHASe :[SENSe:]TRACKing:TIME :[SENSe:]TRACKing:LEVel
DISPLAY LIST GRAPH	:DISPlay[:WINDow<1|2>]:TABLe
EVM VS SYMBOL	:CONFigure:BURSt:EVM:ESYMbol[:IMMediate]
EVM VS CARRIER	:CONFigure:BURSt:EVM:ECARrier[:IMMediate]
Y AXIS/ DIV	:DISPlay[:WINDow<1|2>]:TACe1:Y[:SCALe]:AUTO :DISPlay[:WINDow<1|2>]:TRACe1:Y[:SCALe]:PDIVision
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIMe] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

SPECTRUM	---
GENERAL SETTINGS	:CONFigure:STANdard :[SENSe:]FREQuency:CENTer :CONFigure:CHANnel :CONFigure:POWer:AUTO :DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet :CONFigure:POWer:EXPected:RF :CONFigure:POWer:EXPected:IQ :[SENSe:]SWEep:TIME :[SENSe:]SWEep:COUNt :[SENSe:]BURSt:COUNt:STATe :[SENSe:]BURSt:COUNt :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SELect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe]
DEMOD SETTINGS	:[SENSe:]DEMod:FORMat:SIGSymbol :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :[SENSe:]DEMod:FORMat:AUTo :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMbols:EQUal :[SENSe:]DEMod:BANalyze:SYMbols:MIN :[SENSe:]DEMod:BANalyze:SYMbols:MAX :[SENSe:]DEMod:CESTimation :[SENSe:]TRACKing:PHASe :[SENSe:]TRACKing:TIME :[SENSe:]TRACKing:LEVel
DISPLAY LIST GRAPH	:DISPlay[:WINDow<1|2>]:TABLe
SPECTRUM FLATNESS	: CONFigure:BURSt:SPECtrum:FLATness[:IMMediate]
SPECTRUM ESTI	:CONFigure:BURSt:SPECtrum:MASK:SELect IEEE | ETSI
SPECTRUM MASK	:CONFigure:BURSt:SPECtrum:MASK[:IMMediate] (query only 802.11b)
SPECTRUM FTT	:CONFigure:BURSt:SPECtrum:FFT[:IMMediate]
SPECTRUM ACPR	:CONFigure:BURSt:SPECtrum:ACPR[:IMMediate] Results: :CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult[:CURRent]? :CALCulate<1|2>:MARKer<1>:FUNCtion:POWer:RESult:MAXHold?
ACP RELABS	:[SENSe:]POWer:ACHannel:MODE REL | ABS query only – 802.11j
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIMe] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

CONSTELL	---
GENERAL SETTINGS	:CONFigure:STANdard :[SENSe:]FREQuency:CENTer :CONFigure:CHANnel :CONFigure:POWer:AUTO :DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet :CONFigure:POWer:EXPected:RF :CONFigure:POWer:EXPected:IQ :[SENSe:]SWEep:TIME :[SENSe:]SWEep:COUNt :[SENSe:]BURSt:COUNt:STATe :[SENSe:]BURSt:COUNt :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SELect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe]
DEMOD SETTINGS	:[SENSe:]DEMod:FORMat:SIGSymbol :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :[SENSe:]DEMod:FORMat:AUTo :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMbols:EQUal :[SENSe:]DEMod:BANalyze:SYMbols:MIN :[SENSe:]DEMod:BANalyze:SYMbols:MAX :[SENSe:]DEMod:CESTimation :[SENSe:]TRACKing:PHASe :[SENSe:]TRACKing:TIME :[SENSe:]TRACKing:LEVel
DISPLAY LIST GRAPH	:DISPlay[:WINDow<1|2>]:TABLe
CONSTELL	:CONFigure:BURSt:CONStellation:CSYMbol[:IMMediate]
CONSTELL VS CARRIER	:CONFigure:BURSt:CONStellation:CCARrier[:IMMediate]
CARRIER SELECTION	:CONFigure:BURSt:CONStellation:CARRier:SELect
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIMe] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

