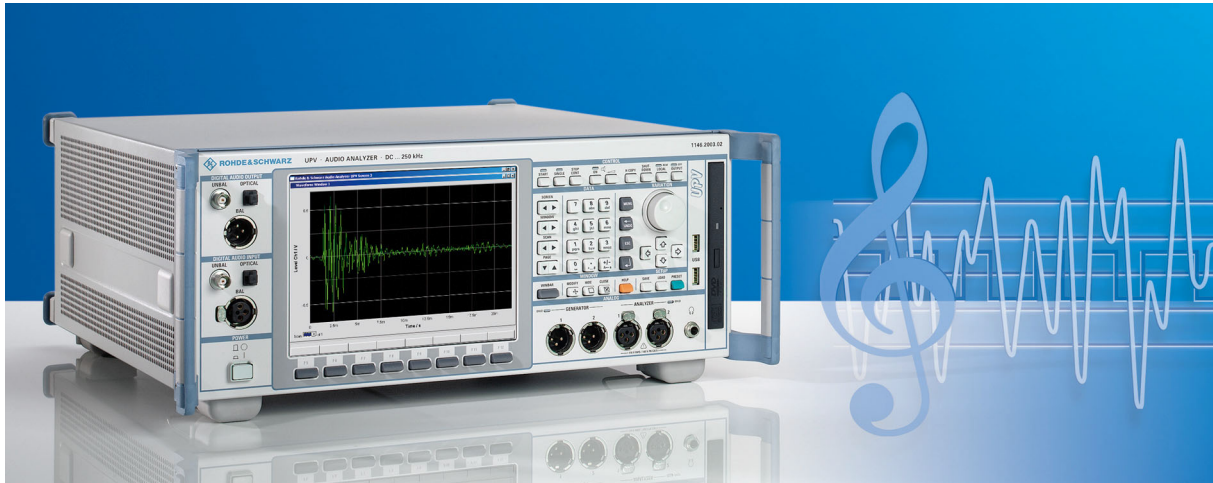


# Manual



## Audio Analyzer DC to 250 kHz

**R&S<sup>®</sup> UPV**  
1146.2003.02

Printed in Germany



**Dear Customer,**

The Audio Analyzer includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (<http://www.openssl.org/>).

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG  
Trade names are trademarks of the owners.

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



# Safety Instructions

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

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

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

## Symbols and safety labels

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

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

## Safety Instructions

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

### Tags and their meaning

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

### Basic safety instructions

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

## Safety Instructions

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

## Safety Instructions

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



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



## Informaciones de seguridad

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

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

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

### Símbolos y definiciones de seguridad

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

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



## Informaciones de seguridad

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

### Palabras de señal y su significado

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

### Informaciones de seguridad elementales

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

## Informaciones de seguridad

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

## Informaciones de seguridad

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

## Certified Quality System

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

**DQS REG. NO 001954 QM/ST UM**

### QUALITÄTSZERTIFIKAT

*Sehr geehrter Kunde,*

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

Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

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

### CERTIFICATE OF QUALITY

*Dear Customer,*

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

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

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

### CERTIFICAT DE QUALITÉ

*Cher Client,*

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

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

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



**ROHDE & SCHWARZ**



Certificate No.: 2004-25

This is to certify that:

Equipment type	Stock No.	Designation
UPV	1146.2003.02	Audio Analyzer
UPV-B1	1146.5202.02	Low Distortion Generator
UPV-B2	1146.4306.02	Digital Audio I/O
UPV-B3	1146.4806.02	Second Analog Generator
UPV-B41	1146.5402.02	I2S Interface

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

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

Conformity is proven by compliance with the following standards:

EN61010-1 : 2001-12  
EN55011 : 1998 + A1 : 1999 + A2 : 2002  
EN61326 : 1997 + A1 : 1998 + A2 : 2001

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

Affixing the EC conformity mark as from 2004

**ROHDE & SCHWARZ GmbH & Co. KG**  
**Mühldorfstr. 15, D-81671 München**

Munich, 2005-01-26

Central Quality Management MF-QZ / Radde

# 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 Rohde & Schwarz equipment always up-to-date, please subscribe to an electronic newsletter at

<http://www.rohde-schwarz.com/www/response.nsf/newsletterpreselection>

or request the desired information and upgrades via email from your Customer Support Center (addresses see below).

## Feedback

We want to know if we are meeting your support needs. If you have any comments please email us and let us know [CustomerSupport.Feedback@rohde-schwarz.com](mailto:CustomerSupport.Feedback@rohde-schwarz.com).

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### USA & Canada

Monday to Friday (except US-state holidays)  
8:00 AM – 8:00 PM Eastern Standard Time (EST)

USA: 888-test-rsa (888-837-8772) (opt 2)  
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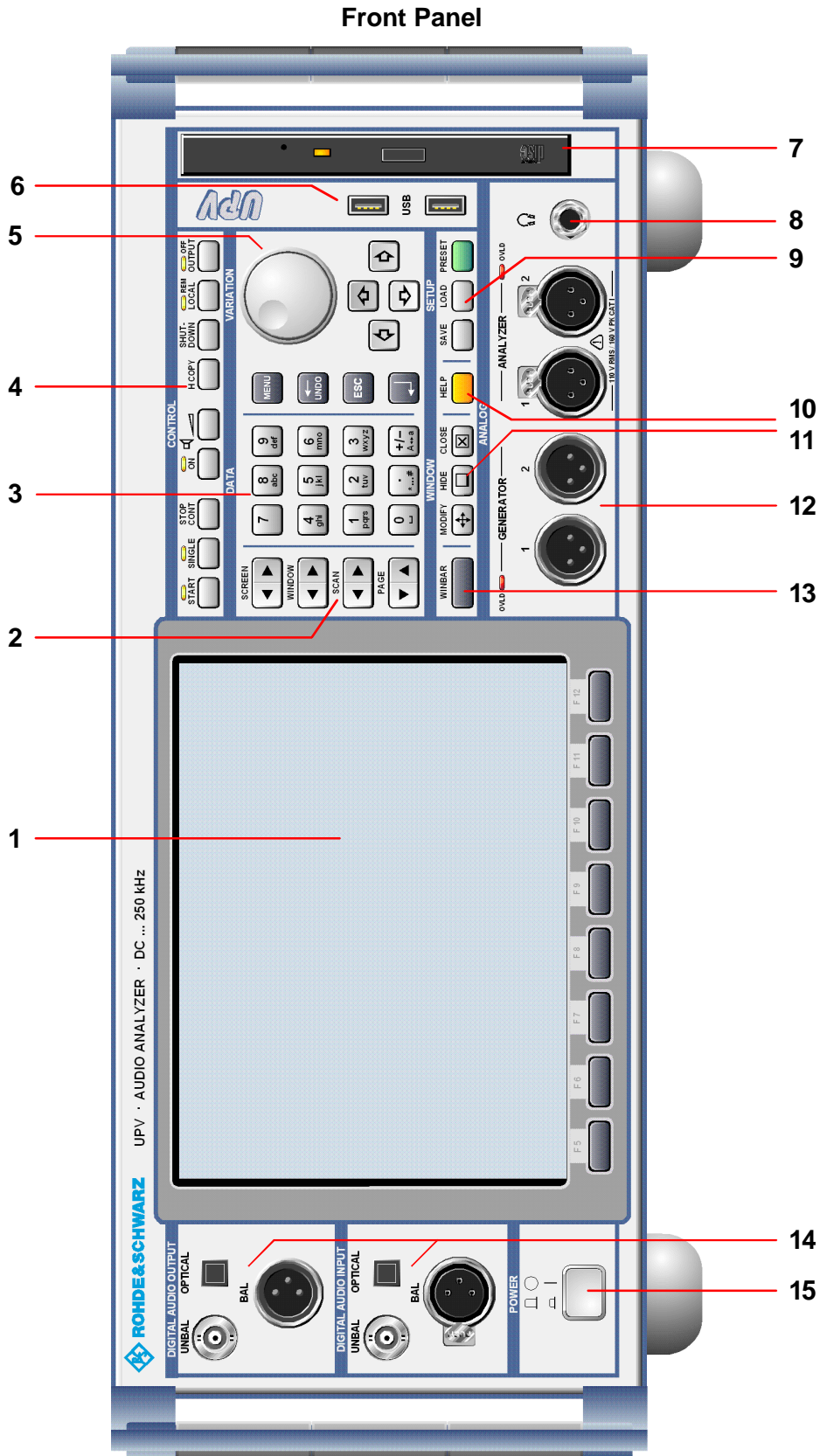


Fig. 1-1 Front Panel

# 1 Putting into Operation

Chapter 1, "*Putting into Operation*", describes the control elements and connectors at the front and rear of the Audio Analyzer R&S UPV and shows how the instrument is put into operation. It also describes the connection of peripherals such as printer, keyboard, mouse and monitor. Specifications for the interfaces can be found in the data sheet.

The introduction in Chapter 2, "*Getting Started*", provides an overview of the functions and operating concept of the audio analyzer. Detailed operating instructions and an overview of the menus are provided in Chapter 3, "*Manual Operation*".

The CD-ROM contains the entire manual complete with the other chapters in printable PDF format: The individual menus and functions of the instrument including the associated remote-control commands are explained in detail in the reference section (Chapter 4). Basic information on remote control of the instrument is provided in Chapters 5 to 7, "Fernsteuerung - Grundlagen" and "Fernsteuerung - Befehle". A detailed description of the instrument interfaces can be found in Chapter 8, "Wartung und Geräteschnittstellen". Chapter 9, "Fehlermeldungen" contains an overview of the possible error messages output by the instrument.

---

**Notes:**

*The audio analyzer has the WindowsXP® Embedded operating system. No special knowledge of the operating system used is required for operation of the instrument.*

*It is, however, assumed that users possess basic PC knowledge, such as what files and directories etc are or how data is transferred using the Windows® Explorer. This information is therefore not specified in detail here.*

*The instrument can be fully operated via the control elements on the front panel. It is, however, also possible to operate the instrument using an external keyboard and mouse. Operation follows the same basic rules which apply to other Windows programs in use today. It is also assumed that users are familiar with these basic rules. This information is therefore not specified in detail here.*

---



# Description of the Front Panel

This section provides an overview of the control elements and connectors on the front of the R&S UPV.

## 1 Screen with softkeys

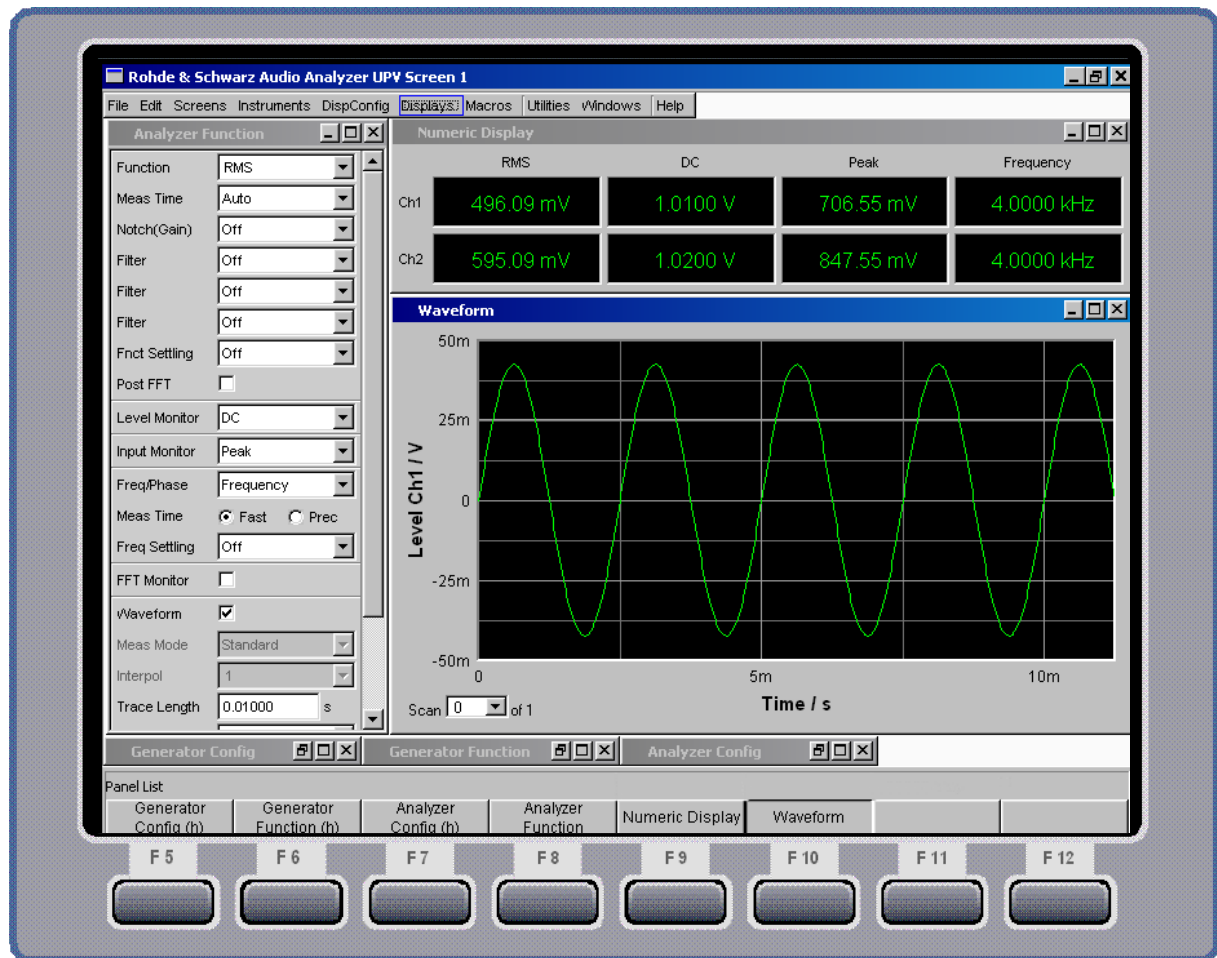


Fig. 1-2 Screen

The large screen shows all of the important settings and states of the audio analyzer in a clearly organized display. 5 displays ("screens") are provided to ensure clearer organization of the many possible panels and display windows.

The **display** is divided into the following sections:

- menu bar
- operating and display area
- **WINBAR** with softkey labels
- softkeys

The **menu bar**

- contains a row of pull-down menus which can be used to, for example, load instrument settings, select panels and screens or call up help functions.
- The menu bar appears when the MENU key is pressed or the mouse pointer is moved to the left of the screen. It otherwise remains hidden in order to save space.

In the **operating and display area**

- the Audio Analyzer R&S UPV is operated using numerous panels which can be selected by the user
- the measurement results are displayed numerically and/or graphically in the format selected by the user

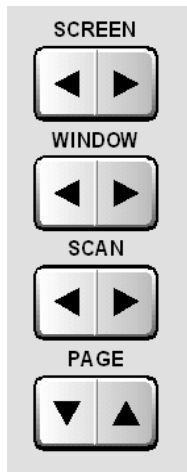
The **softkey bar/WINBAR** at the bottom of the screen has two functions:

- In normal operating mode, the **softkey bar** containing the functions available in the selection windows of the panels is visible; the softkeys permit rapid selection without needing to use the mouse.
- When the WINBAR key is pressed, the **WINBAR** containing the names of all opened panels / graphical windows is displayed in place of the softkey bar. Pressing the associated softkey puts the focus on the corresponding panel / graphical window, i.e. it becomes active. At the same time, the system returns to normal operating mode (see above).
- It is possible to toggle between the softkey bar and WINBAR at any time by pressing the WINBAR key.

The function of the **softkeys**

- corresponds to the label on the softkey bar and WINBAR. The softkeys can also be operated using the function keys on the external keyboard or by clicking the associated button.

## 2 Navigation keys



The **navigation keys** are 4 rocker buttons which are used for forward and backward switching.

- |        |   |  |
|--------|---|--|
| SCREEN | – | Switches between the individual display settings (the "screens").  |
| WINDOW | – | Switches the focus to each of the panels open in the visible screen in sequence (the panel with the focus is active).  |
| SCAN   | – | Changes between the individual curve traces ("scans") in graphical displays so that, for example, measurement values can be read off from the curves using the cursor. |
| PAGE   | – | Scrolls back and forward in the tables one page at a time.   |

## 3 Data entry keys

Numeric keys



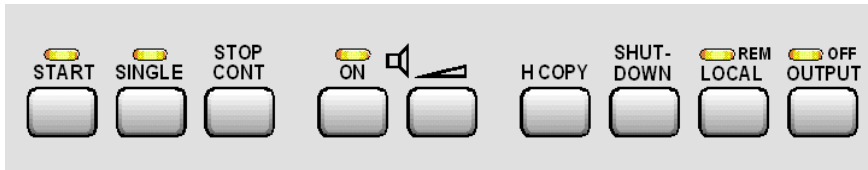
- |       |   |  |
|-------|---|--|
| 0...9 | – | Entry of numeric values                            |
| .     | – | Entry of decimal point                             |
| +/-   | – | Entry of sign                                      |
| abc   | – | Entry of letters                                   |
| _     | – | Entry of a space                                   |
| *...# | – | Entry of special characters                        |
| A ↔ a | – | Switchover between uppercase and lowercase letters |

Function keys



- |       |   |  |
|-------|---|--|
| MENU  | – | Displays the menu bar on the screen                            |
| UNDO  | – | Deletes the character to the left of the cursor                |
|       | – | Undoes the action last performed                               |
| ESC   | – | Closes the open window; the old value or parameter is retained |
| ENTER | – | Completes the data entry; the new value is adopted             |
|       | – | Confirms (OK) and closes open entry windows                    |
|       | – | Pressing the rotary knob has the same effect                   |

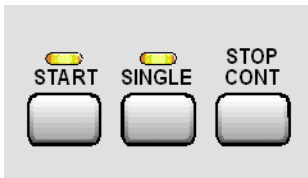
4 CONTROL panel



The CONTROL panel contains the following operating functions. These functions are described in detail below:

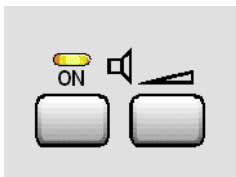
- Start measurements / sweeps
- Loudspeaker control
- Hardcopy of the screen contents
- Shut down the operating system
- Switch between remote / manual operation
- Switch off outputs

Keys for starting measurements and sweeps



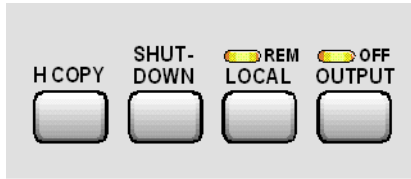
- |           |   |  |
|-----------|---|--|
| START     | - | Starts continuous measurements and sweeps (LED lights up); Resets Min/Max values for bargraph displays, averaging for measurement results, and limit overranging |
| SINGLE    | - | Starts a single measurement or a single sweep (LED lights up during execution)   |
| STOP/CONT | - | Measurement / sweep is stopped or continued (toggle function)  |

Keys for setting the loudspeaker



- |        |   |   |
|--------|---|---|
| ON     | - | Switches the loudspeaker or connected headphones on and off (toggle function) |
| Volume | - | Opens a window for adjusting the audio monitoring volume                      |

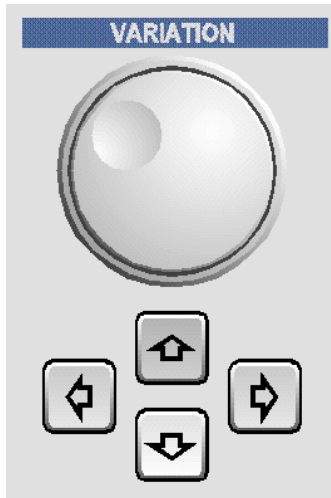
Keys for printing hardcopies, shutting down the operating system, switching between remote/local operation, switching off outputs



- H COPY
  - Depending on the settings under Utilities printout of the screen contents on the connected printed is started
  - the screen contents are stored in a file
- SHUT-DOWN
  - Stores the current settings on the hard disk and then shuts down the Windows operating system
- LOCAL
  - Switches from remote operation to manual operation; the LED lights up with remote operation
- OUTPUT
  - Switches all outputs of the measuring instrument off or on again; the LED lights up when the outputs are switched off

**5 VARIATION panel**

Rotary knob



- Moves the focus in the panels, selection windows and tables
- Varies the entry value at the cursor position
- Moves the active cursor inside the graphical windows
- Switches the measuring steps forwards and backwards for manual sweeps
- Pressing the rotary knob has the same effect as pressing the Enter key

Cursor keys



- Move the focus in the panels, selection windows and tables
- Vary the entry value at the cursor position

Cursor keys



- Move the active cursor inside the graphical windows
- Move the cursor position in entered values
- Switch the measuring steps forwards and backwards for manual sweeps

**6 USB connectors**

USB (Universal Serial Bus) interfaces of type A (host USB) for:

- connecting peripherals such as mouse, keyboard, printer
- connecting a USB stick for transferring files
- There are two additional USB interfaces (type A) at the rear of the instrument.