STATISTICS	---
GENERAL SETTINGS	:CONFigure:STANdard :[SENSe:]FREQuency:CENTer :CONFigure:CHANnel :CONFigure:POWer:AUTO :DISPlay[:WINDow<1|2>]:TRACe<1…3>:Y[:SCALe]:RLEVel:OFFSet :CONFigure:POWer:EXPected:RF :CONFigure:POWer:EXPected:IQ :[SENSe:]SWEep:TIME :[SENSe:]SWEep:COUNt :[SENSe:]BURSt:COUNt:STATe :[SENSe:]BURSt:COUNt :TRIGger[:SEQuence]:MODE :TRIGger[:SEQuence]:HOLDoff :TRIGger[:SEQuence]:LEVel:POWer :TRIGger[:SEQuence]:LEVel:POWer:AUTO :[SENSe:]SWAPiq :INPut:SELect :INPut:IQ:IMPedance :INPut:IQ:BALanced[:STATe] :[SENSe:]IQ:LPASs[:STATe] :[SENSe:]IQ:DITHer[:STATe]
DEMOD SETTINGS	:[SENSe:]DEMod:FORMat:SIGSymbol :[SENSe:]DEMod:FORMat:BANalyze:BTYPe :[SENSe:]DEMod:FORMat:AUTo :[SENSe:]DEMod:FORMat:BANalyze :[SENSe:]DEMod:BANalyze:SYMbols:EQUal :[SENSe:]DEMod:BANalyze:SYMbols:MIN :[SENSe:]DEMod:BANalyze:SYMbols:MAX :[SENSe:]DEMod:CESTimation :[SENSe:]TRACKing:PHASe :[SENSe:]TRACKing:TIME :[SENSe:]TRACKing:LEVel
DISPLAY LIST GRAPH	:DISPlay[:WINDow<1|2>]:TABLe
CCDF	:CONFigure:BURSt:STATistics:CCDF[:IMMediate]
BIT STREAM	:CONFigure:BURSt:STATistics:BSTReam[:IMMediate]
SIGNAL FIELD	:CONFigure:BURSt:STATistics:SFIeld [:IMMediate]
PCLP HEADER	:CONFigure:BURSt:STATistics:SFIeld[:IMMediate] (query only - 802.11b)
GATING ON OFF	:[SENSe:]SWEep:EGATe
GATE SETTINGS	:[SENSe:]SWEep:EGATe:HOLDoff[:TIMe] :[SENSe:]SWEep:EGATe:HOLDoff:SAMPle :[SENSe:]SWEep:EGATe:LENGth[:TIMe] :[SENSe:]SWEep:EGATe:LENGth:SAMPle :[SENSe:]SWEep:EGATe:LINK

Key DISP

FULL SCREEN	:DISPlay:FORMat SINGle
SPLIT SCREEN	:DISPlay:FORMat SPLit

Key LINES

```
:CALCulate<1|2>:LIMit<1>:BURSt:ALL
:CALCulate<1|2>:LIMit<1>:BURSt:ALL: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: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: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
```

Key MKR

MARKR 1	:CALCulate<1|2>:MARKer<1>:STATe :CALCulate<1|2>:MARKer<1>:X :CALCulate<1|2>:MARKer<1>:Y :CALCulate<1|2>:MARKer<1>:SYMBol :CALCulate<1|2>:MARKer<1>:CARRier
UNZOOM	:CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM 1
MARKER ZOOM	:CALCulate<1|2>:MARKer<1>:FUNCtion:ZOOM <numeric value>
MARKER OFF	:CALCulate<1|2>:MARKer<1>:AOFF