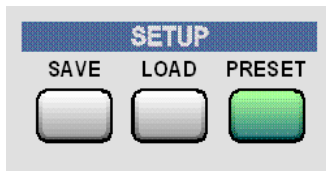
**7 Combined CD/DVD drive**

The integrated combined CD/DVD drive is used to

- install software updates on the R&S UPV
- install sequence programs and macros
- import data and instrument settings from other R&S UPVs
- play back test and music signals in WAV format
- store data on a CD-ROM

**8 Headphone connector**

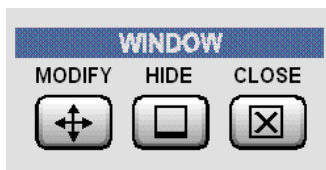
Connection of headphones for audio monitoring of the analysis or generator signal

**9 SETUP panel**

- |        |   |   |
|--------|---|---|
| SAVE   | - | Opens a window for storing instrument settings            |
| LOAD   | - | Opens a window for loading predefined instrument settings |
| PRESET | - | Loads the factory settings of the instrument              |

**10 HELP key**

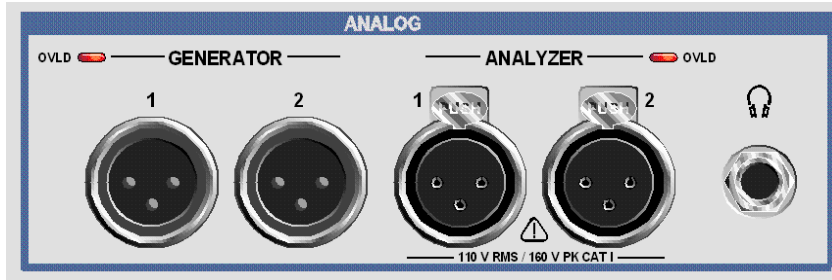
Pressing this key displays a context-sensitive help text

**11 WINDOW panel**

- |        |   |   |
|--------|---|---|
| MODIFY | - | Opens a selection of functions on the softkey bar; these functions can be used in conjunction with the rotary knob to move or resize the active panel or graphical window |
| HIDE   | - | Minimizes ("hides") the active panel or graphical window  |
| CLOSE  | - | Closes the active panel or graphical window   |

## 12 Analog audio interfaces

Output and input connectors of the analog generators and analyzers



### Warning!

The instrument complies with measuring category I; make sure that the input voltage at the connectors of the analog analyzers does not exceed 110 V (effective, sinusoidal) and 160 V (peak value).

Do not use the instrument in measuring categories II, III and IV.

#### Explanation:

Measuring circuits as defined in section 6.7.4 of EN61010-1:

Measuring category I is intended for measurements on circuits which are not connected to the high-voltage current system.

## 13 WINBAR key



It is possible to toggle between the softkey bar and WINBAR at any time by pressing the **WINBAR** key:

- In normal operating mode, the softkey bar containing the functions available in the selection windows of the panels is visible; the softkeys permit rapid selection without needing to use the mouse.
- When the **WINBAR** key is pressed, the WINBAR containing the names of all opened panels / graphical windows is displayed in place of the softkey bar. Pressing the associated softkey puts the focus on the corresponding panel / graphical window, i.e. it becomes active. At the same time, the system returns to normal operating mode (see above).



## 14 Digital audio interfaces

Inputs and outputs for connecting digital consumer devices and professional studio equipment.

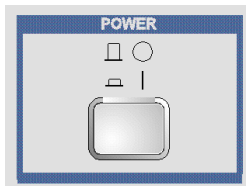


- |         |   |   |
|---------|---|---|
| UNBAL   | – | BNC connectors  |
| OPTICAL | – | Optical interface conforming to EIAJ CP-340, TOSLINK system |
| BAL     | – | XLR female and male connector                               |

**Note:**

*These interfaces are only available in conjunction with the R&S UPV-B2 option.*

## 15 Power switch



The power switch switches on the instrument and starts the booting process.

**Warning:**

*The instrument must be set up in such a way that operation of the power switch is not obstructed.*

**Note:**

*It is strongly recommended to shut down the operating system before switching off the instrument (using the **SHUT-DOWN** key or the mouse).*



Rear Panel

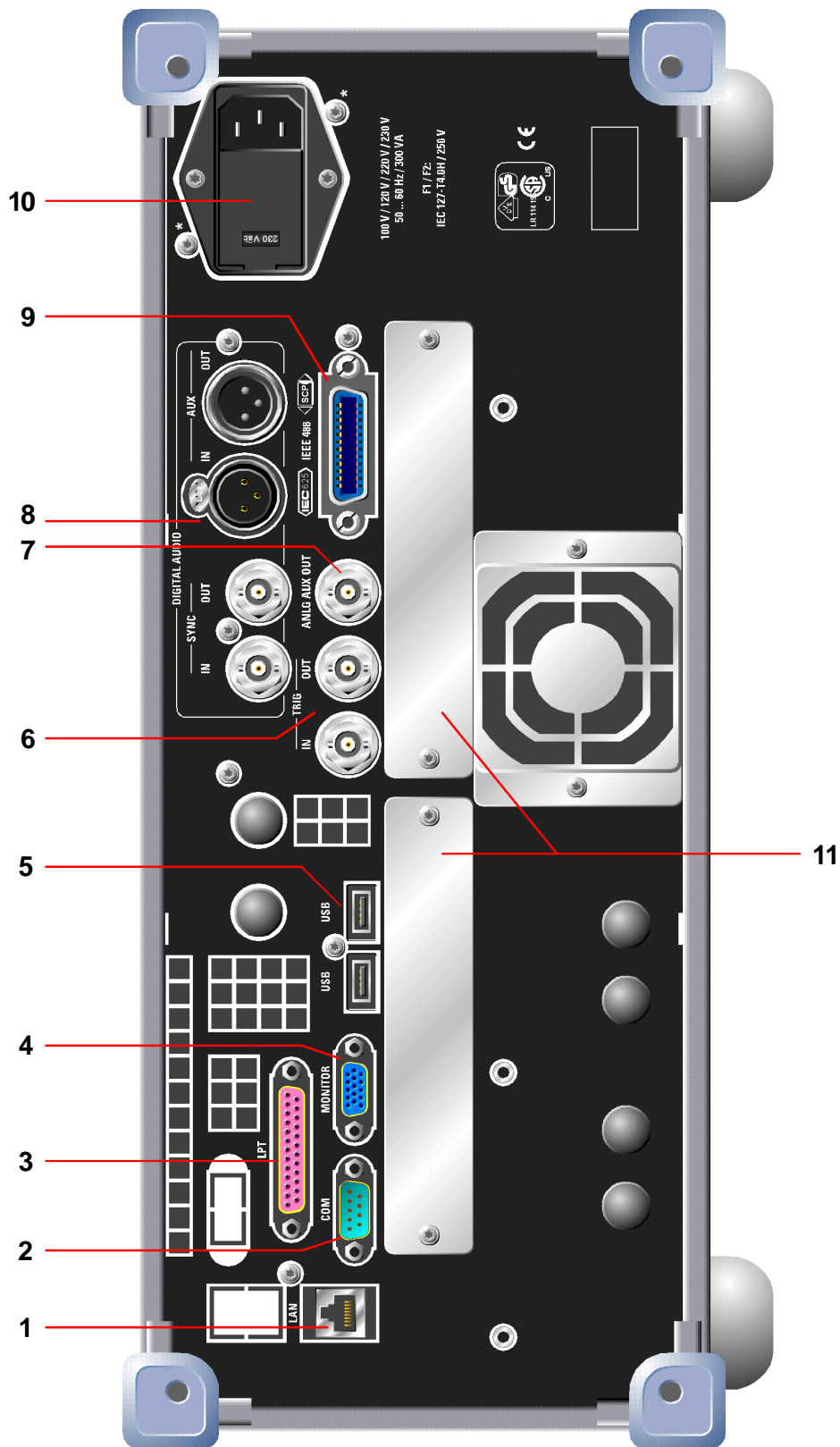


Fig. 1-3 Rear Panel

# Description of the Rear Panel

This section provides an overview of the connectors at the rear of the R&S UPV.

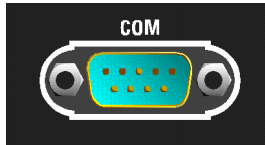
## 1 LAN connector



LAN interface

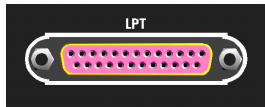
- Integration of the audio analyzer in a network
- Remote operation of the audio analyzer from a remote computer
- Remote control of the audio analyzer
- Loading of firmware updates

## 2 RS-232-C interface



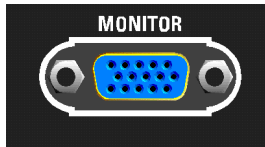
RS-232-C interface, 9-pin D-SUB connector (male)

## 3 Printer interface



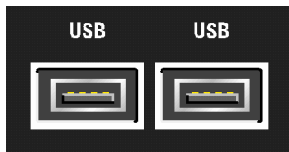
Parallel printer interface, 25-pin D-SUB connector (female)

## 4 Connector for external monitor



Connector for an external monitor,  
15-pin D-SUB connector (female), 3-tier

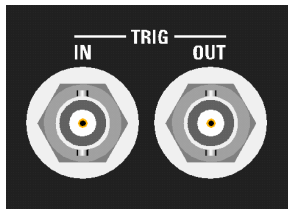
## 5 USB connectors



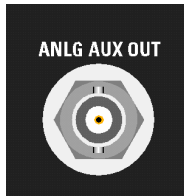
USB (Universal Serial Bus) interfaces of type A (host USB).

- Connection of peripherals such as mouse, keyboard, printer
- Connection of a USB stick for transferring files

There are additional USB interfaces on the front of the instrument.

**6 Trigger connectors**

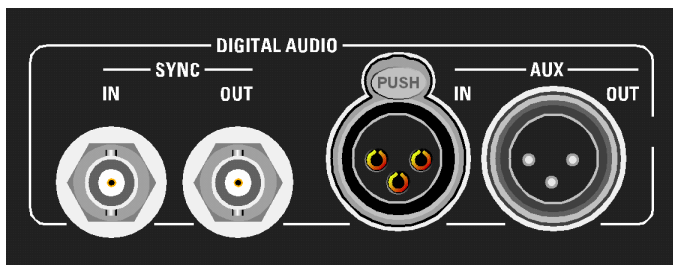
- TRIG IN – Input for triggering measurements
- TRIG OUT – Trigger output and clock output

**7 Analog auxiliary output**

- Additional analog output for special applications
- DC output, e.g. for supplying power to hearing aids
  - Output for the analog generator signal via an integrated amplifier for the direct actuation of small loudspeakers
  - Output for single-channel audio monitoring

**8 Digital synchronization and expansion interfaces**

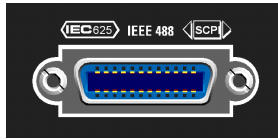
Inputs and outputs for reference and sync signals, and auxiliary interfaces for the R&S UPV-B2 option (digital audio interfaces)



- SYNC IN – Synchronization input for word-clock signals
- SYNC OUT – Output for synchronizing digital peripherals to the word clock or biphas clock of the R&S UPV
- AUX IN – Input for a digital audio reference signal (DARS) or auxiliary input for digital audio signals
- AUX OUT – Output for a digital audio reference signal (DARS) generated by the R&S UPV or auxiliary output for digital audio signals

**Note:**

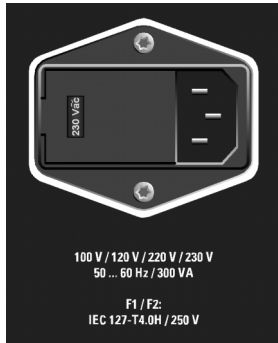
*These interfaces are only available in conjunction with the R&S UPV-B2 option.*

**9 IEC/IEEE-bus connector**

IEC/IEEE-bus connector (IEC 625/IEEE 488) for remote control of the R&S UPV

**Note:**

*Requires the R&S UPV-K4 option (remote control).*

**10 AC supply voltage connector**

AC supply voltage connector with indication of the set nominal AC supply voltage

**Caution!**

*The R&S UPV must be set to the nominal voltage of the AC system used.*

*Before switching on the instrument for the first time, check whether the correct AC supply voltage is set.*

**11 Slots for expansion plug-ins**

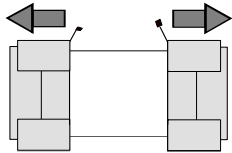
In the rear panel of the R&S UPV, there are two slots into which expansion plug-ins can be inserted (see Chap. 4 and data sheet). For example, an I<sup>2</sup>S interface can be fitted in addition to the optional digital audio interfaces on the front of the instrument.

## Putting into Operation

The following section describes how to put the instrument into operation and to connect peripherals such as printer and monitor. It contains general safety instructions for instrument operation.

Installation of the options is described separately for each option in the respective sections of Chapter 4, "*Instrument Functions*"; software updates are explained in Chapter 8, "*Maintenance and Interfaces*".

### Unpacking the Instrument



Remove protective covers

- Remove the instrument from its packaging and check the equipment for completeness using the delivery note and the accessory lists for the various items.
- Remove the two protective covers from the front and rear of the audio analyzer and check the instrument for any damage.
- If there is damage, immediately contact the carrier who delivered the instrument. In this case, make sure not to discard the box and packing material.
- It is advisable to keep the original packing material in case the audio analyzer is to be transported or shipped at a later date. Keep at least the two protective covers for the front and rear to prevent control elements and connectors from being damaged.

### Setting up the Instrument or Installing It in a 19" Rack

The instrument is designed for indoor use. It can either be set up as a separate unit or mounted in a 19" rack.

A rack adapter (see the data sheet for the order number) is required for installation in a 19" rack. The mounting instructions are supplied with the adapter.

## Safety Instructions

### General Safety Instructions



#### Caution!

*Before putting the instrument into operation, check the following points:*

- *The housing covers must be in place and their screws must have been tightened.*
- *Vents must be unobstructed. Make sure that the air can escape freely through the vents at the rear and at the sides. The minimum distance to the wall should therefore be at least 10 cm.*
- *The voltage level at the inputs must not exceed the permitted limits.*
- *The instrument should only be operated in horizontal position on an even surface.*
- *The ambient temperature must not exceed the range specified in the data sheet.*
- *The instrument complies with measuring category I; the input voltage at the connectors of the analog analyzers should not exceed 110 V (effective, sinusoidal) and 160 V (peak value). The instrument should not be used in measuring categories II, III and IV.*

*Explanation:*

*Measuring circuits as defined in section 6.7.4 of EN61010-1:*

*Measuring category I is intended for measurements on circuits which are not connected to the high-voltage current system.*

- *The outputs of the instrument should not be overloaded and correct polarity must be ensured.*

*Failure to observe the above points may result in damage to the instrument and/or injury to the user.*

### Protection Against Electrostatic Discharge



*To avoid damaging the electronic components of the DUT due to electrostatic discharge caused by contact, the use of appropriate protective measures is recommended.*

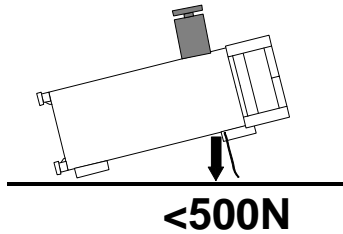


## Setting Up the Instrument



### Warning!

*The instrument feet must be either fully folded in or fully folded out. Only then can a stable position of the instrument and reliable operation be ensured. The uniform pressure on the folded-out feet must not exceed 500 N (weight of instrument and of equipment stacked on top) Stacked instruments must be secured against slipping (e.g. by locking the feet to the top of the front-panel frame).*



*If the instrument is shifted with the feet out, the feet might fold in. To avoid injuries, do not shift the instrument with the feet out.*

## EMC Safety Precautions

To prevent electromagnetic interference, only suitable, shielded signal and control cables should be used.

## Connecting the R&S UPV to the AC Supply

The power supply connector is at the rear of the instrument (see below). The Audio Analyzer R&S UPV can be set up for connection to AC supply systems of **100 V**, **120 V**, **220 V** and **230 V** and can be operated with  $\pm 10\%$  tolerance and an AC supply frequency of 47 Hz to 63 Hz. The instrument is also suitable for operation with power supply systems with the other nominal voltages specified in the table below :

Nominal AC supply voltage	Voltage selector setting	Tolerance of Instrument
110 V	100 V	+4% -18%
	120 V	+20% -6%
115 V	120 V	+15% -10%
127 V	120 V	+4% -18%
240 V	230 V	+10% -14%

## Setting the AC Supply Voltage



Before switching on the instrument for the first time, check whether the correct AC supply voltage is set. If the AC supply voltage is not correct, it must be adjusted in the following way:

- Disconnect the power cable.
- Open the flap covering the voltage selector using a small screwdriver (or similar).
- Remove the cylinder labelled with the nominal voltages and reinsert it so that the value visible through the hole in the cover flap when refitted corresponds to the desired nominal voltage. If the desired voltage is not printed on the cylinder, select the nearest suitable value according to the table above.
- Close the flap.

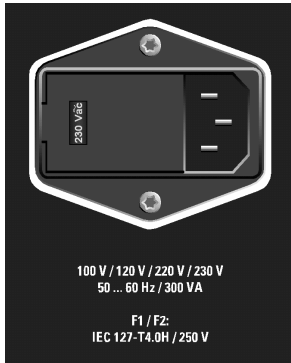
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**Note:**

*The Audio Analyzer R&S UPV is operated with the same fuses for all of the specified nominal AC supply voltages. The precise designation of the fuses is indicated on the rear of the instrument*

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## Switching On



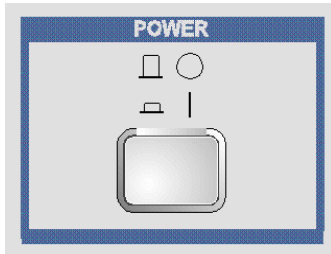
- Connect the audio analyzer to the power supply system using the supplied power cable.

---

**Note:**

*Since the instrument is in compliance with safety class EN61010-1, it should only be connected to a socket with earthing contact.*

---



- Press the power switch on the front of the instrument.

The instrument starts the booting process and all modules are supplied with power.

## Start Screen and Booting of the R&S UPV

After the instrument has been switched on, the installed BIOS version and the processor details are displayed on the screen for a few seconds.

After this, the WindowsXP® Embedded operating system boots first followed by the instrument firmware. During booting of the instrument firmware, a self-test is performed. The most recent instrument settings saved automatically at power-off are then loaded so that the instrument is in the same state as it was before power-off. After booting is completed, the audio analyzer screen appears and the instrument is ready to be operated.


---

**Note:**

*If the software should crash unexpectedly and the instrument is operated via the front panel, it can only be rebooted by pressing the power switch. If the instrument is operated using an external keyboard, it is recommended to attempt a restart by pressing **Ctrl+Alt+Del** (warm start) first.*

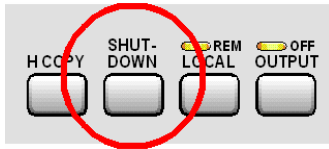
---

## Restarting the R&S UPV

If the R&S UPV firmware was closed without shutting down the operating system (e.g. by clicking the  icon in the title bar), the program can be restarted in two different ways using the mouse:

- Click the "R&S UPV" icon on the desktop
- Click the start button in the task bar, then select the folders "All Programs", "Rohde & Schwarz", "UPV" and click the "R&S UPV" icon.

## Switching Off



- Press the **SHUT-DOWN** key on the front of the instrument.

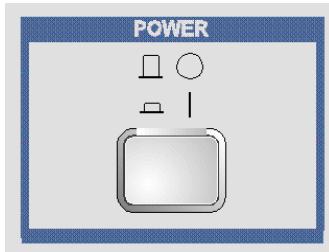
The R&S UPV stores the current settings on the hard disk and then shuts down the operating system.

---

**Note:**

*Alternatively, in the case of operation with the mouse, the operating system can also be shut down in the same way as other Windows applications.*

---



- Press the power switch on the front of the instrument.

The instrument is disconnected from the supply system and the power supply to all modules is interrupted.



**Warning:**

Switching off the instrument without first shutting down the operating system in the proper way could result in the loss of data or cause booting problems the next time the instrument is switched on.

## Function Check

The audio analyzer monitors the most important instrument functions automatically when it is switched on.

## Presets



Pressing the **PRESET** key loads a set of defined instrument settings . The most important parameters set here are:

Generator frequency (analog)	1 kHz
Generator level (analog)	0.1 V
Generator signal	Sinusoidal
Generator frequency (digital)	997 Hz
Generator level (digital)	0.1 FS
Generator signal	Sinusoidal
Analyzer interface (analog)	XLR measuring input (analog)
Analyzer interface (digital)	XLR measuring input (digital)
Analyzer function	RMS
Frequency measurement	ON
FFT monitor function	OFF

The preset function sets all parameters and settings, even those of inactive operating modes.

The presets not included in the list above are specified in the \*RST values for the associated IEC/IEEE-bus commands.

# Windows XP Embedded

**Caution:**

*The drivers and programs used in the instrument under WindowsXP® have been adapted to the audio analyzer. To avoid impairment of instrument functions, only the settings described below are permissible. Existing software must only be modified with update software released by Rohde & Schwarz. Likewise, only programs authorized by Rohde & Schwarz for use on the instrument must be executed.*

The audio analyzer has the WindowsXP® Embedded operating system. When supplied, the configuration of this operating system is optimized to the functions of the audio analyzer. Changes in the system setup are only required when peripherals like keyboard and printer are installed or in the event that the network configuration does not comply with the default settings (see sections below).

When the audio analyzer is switched on, the operating system boots and the instrument firmware is then started automatically without a password query (auto login).

**Note:**

*Auto login is performed with the user name and the password "instrument". The standard user has administrator rights so that printer and network installations are possible.*

The operating system can only be accessed if an external keyboard is connected. Pressing the **Windows** key on the external keyboard (next to the CTRL key) opens the WindowsXP® Start menu where the WindowsXP® programs can be called up. Connecting a mouse makes WindowsXP® easier to use.

The system settings under WindowsXP® are made in the menu **Start - Control Panel** (the required settings can be found in the descriptions of WindowsXP® and the hardware).

The R&S UPV does not have a floppy disk drive. Data is exchanged using a USB stick which is inserted into one of the USB interfaces. The USB stick is automatically assigned a free drive letter and the data can be transferred in Windows Explorer.

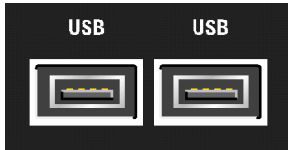
**Power-saving mode:**

A power-saving mode is configured by default for the R&S UPV. The hard disk switches to power-saving mode if it is not accessed for 30 minutes. The computing power for the instrument functions is, however, not reduced. Power-saving mode is deactivated as soon as the hard disk is accessed again.

## Connecting an External Keyboard

A commercially available, external keyboard with USB interface can be connected to the R&S UPV. A keyboard simplifies the input of list entries, comment texts, file names, etc and is required for operating WindowsXP®.

The keyboard is connected to one of the USB interfaces at the front or rear of the instrument.

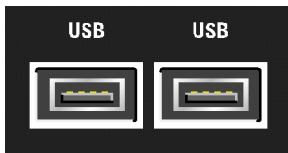


The keyboard is detected automatically when it is connected. The UK keyboard assignment is the default setting. The keyboard language and special settings, e.g. the repeat rate and so on, can be changed in the WindowsXP® menu **Start - Control Panel - Keyboard** or **Regional and Language Options**. The menu is opened by pressing the **Windows** key on the external keyboard .

## Connecting a Mouse

A commercially available mouse with USB interface can be connected to the R&S UPV. The mouse makes it easier to move and resize the panels / graphical windows on the screen and provides alternative operating modes. It is recommended for easy operation of WindowsXP®.

The mouse is connected to one of the USB interfaces on the front or rear of the instrument.



The mouse is detected automatically when it is connected. Special settings, e.g. the speed of the mouse pointer and so on, can be made in the WindowsXP® menu **Start - Control Panel - Mouse**. The menu is opened by pressing the **Windows** key on the external keyboard.

## Connecting an External Monitor

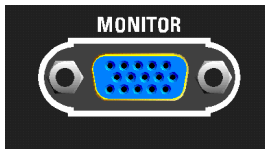


**Caution:**

*Make sure that the instrument is switched off before connecting the monitor. The monitor and the R&S UPV could otherwise be damaged.*

*Do not modify the screen driver (Display type) and the display configuration since this will impair instrument operation.*

An external monitor with an analog interface can be connected to the MONITOR connector at the rear of the R&S UPV.



The connector interface is described in Chapter 8 "[Maintenance and Interfaces](#)".

### Connection

To prevent damage to the monitor and R&S UPV, the instrument must be switched off before an external monitor is connected. After connection, the external monitor is detected when the instrument is started. The screen display with all elements, e.g. panels, measurement displays, WINBAR and so on, then appears both on the external screen and on the instrument. No further settings are required.

## Installing Options

The R&S UPV can be equipped with numerous options. These options can be divided into three basic categories:

Software options	Can be installed by the user himself; a unique activation code supplied with the option is required.
Hardware plug-ins	Inserted into the appropriate slots in the rear of the Audio Analyzer R&S UPV.
Hardware options	Installed in the Audio Analyzer R&S UPV; these options can only be retrofitted by a Rohde & Schwarz Service Center.



## Connecting the R&S UPV to a Network (LAN)

The R&S UPV has a network connector and can be connected to a LAN (Local Area Network).

Network administrators with the appropriate rights can transfer files across the network and use network resources such as the network directories or printers. The instrument can also be remote-controlled and manually operated in the network.

With manual remote operation, the R&S UPV can be operated from an external computer at any remote location. For example, from his desk the user can operate one or more R&S UPVs that are part of a test setup located in another section of the building.

Remote control of the instrument via the LAN interface is described in Chapter 5.

### Connection to the Network



**Caution:**

*We recommend that connection of the instrument to the network be co-ordinated with the network administrator. Connection errors may affect the entire network.*

*Make sure that the instrument is switched off before connecting and disconnecting the network cable. Only then can the network connection be reliably detected and impairments to instrument operation avoided.*

The instrument is connected to the network using a commercially available RJ45 cable connected to the LAN interface at the rear of the instrument.



The connector is described in Chapter 8 "[Maintenance and Interfaces](#)".

## Configuring the R&S UPV for Network Operation

The network interface operates with 100 MHz-Ethernet IEEE 802.3u. The TCP/IP network protocol and the associated network services are preconfigured.

In order to exchange data in a local network (LAN), each connected computer or instrument must have a unique IP address or a unique computer name. In addition, network access of the different users is organized by the assignment of access rights.

The access rights determine which of the available network resources, e.g. file storage systems, are available for the R&S UPV.

### Networks with DHCP

The R&S UPV is preconfigured for networks using DHCP (Dynamic Host Configuration Protocol). In these networks, the R&S UPV is automatically assigned a free IP address. In this case, a unique computer name is used for identification in the network.

Each R&S UPV is given a unique computer name at the factory. This name can be queried and changed in the WindowsXP® menu **Start - My Computer** (see "[Querying the Computer Name](#)" below).

### Networks with fixed IP addresses

In networks using fixed IP addresses, usually the network operator organizes the addresses. The IP address has to be entered in the Windows menu **Start - Control Panel** (see "[Entering the IP Address](#)").

### Point-to-point connections

To set up a simple network (a LAN connection between an R&S UPV and a computer without integration in a large network), an IP address must be assigned to the R&S UPV and the computer. The IP addresses 192.168.xxx.yyy are available, whereby both xxx and yyy can have the values 1 to 254; the value for the subnet mask is 255.255.255.0.

In this case, a commercially available cross-over RJ45 cable must be used for the connection.

### User ID

The user "**instrument**" is set for the R&S UPV. The user is used for the auto login when the instrument is started and for manual remote operation. The password is also "**instrument**". By assigning the respective rights, the network administrator decides which directories and resources in the network can be accessed by the R&S UPV.

## Preparations

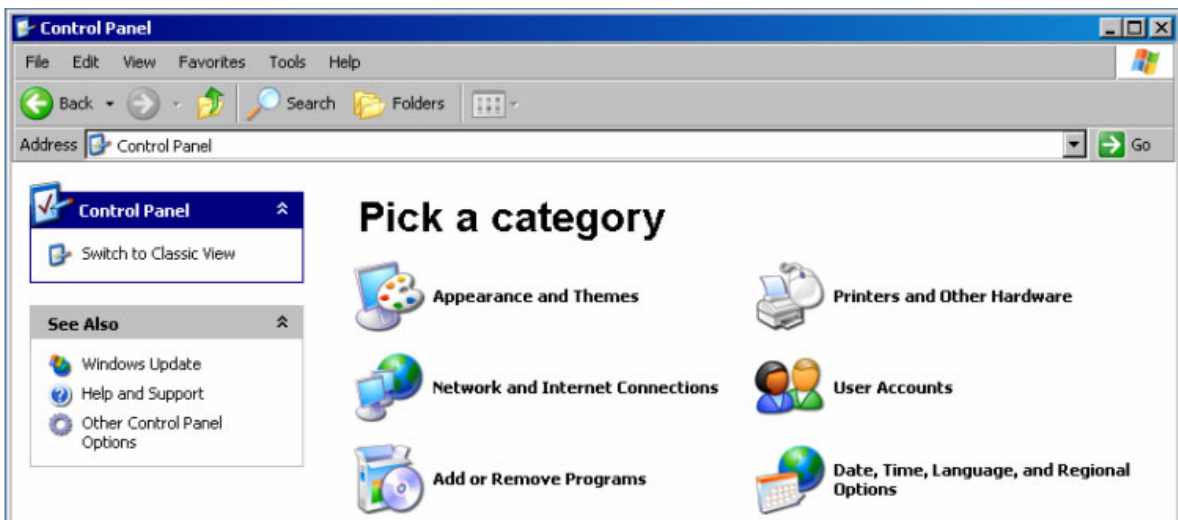
The instrument is configured for network operation in the menus of the WindowsXP® Embedded operating system. The operating system can only be accessed if an external keyboard is connected; connection of a mouse is recommended for easy operation. The instrument should be switched off before the keyboard and mouse are connected. This will ensure that the keyboard and mouse are correctly detected by the operating system.

## Entering the IP Address

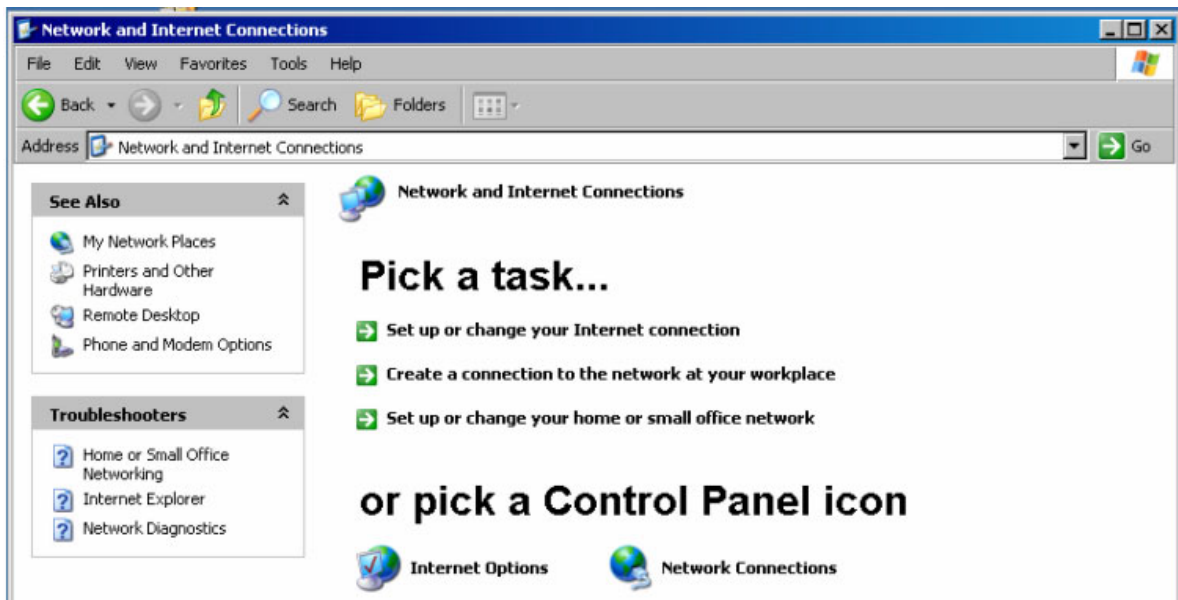
1. Call up the Start menu using the **Windows** key on the external keyboard (next to the Ctrl key).



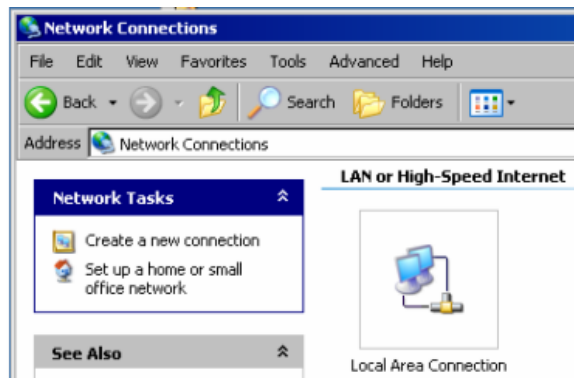
2. Click **Control Panel**



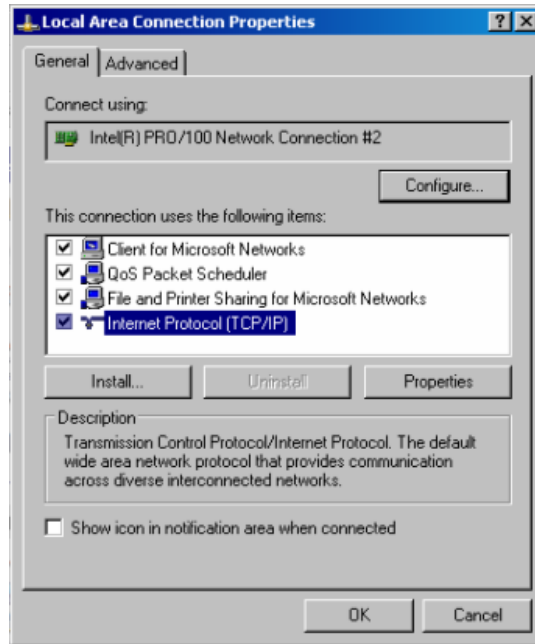
3. Click **Network and Internet Connections** and then click **Network Connections** bottom right in this menu.