Key MKR->

SELECT MARKER	---
MKR->TRACE	:CALCulate<1|2>:MARKer<1>:TRACe

Hotkeys

SPECTRUM	:INSTrument:SELect SANalyzer :INSTrument:NSELect 1
WLAN	---
AUTO LVL	:CONFigure:POWer:AUTO ONCE
RUN SGL	:INITiate:CONTinuous OFF; INITiate[:IMMediate]
RUN CONT	:INITiate:CONTinuous ON; INITiate[:IMMediate]
REFRESH	---
SCREEN A/B	:DISPlay[:WINDow<1|2>]:SELect :DISPlay[:WINDow<1|2>]:SSELect

5 Remote Control - Programming Examples

The following section provides some examples of commonly performed operations whe using R&S FSQ-K90/K91/K91n. For more general remote control examples, refer to the programming examples chapter in the instrument user manual.

Synchronization of Entry of Option

The following example shows how to synchronize the entry of the FS-KWLAN option.

```
analyzer% = 20    ,Instrument address

CALL IBWRT(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, j & n 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
STATistics:CCDF	CCDF
STATistics:BSTReam	Bit Steam
STATistics:SFIeld	Signal Field

The following example shows how to select a Spectrum Mark ETSI measurement:

```
REM select Spectrum Mask Select ETSI
CALL IBWRT(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 been 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 executed only when the entire sweep is
REM complete.
CALL IBWRT(analyzer%, "INIT:CONT OFF")

REM ------ First possibility: Use of *WAI -----------------------------
CALL IBWRT(analyzer%, "INIT:IMM; *WAI")

REM ------ Second possibility: Use of *OPC? ---------------------------
OpcOk$ = SPACE$(2) 'Space for *OPC? - Provide response
CALL IBWRT(analyzer%, "INIT:IMM; *OPC?")

REM ------ Here the controller can service other instrument------------
CALL IBRD(analyzer%, OpcOk$) 'Wait for "1" from *OPC?

REM ------- Third possibility: Use of *OPC ----------------------------
REM To be able to use the service request function in
REM conjunction with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM IBCONF!
CALL IBWRT(analyzer%, "*SRE 32")    'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 1")     'Set event-enable bit for
                                    'operation-complete bit

CALL IBWRT(analyzer%, "INIT:IMM; *OPC")   'Start sweep and
'synchronize with OPC

CALL WaitSRQ(boardID%,result%)            'Wait for service request

REM ------- Fourth possibility: Use of INIT:IMM ----------------------
REM To be able to use the service request function in
REM conjunction with a National Instruments GPIB driver, the setting
REM "Disable Auto Serial Poll" must be changed to "yes" by means of
REM IBCONF!
CALL IBWRT(analyzer%, "*SRE 128")   'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 0")     'Set event-enable bit for
                                    'operation-complete bit
CALL IBWRT(analyzer%, "STATus:OPERation:ENABle 16")   'Enable bit 4 of status
'operation register'
CALL IBWRT(analyzer%, "STAT:OPERation:NTRansition 16") 'Set Negative
'transition to 1
CALL IBWRT(analyzer%, "STATus:OPERation:PTRansition 0") 'Set Positive
'transition to 0
CALL IBWRT(analyzer%, "INIT:IMM")   'Start sweep and synchronize with OPC
CALL WaitSRQ(boardID%,result%)      'Wait for service request

REM Continue main program here.

END SUB
REM ***************************************************************
```

6 List of Warnings & Error Messages

The list of possible warning & error messages are shown below:

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 *REFRESH* 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 *REFRESH* hotkey to remove this error.
No bursts found	This message is displayed if no valid burst was detected in the input data. To correct this problem, check the following: The connections between the DUT and analyzer are correct. The input signal is of a sufficient level. The capture time is long enough to capture at least one complete burst. If running with a Free Run trigger, 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. Check that the demod settings are correct.
No bursts of desired type to analyze	This message is displayed if bursts are found, but none of the desired type to analyse. Verify that the setting for Burst Type is correct.
No signal found	This message is displayed when an automatic level detection measurement is performed 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, try increasing the setting for the Signal Level parameter (or settings Auto Level). If this does not clear the problem, an external attenuation may need to be applied.

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