4. In the **Network Connections** menu, right-click **Local Area Connection** and then click the **Properties** button.

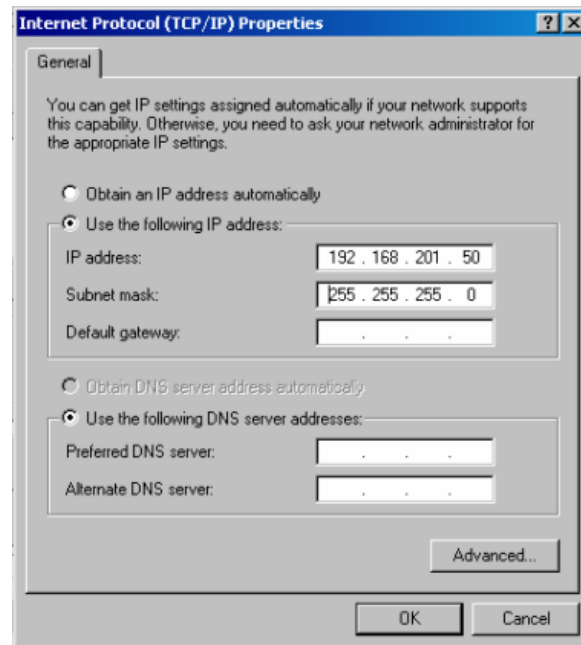


- On the **General** tab, select **Internet Protocol (TCP/IP)** in the field **This connection uses the following items:** and then click the **Properties** button.



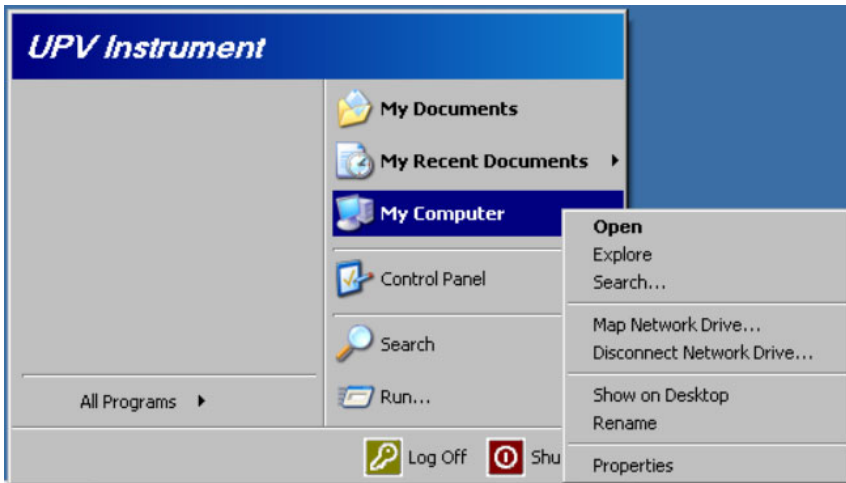
- In the **Internet Protocol (TCP/IP) Properties** menu, enter the IP address in the **Use the following IP address:** field (all data can be accessed by the network administrator). Terminate the entry in all menus with OK.

**Obtain an IP address automatically** (DHCP = Dynamic Host Configuration Protocol) is the default setting.



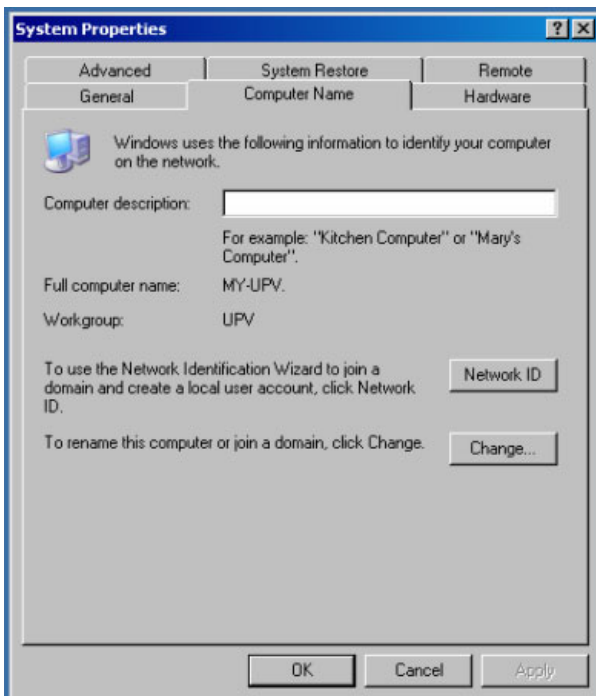
## Querying the Computer Name

1. Call up the Start menu using the **Windows** key on the external keyboard (next to the Ctrl key). Highlight **My Computer** and right-click to call up a context menu.



2. Click **Properties** and select the **Computer Name** tab in the menu.

The computer name is displayed under **Full Computer Name**:. The name can be changed in the **Change** submenu.



## Accessing Directories in the Network

Access to network drives depends on access rights and whether the drives in question have been enabled. The complete integration of the R&S UPV in a large network with the necessary assignment of rights is highly complex and normally performed by a network administrator.

Accessing the hard disk of a computer connected to the network from the R&S UPV is, however, relatively easy. The directory which the R&S UPV is to access simply has to be enabled on the remote computer. This directory is then accessed from the R&S UPV using a WindowsXP® search function.

This procedure is also of importance for a point-to-point connection, for instance in order to start a firmware update for which the files have been stored on the hard disk of the remote computer.

---

**Note:**

*Both the computer and the audio analyzer must have a computer name and an IP address (see the section "[Configuring the R&S UPV for Network Operation](#)")*

---

### Enabling the desired directory on the remote computer

---

**Note:**

*The menu name may deviate from the name specified in the operating sequence, depending on the language and on the operating system used on the computer.*

---

1. On the computer, select the directory to be enabled in Windows Explorer and right-click to call up the **Properties** menu.
2. In the **Sharing** panel, activate the **Share this folder** tick box.
3. Write down the name of the computer (see the section "[Querying the Computer Name](#)").

### Accessing the enabled directory from the R&S UPV

1. Press the **Windows** key to call up the Start menu.
2. In the **Search** menu, select **Computers or People** and then **A Computer on the Network**.
3. Enter the name of the computer under **Which Computer you are looking for?** and start the search by pressing Enter.  
The name of the computer is given as the search result.
4. Click the computer name. The enabled directory is displayed and the files stored there can be used in the R&S UPV.

---

**Note:**

*If a user name and password are requested when you click the computer, the login name and password used on the computer must be entered.*

---

## Configuration for Manual Remote Operation

The R&S UPV can be operated manually from an external computer via a network connection. The Windows program **Remote Desktop Connection** is used for operation. Manual remote operation is described in Chapter 3 in the section ["Manual Remote Operation"](#).

Manual remote operation of the audio analyzer is only possible if

- the Windows 95 operating system or higher and the **Remote Desktop Connection** program are installed on the external computer and a LAN interface is configured for the network
- the audio analyzer and the computer are connected via the LAN (see ["Configuring the R&S UPV for Network Operation"](#))
- the **Remote Desktop Connection** program is activated on the audio analyzer (see ["Activating the Remote Desktop Connection program at the R&S UPV"](#))
- the R&S UPV data has been entered in the **Remote Desktop Connection** program on the external computer (IP address or computer name of the R&S UPV in the network (see ["Querying the Computer Name"](#)))
- the user has logged on at the R&S UPV from the external computer by entering the correct user name (instrument) and the correct password (instrument) (see ["Starting manual remote operation at the external computer"](#))

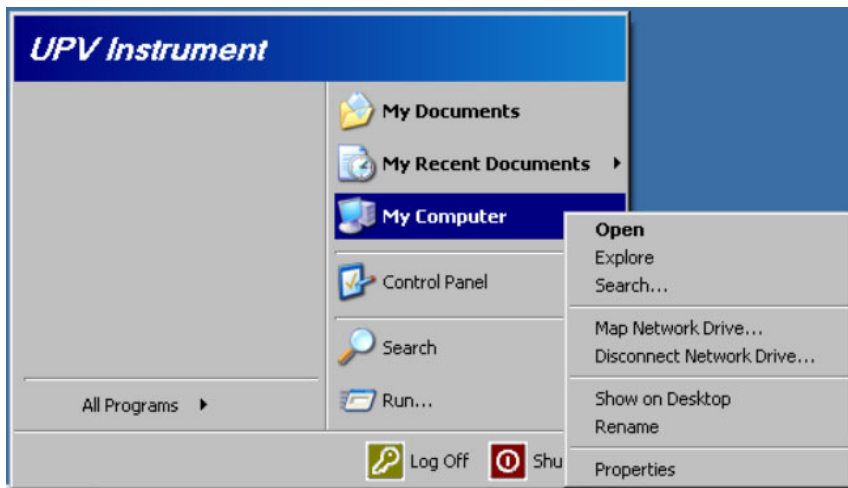


## Activating the Remote Desktop Connection program at the R&S UPV

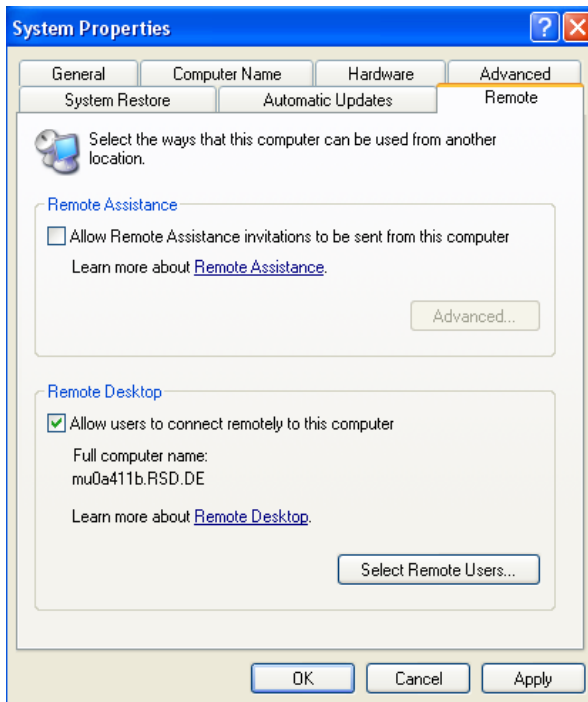
**Caution:**

After activation of the remote desktop, any user on the network who knows the computer name and login data of the audio analyzer can access this R&S UPV.

1. Call up the Start menu using the **Windows** key on the external keyboard (next to the Ctrl key). Highlight **My Computer** and right-click to call up a context menu.



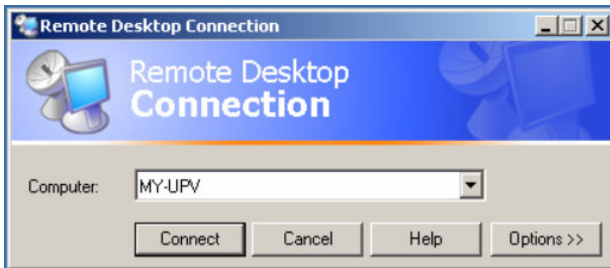
2. Click **Properties** and select the **Remote** tab in the menu.
3. Activate the **Allow users to connect remotely to this computer** tick box.



## Starting manual remote operation at the external computer

The **Remote Desktop Connection** program is already installed in the WindowsXP® operating system. For all other Windows operating systems from Windows95™ and higher, the program can be downloaded free-of-charge from the Internet (<http://www.microsoft.com>). It can be loaded onto any external computer by following the instructions also provided on the Internet.

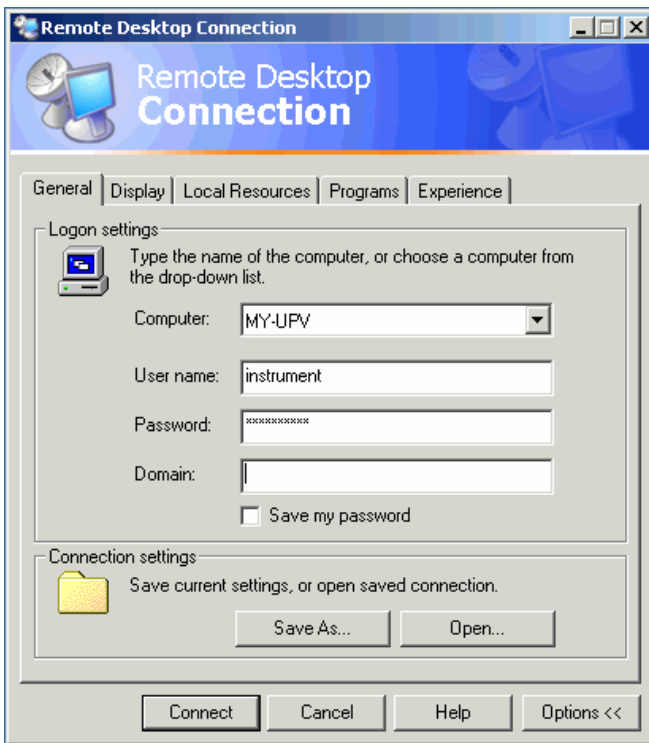
1. If necessary, install the **Remote Desktop Connection** program on the external computer.
2. Start the program in the Windows menu **Start - All Programs - Accessories - Communications**.




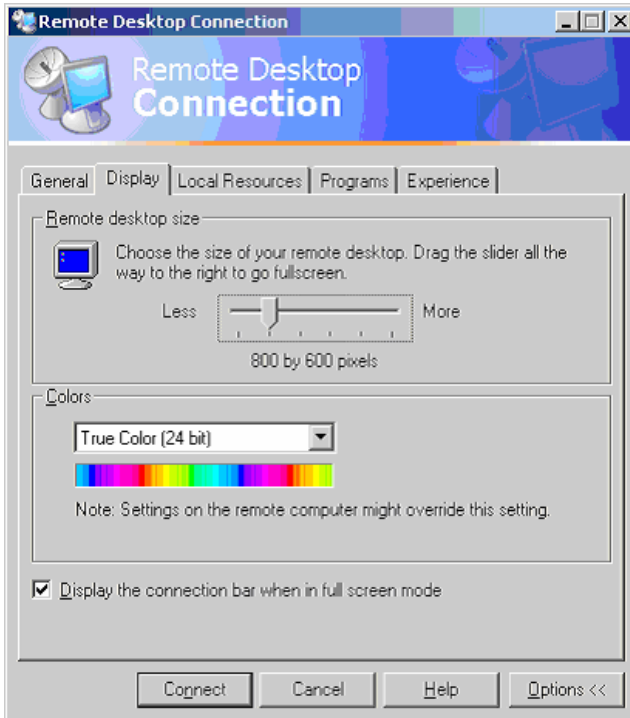
Before the program can be used for the first time, the instrument and user ID of the R&S UPV must be entered on the external computer. The instrument ID (i.e. the computer name of the R&S UPV) identifies the R&S UPV in the network. Every R&S UPV is supplied together with a computer name which can be used for manual remote operation. Querying the computer name is described in the section "[Querying the Computer Name](#)".

The user ID is necessary as it authorizes access to the R&S UPV. It is preset on the R&S UPV and is **instrument** for both the user name and the password. No entry is needed in the **Domain** field.

3. Enter the instrument and user ID on the **General** tab of the extended **Remote Desktop Connection** menu (called up by pressing the **Options>>** button).



4. The login data can be stored with the **Save As** button.  
If it is stored as the file **default.rdp**, the connection to the R&S UPV is offered by default when the program is started. If it is stored under a different name, the setting for the connection to the R&S UPV is offered in the selection list which is displayed by pressing the  button in the **Computer:** field.
5. Set the display resolution of the R&S UPV screen to 800 x 600 on the **Display** tab.



6. Set up the connection by pressing the **Connect** button.

When the connection has been set up, the audio analyzer screen appears on the external computer. Operation is possible with the mouse and/or the keyboard. Keys on the front panel which do not have a direct equivalent on the keyboard can be replaced by key combinations, (see the table in Chapter 3 in the section "[Operation Using an External PC Keyboard](#)").

If several R&S UPVs are to be manually operated from one computer by means of manual remote control, a separate **Remote Desktop Control** window must be opened for each R&S UPV. This is

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## 2 Getting Started

### Introduction - Getting Started

The Audio Analyzer R&S UPV is able to perform virtually all measurements occurring in the audio world, from frequency response measurements through distortion factor and spectral displays to the analysis of digital data streams. Several measurement functions can be carried out and displayed at the same time, whereby in the audio frequency range the measurements are performed as real two-channel functions.

The R&S UPV performs all measurements using digital signal processing. Here, analog signals to be measured are first subjected to complex preprocessing on analog measurement modules before they are digitalized and fed to the digital measurement routines.

This concept offers numerous advantages, for example:

- The measurement methods at the analog and digital interfaces are identical.
- The measurement functions are available at both the analog and the digital interfaces.
- Operation at the analog and digital interfaces is the same.

The many available options mean that the Audio Analyzer R&S UPV can be adapted to perform a wide variety of different tasks. The basic version of the instrument has analog audio interfaces. A number of other measurement functions are also available, but only after the appropriate options have been installed (see the data sheet for details).

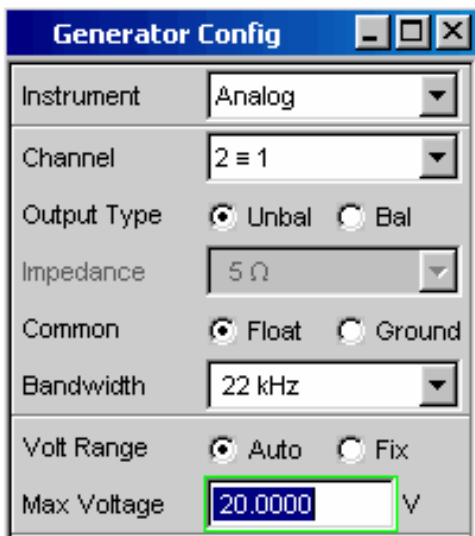
This chapter, "Getting Started", only describes the functions available in the basic version of the Audio Analyzer R&S UPV.

## Important Information for Measurements

### Maximum Output Voltage of the R&S UPV Generator



The generator of the Audio Analyzer R&S UPV can generate analog output voltages with an RMS of up to 20 V. These levels can damage or even destroy sensitive input circuits.



In the **Generator Config** panel, it is possible to limit the analog output voltage. For measurements on sensitive circuits, it is advisable to set an appropriately low value in the **Max Voltage** field; this value then applies to all analog output signals, irrespective of the signal shape. The maximum voltage is not exceeded even in the case of changes made using the rotary knob.

The section ["Function Selection and Value Entry"](#) from page 2.9 onwards and Chapter 3 ["Manual Operation"](#) explain how to set these values and change values using the rotary knob.



The pulse level of the digital audio signals can be up to 8 V. Although the risk of destruction is generally much smaller than for analog circuits, care must still be taken when making settings for digital circuit energization.

### Rapid Deactivation of the Outputs



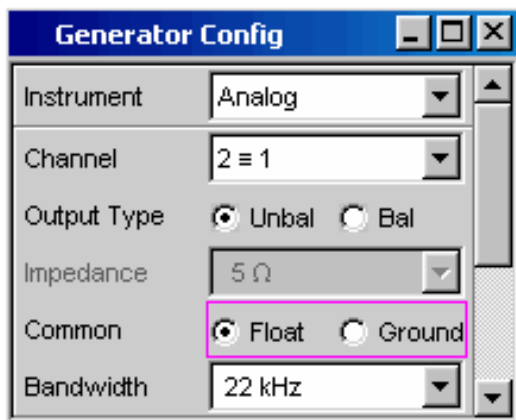
In the event of faults, all outputs of the R&S UPV can be deactivated by pressing the **Output OFF** key. The key affects all audio outputs, i.e. for both analog and digital audio signals.

The deactivated lines can only be reactivated by pressing the **OUTPUT OFF** key again.

The status of the key is indicated by an LED. Illumination of the LED means **OUTPUT OFF**.

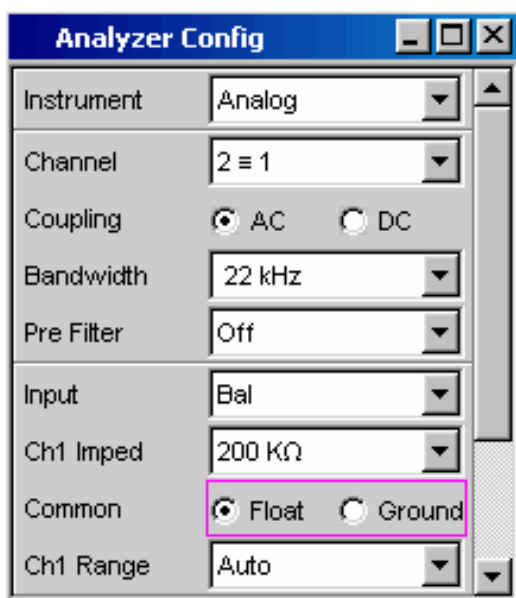
More detailed information on this key can be found in Chapter 3 in the section ["Rapid Deactivation of the Outputs"](#).

## Avoiding Hum Loops



It is generally known in audio engineering that analog circuits must always be set up in such a way that hum signal pick-up is avoided. For this reason, it is important that a ground connection (grounding contact) be provided at only one point in the entire circuit.

Both the generator and the analyzer are configured as floating devices in order to prevent an additional, inadvertent ground connection via the Audio Analyzer R&S UPV. The two **Common** fields of the **Generator Config** and **Analyzer Config** panels are factory-set to **Float**.



There are, however, some applications where the audio circuit to be tested is set up without any ground connection at all. It may be necessary to create a defined ground connection especially if hum pick-up is suspected. This can be done at the Audio Analyzer R&S UPV by switching the **Common** field to **Ground** for either the generator or the analyzer (depending on the application).

More detailed information on how to make these settings can be found in this chapter in the section ["Function Selection and Value Entry"](#) from page 2.9 onwards and in Chapter 3 ["Manual Operation"](#).

## Help System



The Audio Analyzer R&S UPV has a context-sensitive help system. If you have a question while operating the instrument, pressing the **HELP** key opens a help page containing information on the currently highlighted parameter field. From here it is possible to move to other help pages using the contents list, the index, scroll arrows and page-internal links.

The help texts are available in English and German.

More detailed information on this key can be found in Chapter 3 in the section ["Help System"](#).

# Brief Introduction to the R&S UPV Operating Concept

## Windows® User Interface and Control Elements

To provide the user with a familiar environment, operation is largely based on the Windows® user interfaces. All panels, entry windows, etc are made up of known elements.

Operation follows the same basic rules which apply to other Windows® programs in use today. It is assumed that the user is familiar with these basic rules. This information is therefore not given in detail in this manual.

The R&S UPV can be fully operated via the front panel. Additional peripherals such as a mouse and keyboard can be connected but are not essential requirements.

After being switched on, the instrument is in the same state as it was before it was switched off. This applies to all setting parameters of the R&S UPV, including those not currently displayed on the screen.

The instrument is operated using function keys with permanently assigned functions, softkeys with functions which vary according to the application, the rotary knob with integrated entry function, and the display screen via which the panels are operated.

Operation using an external keyboard and mouse is also possible; this is explained in Chapter 3 "Manual Operation".


Selection frames or the highlighting of an entry field (dark background) indicate the current entry focus. Entries can be made in the element with entry focus.

## Display

The display is the central element for operating the R&S UPV. Both the instrument settings in the various panels, and the measurement results are displayed here.

To make the various functions of the Audio Analyzer R&S UPV easier to operate, they are organized in a series of panels. The measurement results can be displayed as digital numeric values, data lists, in analog bargraphs or in result graphics. The user can freely choose the number of panels and the number of graphical windows to be shown in the display. The size of the windows can be changed within wide limits, whereby the font size, scaling and so on are adapted automatically (depending on the selected window). Panels and display windows can be activated by pressing the **WINBAR** key.

5 display windows (or "screens") are provided so that the wealth of information can be better organized.

The direction keys  are used to toggle between the individual screens.



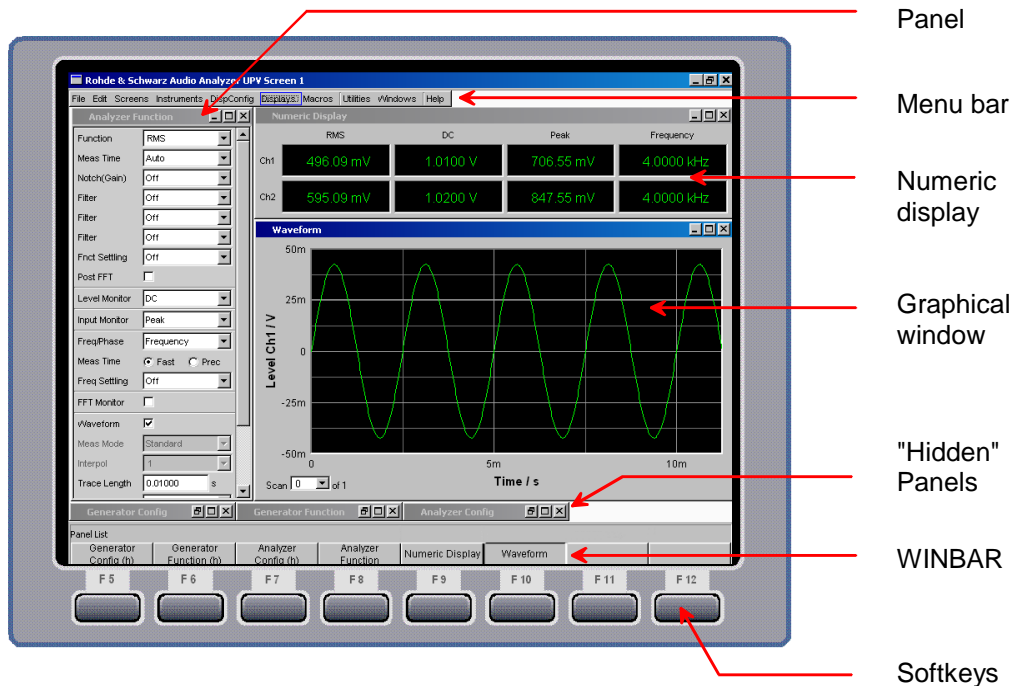
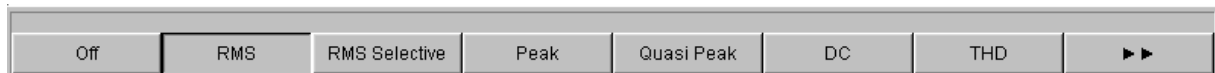


Fig. 2-1 R&S UPV display with main elements

One of the two bars (either the softkey bar or the WINBAR) is always displayed at the bottom of the screen.

In normal operating mode, the softkey bar is visible; it contains eight buttons which are assigned the functions available in the selection windows of the panels. The softkeys underneath the buttons are labelled with their assigned function; pressing the respective softkey permits rapid selection.

If there are more than 8 elements to choose from, the hidden elements in the selection list can be displayed by pressing the last softkey containing the ►► symbol or the first softkey containing the ◀◀ symbol.



When the **WINBAR** key is pressed, the WINBAR appears in place of the softkey bar; this is indicated by "Panel List" in the left-hand corner:



The labelled buttons show the names of all panels and graphical windows open in the current screen. Pressing the associated softkey puts the focus on the corresponding panel / graphical window, i.e. it becomes active. At the same time, the system returns to normal operating mode (i.e. the softkey bar). Hidden panels (see *"Panels and Display Windows"*) are also listed in the WINBAR. If a hidden panel is selected, it is redisplayed on the screen with its previously set size and position; it simultaneously receives the focus.

## Panels and Display Windows

The Audio Analyzer R&S UPV distinguishes between the following panels and display windows:

- **panels** used to make function settings
- **configuration panels** used for configuring how the measurement values are to be displayed
- **numeric display fields** for displaying the measurement values of the various measurement functions
- **combi displays** in which numeric measurement values can be supplemented by bargraphs and limit monitoring
- **graphical windows** in which measurement values are displayed in the form of diagrams
- **data lists** in which the measurement values are listed in tabular form

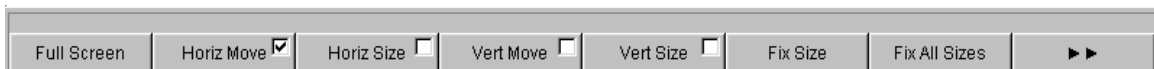
Panels are opened on the currently displayed screen by activating the menu bar using the **[MENU]** key, highlighting the **Instruments** or **DispConfig** button with the rotary knob or cursor keys, opening the pulldown menu with the Enter key or rotary-knob click, and then highlighting the desired panel and selecting it with a rotary-knob click.

Display windows are selected in the same way, except that they are listed under the **Displays** button.

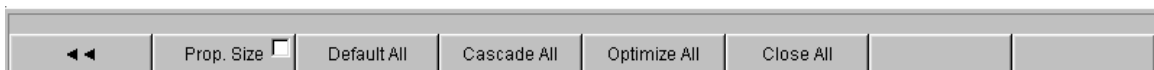
Each panel and display window is a separate window which can be either closed, opened or hidden. Panels / display windows are open if they are displayed on the currently visible screen. If the window is minimized and moved to the bottom of the screen, it is referred to as being "hidden". In both cases, the panel / window is assigned an entry in the WINBAR at the bottom of the display. Only one window on the screen can be activated at any one time using the softkeys on the WINBAR (active windows are identified by their blue title bar).

As soon as a panel / display window is active, it can be moved around on the screen. This is done in the following way:

- Press the **[MODIFY]** key; the following softkeys then appear on the WINBAR:



Additional hidden functions can be shown by actuating the **▶▶** button:



- After selecting the desired direction of movement using the appropriate softkey, the panel can be moved / resized using the rotary knob.

The same panel / display window can be displayed in several screens at the same time. The display characteristics can be different for each of the screens; the content is, however, always the same.

## Structure of the Panels and Display Windows

The table below shows the panels of the Audio Analyzer R&S UPV as well as the main settings that can be made in these panels (a detailed list of all panels together with the most important setting parameters can be found at the end of Chapter 3 "[Manual Operation](#)"):

Panels which can be selected via the **Instruments** menu bar button:

<b>Generator Config</b>	<ul style="list-style-type: none"> <li>• Selection of instrument (analog or digital interfaces)</li> <li>• Configuration of channels and bandwidths</li> <li>• Reference values</li> </ul>
<b>Generator Function</b>	<ul style="list-style-type: none"> <li>• Selection of test signals</li> <li>• Sweep function</li> <li>• Frequency and level settings</li> <li>• Filter and equalizer</li> </ul>
<b>Analyzer Config</b>	<ul style="list-style-type: none"> <li>• Selection of instrument (analog or digital interfaces)</li> <li>• Configuration of channels and measurement bandwidth</li> <li>• Start and trigger conditions</li> </ul>
<b>Analyzer Function</b>	<ul style="list-style-type: none"> <li>• Selection of measurement functions</li> <li>• Measurement speed and accuracy</li> <li>• Activation of filter and equalizer</li> <li>• Activation of Post-FFT</li> <li>• Selection and settings for level monitor</li> <li>• Selection and settings for input monitor</li> <li>• Selection and settings for frequency, phase, group delay measurement</li> <li>• Selection and settings for FFT monitor</li> <li>• Selection and settings for waveform monitor</li> </ul>
<b>Filter</b>	<ul style="list-style-type: none"> <li>• Definition of filter properties</li> </ul>
<b>Auxiliaries</b>	<ul style="list-style-type: none"> <li>• Settings for integrated loudspeaker and connected headphones</li> <li>• Settings for auxiliary analog output</li> <li>• Settings for trigger input and trigger output</li> </ul>

Panels which can be selected via the **DispConfig** menu bar button:

<b>Function Config</b> <b>Level Monitor Config</b> <b>Input Config</b> <b>Freq Phase Config</b>	These four panels contain settings for displaying measurement values <ul style="list-style-type: none"> <li>• in the numeric display fields</li> <li>• in the associated combi displays</li> <li>• and settings for limits, minimum values and maximum values</li> </ul>
<b>Sweep Graph Config</b> <b>FFT-Monitor Config</b> <b>FFT Graph Config</b> <b>Waveform Config</b> <b>Bargraph Config</b>	Up to four of each of these panels are available; they contain settings for displaying measurement values in the graphical windows, e.g. <ul style="list-style-type: none"> <li>• one or two-channel display</li> <li>• units, scaling, gridlines, etc</li> <li>• evaluation of minimum values and maximum values</li> <li>• entry of limit curves</li> <li>• settings for cursors and markers</li> </ul>

The measurement results of the Audio Analyzer R&S UPV are shown in the following display windows (a detailed list of all panels together with the most important setting parameters can be found at the end of Chapter 3 "[Manual Operation](#)"):

<b>Numeric Display</b>	<ul style="list-style-type: none"> <li>• Display of measurement results for measurement function selected in <b>Analyzer Function</b> panel</li> <li>• Display of measurement results for level monitor and/or input monitor selected in <b>Analyzer Function</b> panel</li> <li>• Frequency measurement results, or frequency measurement result and phase / group delay measurement result</li> </ul>
<b>Funct Ch1...2</b> <b>Lev Mon Ch1...2</b> <b>Input Ch1...2</b> <b>Freq Ch1</b> <b>Freq / Phase</b>	These combi displays are extensions to the numeric measurement displays; they show the respective numeric value plus the following additional features: <ul style="list-style-type: none"> <li>• Analog bargraphs</li> <li>• Limits</li> <li>• Minimum and maximum values</li> </ul>
<b>Sweep Graph 1...4</b> <b>FFT-Monitor</b> <b>FFT Graph 1...2</b> <b>Waveform</b> <b>Bargraph 1...2</b>	<ul style="list-style-type: none"> <li>• Up to four of each of these display windows can be opened (depending on the window type) in order to display the scans of the different measurements</li> <li>• Graphical display shows one or two channels</li> <li>• The measurement results are displayed in the way defined in the associated configuration panel</li> </ul>

## Basic Rules of Operation

The following basic rules are intended to simplify operation of the Audio Analyzer R&S UPV:

- **Operating sequence in the panels: top to bottom**  
Changes to parameters of individual menu items may affect the selection or value range of menu items which are usually located further down (they affect the selection or value range in fields located higher up in only a few exceptional cases).
- **Sequence: generator – analyzer – measurement value display**  
Many setting parameters can be used in other panels. For example, the sweep frequency settings can automatically be adopted as the scaling for the graph.

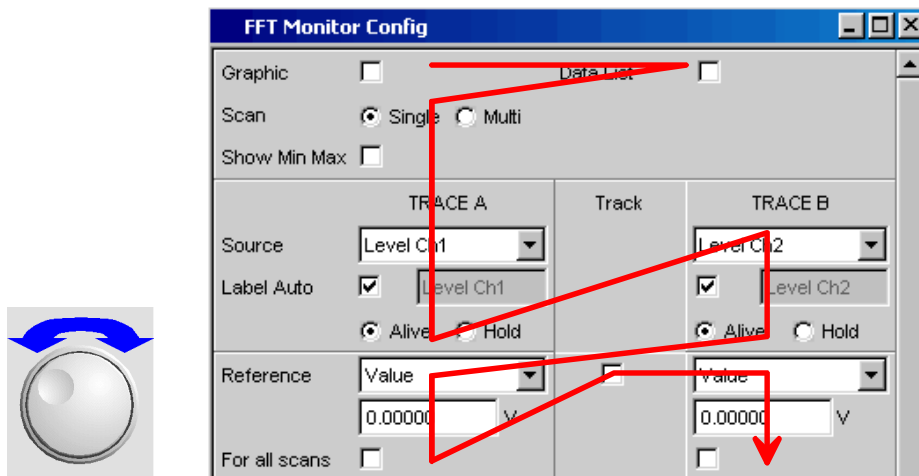
Observing this sequence saves the user having to enter parameters twice.

## Function Selection and Value Entry

All functions and parameters are set in the panels.



The rotary wheel is used for navigating inside the panels. Turning the rotary knob clockwise moves the cursor down or to the right. Here the cursor first moves to the right inside a field, then down through the current group, then jumps over to the right-hand column, down again to the end of the group from where the cursor then moves to the left-hand column of the following group, and so on.

Alternatively, the cursor keys  and  can also be used for navigation.



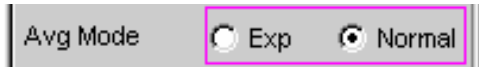
Panels can only be operated if they have the focus (indicated by the blue title bar).

The simplest way of changing from one panel to another in the case of operation via the front panel is

using the direction keys . The  key switches from panel to panel in the sequence in which the panels were opened. Changing to a different open (or to a hidden) panel is also possible using the WINBAR (see the section "Display" on page 2.4).

Before settings can be made in a panel, the relevant parameter field must be highlighted, i.e. it must have the focus. This is indicated by a selection frame around the entry field.

The settings are made in the following ways:



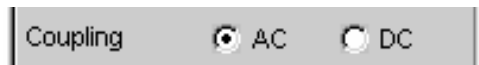
**Highlighting control elements**

A control element is activated by shifting the focus to this element using the rotary knob. The entry focus is indicated by a blue, green or magenta border.



**Activating/deactivating functions**

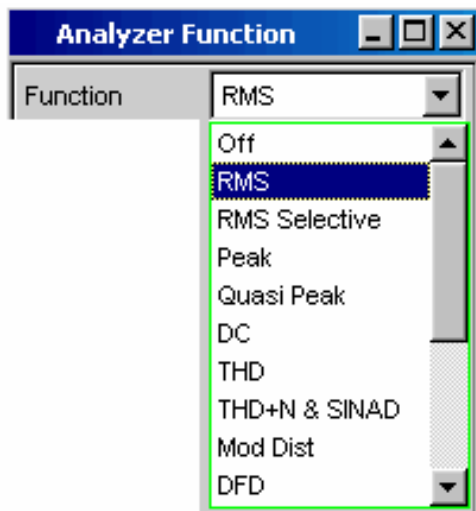
A tick box is used to activate or deactivate functions. If the tick box is activated (checkmark), the assigned setting is selected / enabled.




**Toggling functions**

Radio buttons are used for functions which can be toggled between two settings. A black dot in the appropriate button indicates the selected status.

Only one of the two options can be active at any one time.



**Selecting a parameter**

Actuating the  button opens a selection field. As soon as this parameter field has the focus, a list for selecting the available parameters can be opened with a rotary-knob click. The fold-down parameter list is displayed below the selection field.

Parameters are selected by highlighting the desired item and confirming with the **ENTER** key or rotary-knob click.

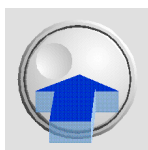
Items in the parameter list are highlighted using the rotary

knob, the cursor keys   or the keys .

The parameter list can be quit without adopting the highlighted parameter by pressing the **ESC** key.

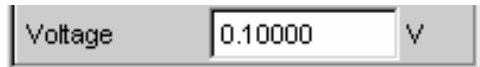
If the list is longer than the displayed window, a scroll bar is available.

Alternatively, parameters can also be selected using the softkeys.

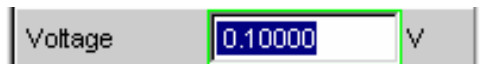


**Note:**

*The contents of the parameter lists are not fixed but vary depending on other settings selected.*



**Numeric value entries**

Numeric values can be entered or edited in these fields. The following applies: Entries outside the possible value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value. The possible value range is displayed above the softkey bar.

**Value entries in Edit mode**

When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame.

To enter the new value, simply begin entering digits using the numeric keypad on the front panel; the old value is deleted automatically when the first key is pressed. The digit to the left of the cursor can be deleted at any time during entry using the **UNDO** key.

If certain digits only are to be changed, position the digit cursor accordingly using the  or  cursor key and enter the new digits.

The numeric entry field is closed with:

**ENTER** The newly entered value is adopted.

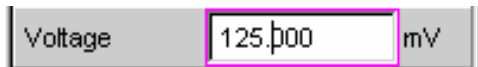
**ESC** The old value is retained.

**Softkeys** The selected unit is set and adopted together with the newly entered value.

The entered value is set in the hardware as soon as the numeric entry field is closed.



**Value entries in Direct mode**



When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame.



Changing to Direct mode is performed by pressing the **ENTER** key or with rotary-knob click; the color of the selection frame then changes to magenta.

The digit cursor then moves to the first digit to the right of the decimal point or, if there is no decimal point, to the digit at the extreme right.



A digit can now be entered using the keypad on the front panel; the digit at the cursor position is replaced. The cursor does not change its position.

The digit cursor can be placed at a different position at any time using the and cursor keys. Digits are then entered at the new position.

In Direct mode, every setting change is immediately passed on to the hardware and executed.

Direct mode can be quit using the **ENTER** function or the **ESC** key.

**Rotary-knob entries in Direct mode**

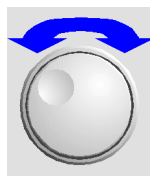


When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame.



Changing to Direct mode is performed by pressing the **ENTER** key or with rotary-knob click; the color of the selection frame then changes to magenta.

The digit cursor then moves to the first digit to the right of the decimal point or, if there is no decimal point, to the digit at the extreme right.



The highlighted digit can then be changed directly using the rotary knob, whereby the numeric value is "carried over", i.e. transferred to the next digit.

The digit cursor can be placed at a different position at any time using the and cursor keys so that other digits can be changed using the rotary knob.

This method is ideal for adjustment work as every change has an immediate effect in the hardware.

Value entry can be completed with a rotary-knob click, the **ENTER** key or the **ESC** key.



As an alternative to the rotary knob, the numeric values can also be changed using the and cursor keys.



V

### Entering / changing the unit of a value

The unit of a numeric value is displayed next to the entry field. When the value is entered, all units available for the respective function are offered on the softkey bar (on more than one level where necessary). The entry can be completed by selecting the unit using a softkey.

This is done differently depending on the selected mode:

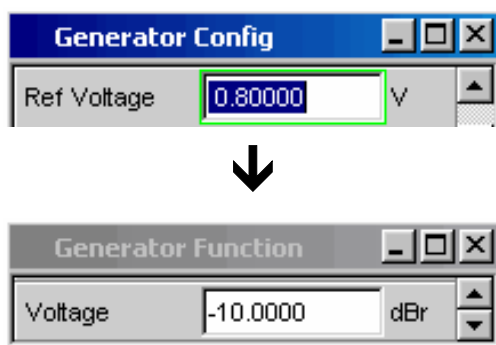
- In Edit mode, the newly entered numeric value is adopted and set together with the selected unit.
- In Direct mode, the physical value (number with the previously selected unit) is converted to the newly selected unit and adopted as the new numeric value.

### Information on using reference values

The Audio Analyzer R&S UPV allows reference values to be used when entering various values. These reference values are used as a basis for settings for other parameters.



The example below explains these interdependencies:

A reference voltage (Ref Voltage) can be set in the **Generator Config** panel. The actual output voltage is set in the **Generator Function** panel where the unit is dBr, i.e. it is possible to enter the output voltage in dB relative to this reference value.





### Alphanumeric entries

When the focus is moved to a text entry field, the system enters Edit mode, which is indicated by a green selection frame.

If the complete text (e.g. for graph labels) is to be newly entered, simply begin entering characters using the keypad on the front panel; the old text is deleted automatically when the first key is pressed. The keypad on the front panel of the R&S UPV is automatically switched to the mode for entering alphanumeric characters. Text is entered in the same way as on mobile phones: The characters assigned to a key are called up in sequence by repeatedly pressing the key. A different key can be pressed immediately to enter the next character; a brief pause must, however, be made when entering characters assigned to the same key. The space character is assigned to the  key, special characters are entered using the decimal-point key and the  key is used to toggle between upper and lower-case characters.



The character to the left of the cursor can be deleted at any time during entry using the **UNDO** key.

If certain characters only are to be changed, position the cursor accordingly using the  or  cursor key and enter the new characters (if the position of the cursor is changed before the first character is entered, the old text will not be deleted).

The text entry field is closed with:

- ENTER      The newly entered text is adopted.
- ESC        The old text is retained.

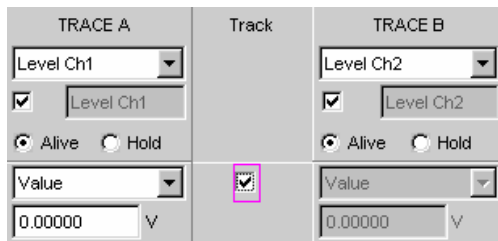
**Display fields**



Sometimes it is very useful for operators to receive additional information about their settings.

Display fields inside the panels are used in such cases. These fields are shown in grey and cannot be accessed. They always contain valid values and therefore always show settings active in the background; the fields are updated as soon as a setting in the associated parameter field is changed.

**Adopting parameters**



In many cases, settings are to apply e.g. to both measurement channels or to both traces. Here the R&S UPV provides multi-column panels which allow settings to be transferred from the left-hand to the right-hand column without the parameter having to be entered a second time.

If the track box has a checkmark, all of the settings within the function group are applicable to both columns. All fields with transferred settings in the right-hand column are shown as display fields. They appear grey and cannot be accessed while the track function is active. If a setting is changed in the associated parameter field in the left-hand column, this change is also shown in the display field in the right-hand column.

**Help function**

Information on the possible entries is given at the bottom of the screen above the softkey bar. The units offered in the softkey bar and the limits specified in the "Valid Range" field always refer to the highlighted parameter field. The valid value range is given in the unit currently selected. Entries outside the specified value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value.

**Note:**

The specified ranges for value entries always take the current status of the instrument into consideration. They are therefore not constant and depend on the presets already configured for other parameters.

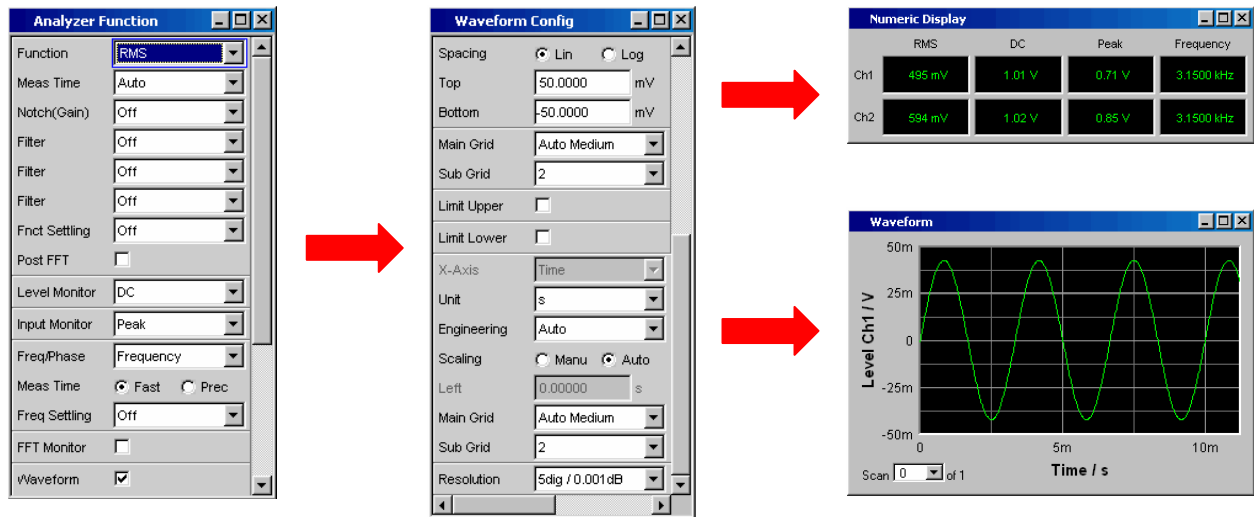
Below is an example for entry of the generator output voltage; additional units can be displayed by actuating the ►► button:



## Measurement Functions and Displaying Measurement Results

The Audio Analyzer R&S UPV offers various types of measurement windows for displaying the results of the numerous measurement functions. The measurement results can be displayed as digital numeric values, in analog bargraphs, in result graphics or in data lists. The user can open any number of measurement windows on the screen.

- **What** (which measurement function) is measured and **how** (which measurement method) measurement is performed, is preset in the **Analyzer Function** panel.
- The **panels for configuring the measurement value display** are used to determine how the measurement results are presented (i.e. which unit, how many digits, etc). A series of panels for the different measurement windows are provided for this purpose.
- The results are finally displayed in the various **measurement windows**.



**What is measured and how measurement is performed**

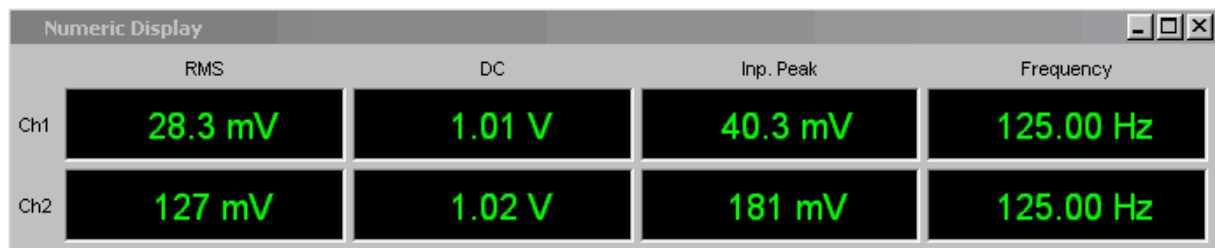
**Display type for measurement results**

**Display of measurement results**

### Numeric display field

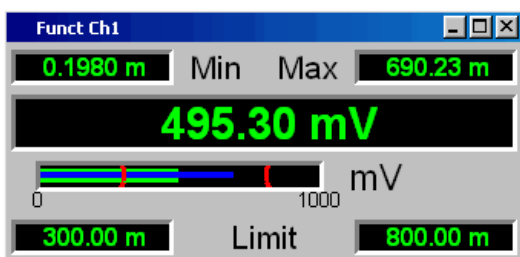
The numeric display field provides a clear overview of the numeric values from various analyzer functions and displays a maximum of 8 numeric value results from the **Analyzer Function** panel. The individual columns are permanently assigned, from left to right:

- Column 1:** Measurement results from the function which is set in the **Function** field of the **Analyzer Function** panel.
- Column 2:** Measurement results for the set **Level Monitor** function.
- Column 3:** Measurement results for the **Input Peak** function.
- Column 4:** Display of either the frequency measurement result or, if **Freq & Phase** or **Freq & GrpDel** is set, display of the frequency measurement result in the first row and display of the phase or group delay measurement in the second row.



### Combi display

The combi display is used if the numeric value of a measurement result is to be supplemented by analog bargraphs, limit monitoring or the storage of maximum and minimum values. The free selection and free scalability mean that especially important or critical results can be monitored and tracked even when viewing the R&S UPV screen from a relatively long distance.

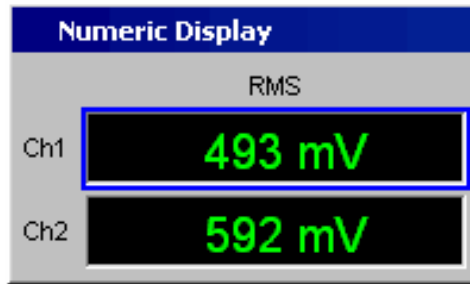


Measured minimum and maximum values

Measurement display

Bargraph

Limit settings



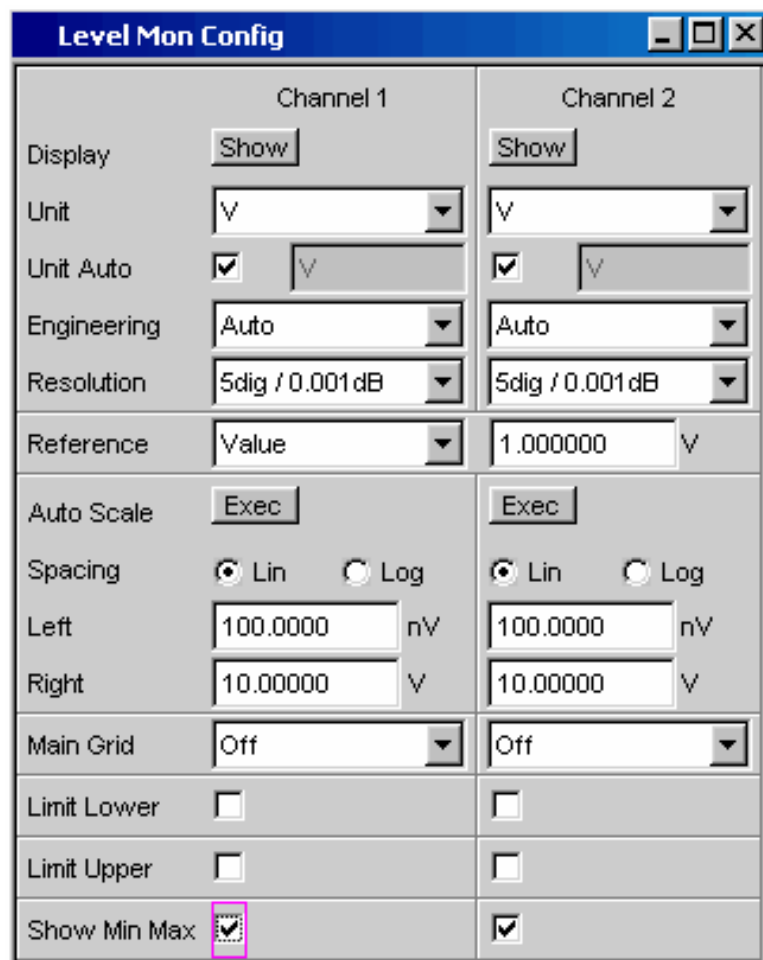
### Opening combi displays

The easiest way to open combi displays is to highlight the respective measurement display in the numeric display field (blue selection frame) and to select the display with the **ENTER** key or rotary-knob click.

### Configuring the numeric display field and combi display

The settings for the individual columns of the numeric display field or for the combi displays are made in the following four configuration panels which can be opened by actuating the **DispConfig** button in the menu bar:

- Funct Config
- Lev Mon Config
- Input Config
- Freq / Phase Config



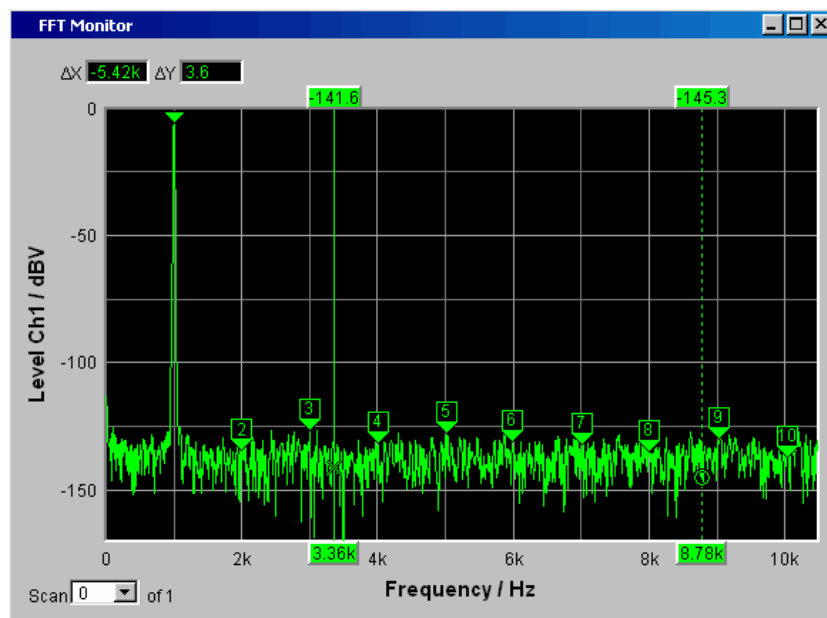
## Graphical windows

The most informative way of displaying measurement results is to use a two-dimensional graph. The Audio Analyzer R&S UPV makes a distinction between the following graphical windows:

- Sweep Graph
- FFT Monitor
- FFT Graph
- Waveform
- Bargraph

These windows can be set using the associated configuration panels.

All graphical displays can be evaluated using horizontal and vertical cursors; markers are used to identify important measurement points. A broad range of softkey control functions can be used to scale graphs, to display sections of graphs, and to perform many other tasks.



# Introduction to Instrument Operation Using Examples

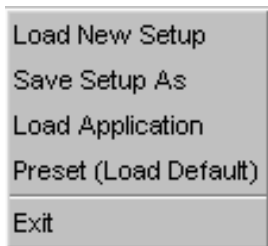
## Measuring the Frequency Response of an Amplifier, Equalizer, etc

This example is based on the factory settings of the Audio Analyzer R&S UPV. It explains the changes made in the individual panels to set up the measurement and describes how to graphically display the measurement results. Finally, the example shows how to save the defined measurement setup on the R&S UPV so that it can be used again for other applications.

### Step 1: Loading the factory settings

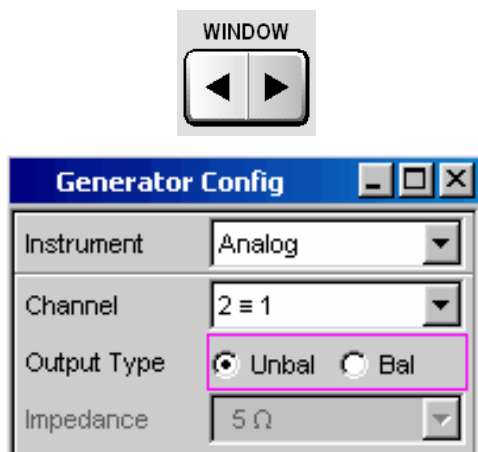


The easiest way to load the factory settings of the instrument is to press the **PRESET** key on the front of the R&S UPV.



Alternatively, the factory settings can be loaded by opening the menu bar with the **MENU** key, highlighting the **File** button with the rotary knob and actuating it with a rotary-knob click, and then highlighting and actuating **Preset** in the displayed list in the same way.

### Step 2: Setting the required generator signal

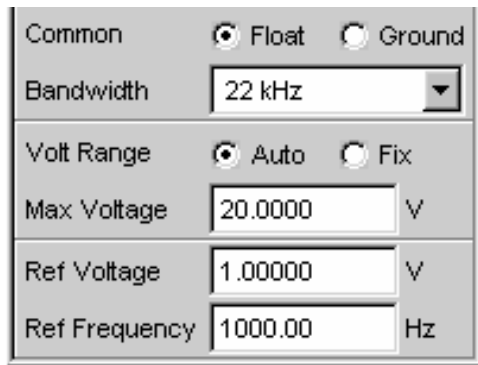


The basic settings for configuring the generator are made in the **Generator Config** panel.

The panel must have the focus before it can be operated. This is already the case with the default setup, otherwise press the **WINDOW** key until the color of the title bar in the desired panel changes to blue.

The frequency response is usually measured on both channels; this is already configured in the **Channel** field.

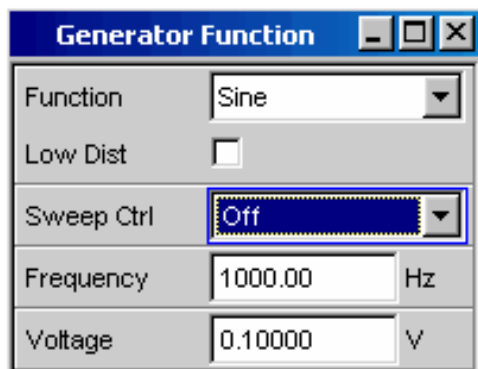
- ← Depending on the DUT, **Output Type** can be switched to balanced circuitry; various output impedances can then be selected in the field below. If necessary, the required parameter field can be highlighted with the rotary knob; this is then indicated by a selection frame (see the screenshot to the left). A rotary-knob click toggles between the two radio buttons.



← Floating output circuitry for the generator (see the section *"Avoiding Hum Loops"* on page 2.3) and a maximum signal frequency of 22 kHz are normally the right settings to be used.

← The other settings are also suitable for the majority of applications and do not have to be adjusted unless necessary.

This completes the settings in the **Generator Config** panel.

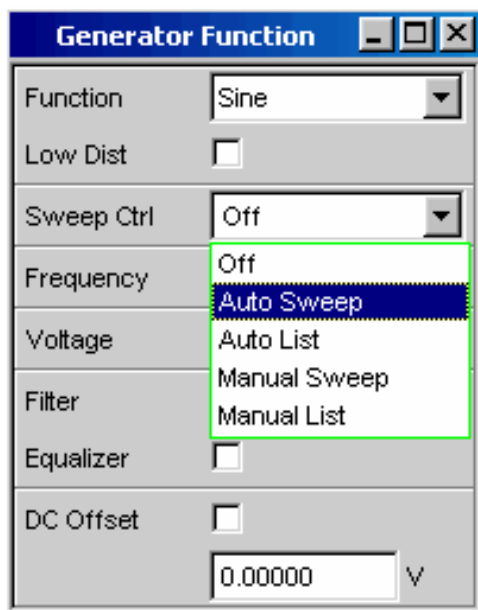


← The **Generator Function** panel must now be activated; once again, press the **WINDOW** key until the color of the panel's title bar changes to blue.

← Sinusoidal signals (Sine) are required; this setting is already selected.

← To be able to measure the frequency response, the sinusoidal signal must be swept in the frequency. A fixed frequency of 1 kHz is preset in the default instrument setup.

To activate the sweep, highlight the **Sweep Ctrl** field by actuating the rotary knob until this field has the blue selection frame (see the screenshot to the left).

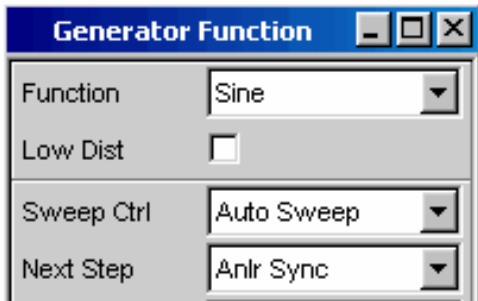


← The fold-down parameter list is opened with a rotary-knob click or by pressing the ENTER key.

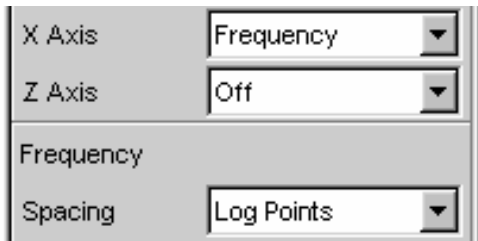
← Use the rotary knob to highlight **Auto Sweep** and activate this setting with another rotary-knob click or with the ENTER key.

The parameter list closes and a number of additional fields appear in which further sweep parameters can be set.





The **Next Step** field must remain set to **Anlr Sync**; this setting causes the next sweep step to be triggered as soon as a valid measurement result is available in the analyzer part. This synchronization optimizes the sweep speed.



The sweep variable must now be specified in the next field. Frequency is already preset here (as required in this example).



No other sweep variable is required; the **Z Axis** field therefore remains set to **Off**.



The next selection field is used to select the algorithm for advancing through the sweep points.

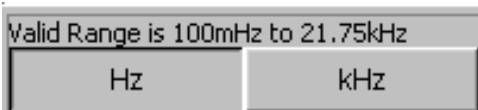
This can be done using a linear or logarithmic step size; the number of individual sweep points (**Points**) or the step size from point to point (**Steps**) can be set.

This selection field is factory-set to **Log Points**; this is the usual setting for frequency response measurements.



The values for the start and stop frequency of the sweep must be entered in the next two fields.

Highlighting the desired field gives it the green selection frame. The required frequency value can now be entered directly using the numeric keypad on the front panel (20 Hz in this example). Pressing the ENTER key adopts the value and adjusts the hardware accordingly.



The possible value range is given above the softkey bar. Entries outside the specified value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value.

As soon as the value entry field is highlighted, all available units are displayed on the softkey bar; additional hidden units can be shown by actuating the **▶▶** button. Value entry can be completed by actuating the softkey labelled with the desired unit; this is a particularly useful feature if a value is to be changed to a different unit.

Start	20.0000	Hz
Stop	20.0000	kHz
Points	50	



The value for the stop frequency is entered in the same way (here 20 kHz).



The number of desired sweep points must be entered in the **Points** field; 30 points are preset here. Up to 1024 points can be selected. 50 points are entered in this example; this generally provides an adequate number of measurement cycle values without making the overall measurement cycle too long.

Voltage	0.10000	V
Filter	Off	▼
Equalizer	<input type="checkbox"/>	
DC Offset	<input type="checkbox"/>	
	0.00000	V



The desired output voltage for the measurement is entered in the **Voltage** field; once again, the field must be highlighted before the value can be entered. The value range is again displayed above the softkeys and the available units are shown in the softkeys.

The remaining fields are not relevant for this example. Configuration of the generator is therefore complete.

### Step 3: Selecting the required measurement

Analyzer Config	
Instrument	Analog
Channel	2 ≡ 1



The basic settings for configuring the analyzer are made in the **Analyzer Config** panel.

Once again, the panel must have the focus before it can be operated ( **WINDOW** key).

The frequency response is usually measured on both channels; this is already configured in the **Channel** field. The setting **2 ≡ 1** means that both channels have the same settings; the following parameter fields appear once only in the panel but affect both channels.

Coupling	<input checked="" type="radio"/> AC <input type="radio"/> DC
Bandwidth	22 kHz
Pre Filter	Off
Input	Bal
Ch1 Imped	200 kΩ
Common	<input checked="" type="radio"/> Float <input type="radio"/> Ground
Ch1 Range	Auto
Ref Imped	600.000 Ω
Start Cond	Auto
Delay	0.00000 s

- ← If necessary, it is possible to toggle between AC and DC coupling using the two radio buttons.
  - ← The fields for the measurement bandwidth are already preset with the appropriate setting; no prefilter is required here.
  - ← In this example, the signal to be measured is supplied via the balanced input sockets (**Bal** setting). The analyzer can also be connected to the generator internally.
  - ← Floating input circuitry for the analyzer (see the section "[Avoiding Hum Loops](#)" on page 2.3) and the autorange function are normally the right settings to be used.
- The default settings in the following fields are also correct.
- This completes the settings in the **Analyzer Config** panel.

Analyzer Function	
Function	RMS
Meas Time	Gen Track
Notch(Gain)	Off
Filter	Off
Filter	Off
Filter	Off
Funct Settling	Off
Post FFT	<input type="checkbox"/>
Level Monitor	RMS
Input Monitor	Peak
Freq/Phase	Frequency
Meas Time	<input checked="" type="radio"/> Fast <input type="radio"/> Prec
Freq Settling	Off
FFT Monitor	<input type="checkbox"/>
Waveform	<input type="checkbox"/>

- The following are set in the **Analyzer Function** panel:
- **what** is measured (which measurement function) and
  - **how** measurement is performed (which measurement method)
- ← The RMS of the voltage must be measured for the frequency response measurement described here; the required setting (**RMS**) is already preselected.
- ← The measurement time for each individual measurement point is selected in the **Meas Time** field. The default instrument setting here is **Auto** which means that the measurement time is automatically adapted to the input frequency, i.e. the measurement cycle speeds up as the frequency increases. This setting can (with just a few exceptions) be used for the majority of applications.
- If the integrated generator is used for measuring the frequency response (as in this example), the setting **Gen Track** should be used. The measurement time is then automatically adapted to the frequency generated in the generator. The frequency information from the generator is passed on directly to the analyzer. The analyzer then adjusts its measurement time to precisely one period (or to an integer multiple of one period). The advantage of this method is maximum measurement speed with maximum accuracy.
- All other parameter fields are not relevant for this example; the settings in the **Analyzer Function** panel are therefore complete.

## Step 4: Displaying the measurement results – Numeric measurement display

	RMS	DC	Inp. Peak	Frequency
Ch1	348 mV	1.01 V	496 mV	80.000 Hz
Ch2	447 mV	1.02 V	637 mV	80.000 Hz

In the default instrument setup, the numeric measurement display is also already open.

If the DUT is correctly connected to the Audio Analyzer R&S UPV, measurement values will already be displayed.

The **panels for configuring the measurement value display** are used to determine how the measurement results are presented (i.e. which unit, how many digits, etc). A series of panels for the different measurement windows are provided for this purpose.

The **Function Config** panel is shown here as an example; the first column of the numeric measurement display is configured in this panel, i.e. the display fields which show the measured level values for the frequency response measurement described here.

The panel has two columns; to simplify matters, only Channel 1 is shown here.

**Function Config**

Channel 1

Unit: V

Unit Auto:  V

Engineering: Auto

Resolution: 3dig / 0.1dB

Reference: Value

0.00000 V

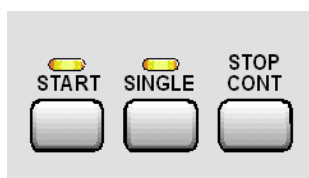
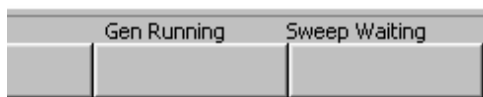
← The unit for the numeric measurement displays is set in the **Unit** field.

← The **Engineering** parameter is used to determine whether the display automatically toggles between  $\mu$ V, mV and V, for example, or whether other unit formats are desired.

← If the measurement results are to be displayed as relative values, they are referred to the reference value set in the **Reference** field.

Other parameter fields in this panel are used to set limits and to display extreme values. These functions are described in detail in Chapter 3 "[Manual Operation](#)" and Chapter 4 "[Instrument Functions](#)".

## Step 5: Starting the sweep



Although the analyzer is already supplying measurement results, the status message "**Sweep Waiting**" above the softkeys indicates that the sweep has not yet been started, although it has been configured in the **Generator Function** panel.

The sweep is started by pressing the **START** key in the top right-hand part of the R&S UPV front panel. The status message "**Sweep Run Cont**" informs the user that when this key is pressed the sweep will start and be repeated continuously.

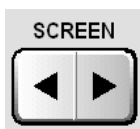
The sweep can be stopped at any time by pressing the **STOP CONT** key (the status message "**Sweep Stopped**" is displayed); the sweep continues if the key is pressed again.

If the **SINGLE** key is pressed, the sweep is started once only; "**Sweep Terminated**" appears in the status field when the sweep cycle has been terminated.

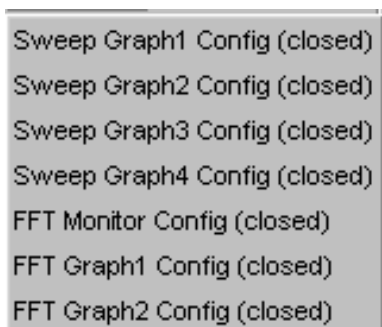
## Step 6: Displaying the measurement results – Graphical windows

The results of a frequency response measurement are usually displayed graphically with the measured output voltage values of the DUT being plotted on the frequency axis.

The following settings are required for this:



Use a different screen for the graphical display so that Screen 1 is not filled with too many panels. To do this, change to Screen 5 by pressing the **SCREEN** key; this screen is empty in the default R&S UPV setup.



Open the menu bar with the **MENU** key and open the **Sweep Graph 1 Config** panel by selecting it in the selection list displayed by actuating the **DispConfig** button.

As explained above, the way in which the measurement results are presented is determined in the **configuration panels**. Each graphical window has its own configuration panels.

The **Sweep Graph 1 Config** panel required here has two columns; to simplify matters, only Trace A is shown in the example.



←

The associated graphical window can be opened by actuating the **Show** button in the **Display** field. The window appears in the same screen so that the effect of the following settings can be observed directly.

←

In each graphical window, one or two traces (Trace A and Trace B) can be plotted on one X-axis. Each trace can consist of a large number of scans. In this example, only one single scan is to be displayed; the **Scan** field can therefore remain set to **Single**.



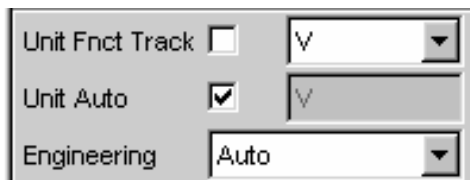
←

The scans can display the results of the different measurements available in the R&S UPV.

For the frequency response measurement, the measurement results for the measurement function selected in the **Function** field in the **Analyzer Function** panel (here the RMS measurement) must be displayed on a graph. For Trace A, the **Source** field is therefore set to the function result of measuring channel 1 (this is already preset in the default setup).

←

The **Alive** setting means that the results are displayed continuously; the **Hold** setting "freezes" the traces.



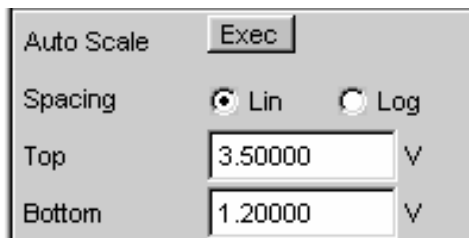
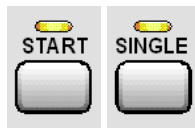
←

The units to be used for the measurement values on the Y-axis are set in the next section.

If the unit used in the numeric display window is also to be used in the graphical window, the **Unit Fnct Track** tick box must be activated. If this is not the case, a unit can be selected from the parameter list next to the tick box.

←

The **Engineering** parameter is used to determine whether the display automatically toggles between  $\mu\text{V}$ , mV and V, for example, or whether other unit formats are desired.



←

All the other default instrument settings are correct and allow a result to be displayed immediately in the form of a graph. If the sweep is started with the **START** or **SINGLE** key, the scan appears in the graphical window.

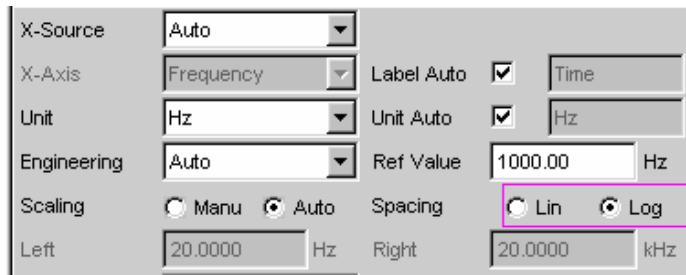
The scaling will probably need to be adjusted. Actuating the **Exec** button in the line **Autoscale** rescales the graph on the basis of the measured minimum and maximum values so that the entire trace fits in the graphical window.

←

The end values for the Y-axis can, however, also be entered in the two fields **Top** and **Bottom**.

←

The default R&S UPV settings for the X-axis are also mostly correct for this example:



By selecting a frequency sweep in the **Generator Function** panel, the X-axis is automatically defined as the frequency axis with the unit Hz.

If **Auto** is set in the **Scaling** field, the start and stop frequency of the sweep defined in the **Generator Function** panel is automatically used as the upper and lower end value for the X-axis.



The **Lin** setting in the **Spacing** field is unsuitable for this example. Since a sweep with logarithmic step size has been selected for this measurement, the X-axis should also be subdivided logarithmically. This setting can be changed quickly with a rotary-knob click.

### Step 7: Using a relative unit in the graphical window

The settings so far made allow the frequency response of the DUT to be displayed graphically but not in a way that conforms to standards.

In the case of frequency response measurement, the relevant standards stipulate that the deviations of the output voltage must be plotted over frequency, whereby the output voltage of the DUT at the reference frequency 1 kHz (for analog measurements) is used as the reference level.

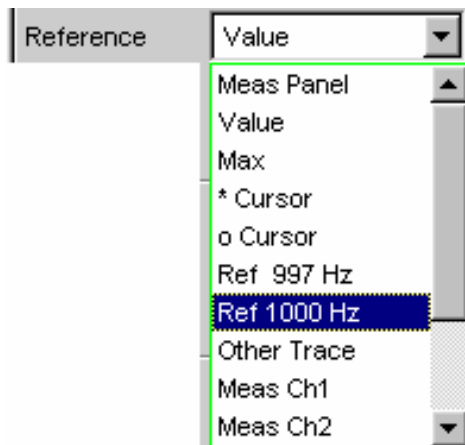
The following settings in the **Sweep Graph 1 Config** panels are used to adapt the graph for this measurement example:



A default reference value of 1 V is set in the **Reference** field.

This value must be replaced by the output voltage value of the DUT measured with the reference frequency of 1 kHz.

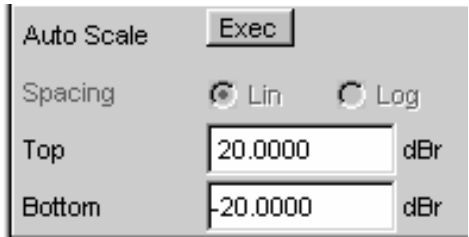
The R&S UPV offers a very simple way of doing this:



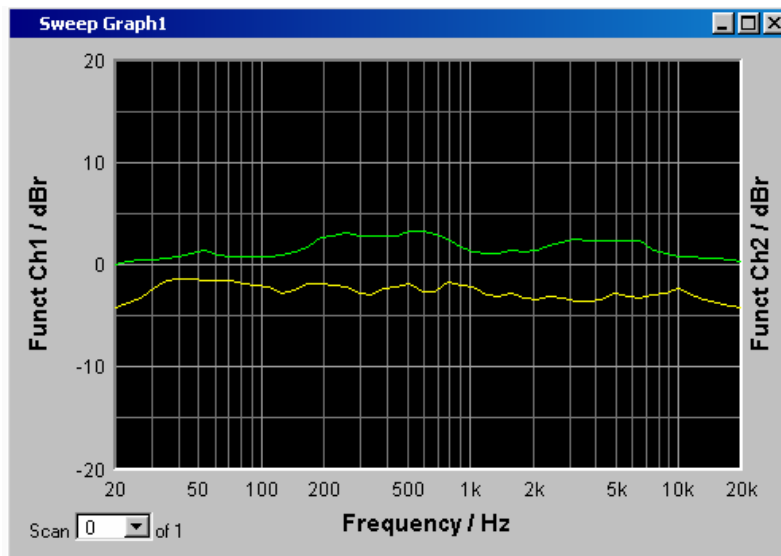
Open the parameter list in the **Reference** field and select the **Ref 1000 Hz** setting. With this setting, the value measured at this frequency is determined (if necessary by means of interpolation between the measurement values at the two adjacent frequencies) and used as the reference value.



← All that remains is to select the unit **dBr** in the **Unit Fct Track** field. All measurement values are then displayed in dB relative to the reference value selected above. This satisfies the standards defining frequency response measurement.



← The Y-axis must now be scaled according to requirement, e.g. from +20 dBr to -20 dBr.



If the measurement result of the second channel has been selected for Trace B, the graphical display for the measured frequency response may look like the example shown opposite.



**Step 8: Saving the instrument setup**

Pressing the **SAVE** key opens the window for saving files.



The desired file name can now be entered using the keypad on the front panel.

The keypad on the front panel of the R&S UPV is automatically switched to the mode for entering alphanumeric characters. Text is entered in the same way as on mobile phones: The characters assigned to a key are called up in sequence by repeatedly pressing the key. A different key can be pressed immediately to enter the next character; a brief pause must, however, be made when entering characters assigned to the same key.

The file extension is assigned automatically once the file name has been entered (here .SET); it is advisable to use this automatic assignment function as it prevents entry errors.



If this instrument setup is to be used again at a later date, simply press the **LOAD** key to reload the setup in the file window.

## Measuring the Harmonic Distortion (THD+N) of a DUT

This example is also based on the factory settings of the Audio Analyzer R&S UPV. However, only the settings in the individual panels which differ from the settings in the previous example are explained.

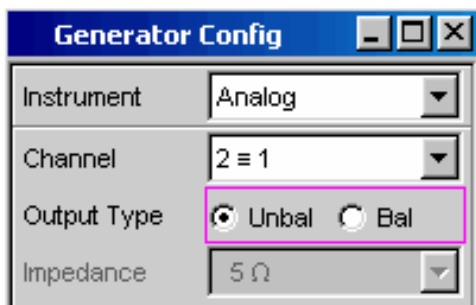
### Step 1: Loading the factory settings



The easiest way to load the factory settings of the instrument is to press the **PRESET** key on the front of the R&S UPV.

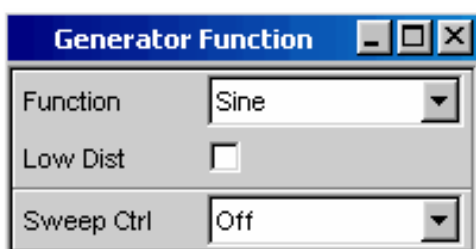
Alternatively, the default setup can also be loaded via the menu bar.

### Step 2: Setting the required generator signal



In the **Generator Config** panel, the basic settings for configuring the generator in this example are the same as those set for the frequency response measurement described in the previous section.

Depending on the DUT, **Output Type** may have to be switched to balanced circuitry.



The **Generator Function** panel must now be activated; once again, press the **WINDOW** key until the color of the panel's title bar changes to blue.

Sinusoidal signals (Sine) are required; this setting is already selected.

The harmonic distortion is often only specified for the reference frequency 1 kHz (for analog applications). Fixed frequencies are therefore used for measurement; as a result, **Sweep Ctrl** must remain set to **Off**.

Frequency	1000.00	Hz
Voltage	0.10000	V
Filter	Off	
Equalizer	<input type="checkbox"/>	
DC Offset	<input type="checkbox"/>	
	0.00000	V



The frequency 1 kHz is already preset in the default instrument setup.



Only the output level required for the measurement may have to be adjusted (in the **Voltage** field).

The remaining fields are not relevant for this example. Configuration of the generator is therefore complete.

### Step 3: Selecting the required measurement

Analyzer Config	
Instrument	Analog
Channel	2 = 1

The basic settings for configuring the analyzer are again made in the **Analyzer Config** panel.

These settings are made in the same way as shown in the previous example.

Analyzer Function	
Function	RMS
	<ul style="list-style-type: none"> <li>Off</li> <li>RMS</li> <li>RMS Selective</li> <li>Peak</li> <li>Quasi Peak</li> <li>DC</li> <li>THD</li> <li><b>THD+N &amp; SINAD</b></li> <li>Mod Dist</li> <li>DFD</li> </ul>

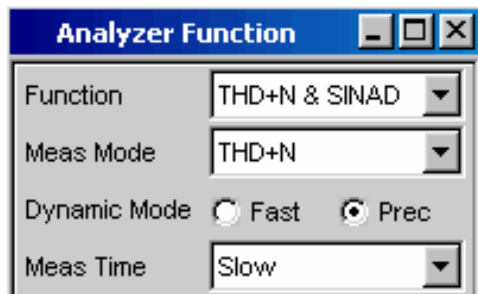


The **Analyzer Function** panel must now be activated; once again, press the **WINDOW** key until the color of the panel's title bar changes to blue.

The measurement function and measurement method are set in this panel.

The measurement function is selected first; the fold-down parameter list is opened with a rotary-knob click or by pressing the ENTER key.

Use the rotary knob to highlight **THD+N & SINAD** and activate this setting with another rotary-knob click or with the ENTER key. The parameter list is then closed again.



In the next field **Meas Mode**, various modes for distortion factor measurement can be selected; the presetting **THD+N** is correct for this example.

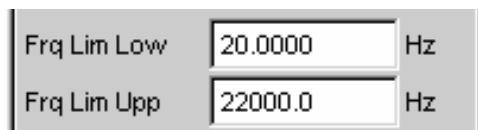


**Dynamic Mode** determines the maximum dynamic response for this measurement: fast measurement with restricted dynamic response or maximum dynamic response with a slightly longer measurement time are the two possible options.



With the THD+N measurement, the fundamental of the signal to be measured is suppressed using a notch filter. The R&S UPV can automatically determine the fundamental from the spectrum and adjust the notch filter to it (**Fundamental Auto**).

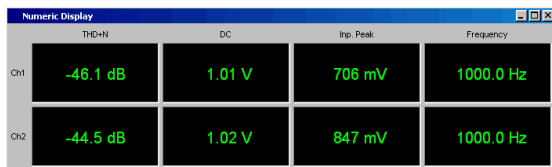
**Filter** and **Equalizer** are only required in exceptional cases.



The calculation for harmonics and noise components can if necessary be restricted to within band limits which can be entered in the two fields **Frq Lim Low** and **Frq Lim Upp**.

All other parameter fields are not relevant for this example; the settings in the **Analyzer Function** panel are therefore complete.

#### Step 4: Displaying the measurement results – Numeric measurement display



In the default instrument setup, the numeric measurement display is already open.

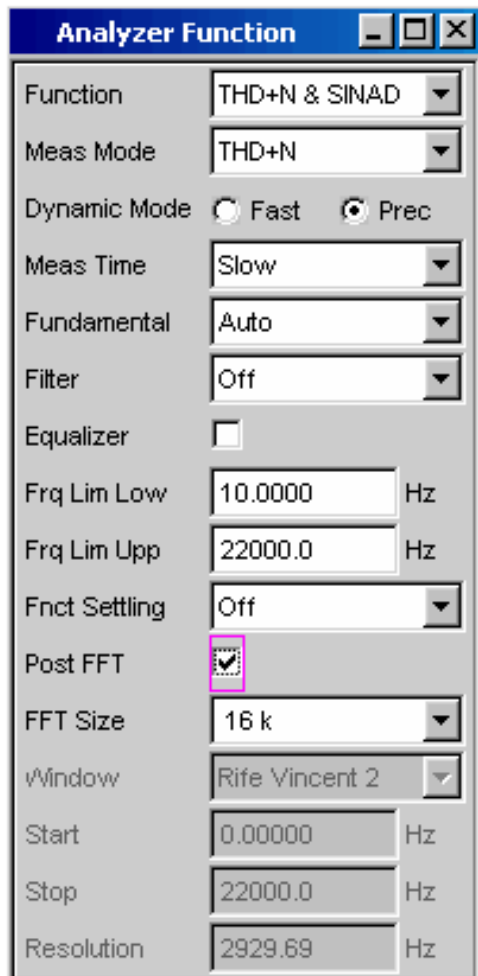
If the DUT is correctly connected to the Audio Analyzer R&S UPV, the measurement values for the harmonic distortion can be read off in the first column.

In the default setup, THD+N values are given in dB; if a display in % is desired, this unit can be changed in the **Function Config** panel.

#### Step 5: Displaying the spectrum in the graphical window

Display of the numeric value alone is sufficient for the majority of harmonic distortion measurements. Here, however, the spectral composition of the output signal at the DUT is also to be analyzed. With the Audio Analyzer R&S UPV, it is possible to follow up all distortion measurements with an FFT analysis.

The necessary settings for this are explained in the following section:



In the **Analyzer Function** panel already used for configuring the THD+N measurement, an FFT analysis to be performed following the measurement can be set after the actual measurement function has been selected.



To do this, highlight the **Post FFT** tick box with the rotary knob and activate it with a rotary-knob click.

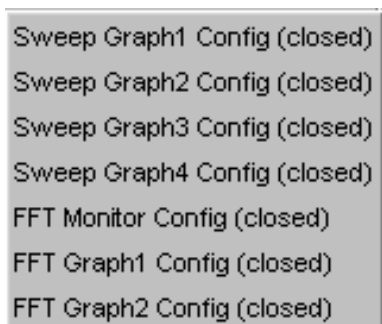
The size of the FFT can be adjusted if necessary.



The majority of the settings for the Post FFT are preset. The resulting parameters for the FFT analysis are shown in the fields below. These fields cannot be changed.



To display the results of the FFT analysis graphically, first change to Screen 5 by pressing the **SCREEN** key; this screen is empty in the default R&S UPV setup.



Open the menu bar with the **MENU** key and open the **FFT Graph 1 Config** panel by selecting it in the selection list displayed by actuating the **DispConfig** button.

As explained in the previous example, the way in which the measurement results are presented is determined in the **configuration panels**. Each graphical window has its own configuration panel.

The **FFT Graph 1 Config** panel required here has two columns; to simplify matters, only Trace A is shown in the example.



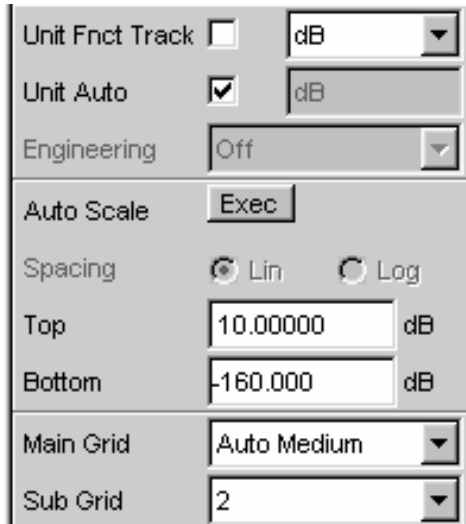
← The associated graphical window can be opened by actuating the **Show** button in the **Display** field. The window appears in the same screen so that the effect of the following settings can be observed directly.



← In each FFT window, one or two traces (Trace A and Trace B) can be plotted on the frequency axis.

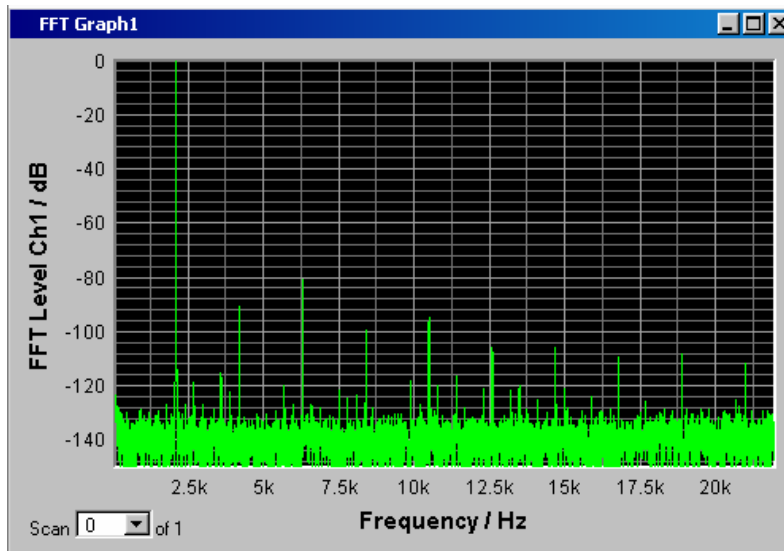
← In this example, the level measurement results of the FFT analysis are to be displayed on a graph. For Trace A, the **Source** field is therefore set to **FFT Level Ch1** (this is already preset in the default setup).

← The **Alive** setting means that the results are displayed continuously; the **Hold** setting "freezes" the traces.



The settings for unit, Y-axis scaling and grid are already preset in the default setup; a result should therefore be visible. If necessary, these settings must be adjusted.

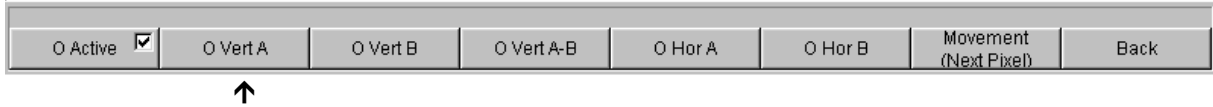
The settings for the X-axis are also mostly correct for this example; they were explained in the previous example.



The spectral display of the output signal with its harmonics may now look like the example shown opposite.

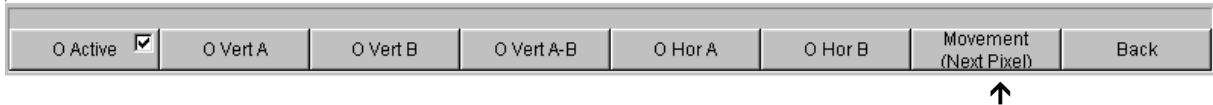


The  $O \leftrightarrow X$  button or a rotary-knob click is used to toggle between the  $O$  and  $X$ -cursor. If, for example, the cursor was activated with the  $O$ -Cursor button, the following softkeys appear:

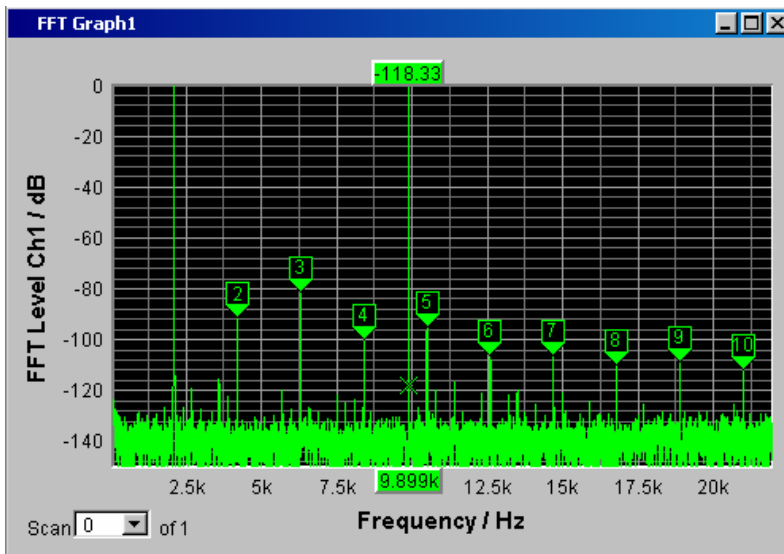
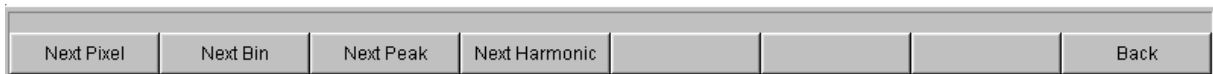


Actuating the  $O$  Vert A button activates a vertical cursor on Trace A; this cursor can then be moved using the rotary knob.

The step size with which the cursor is moved can be set using further softkeys.



The Movement button opens the next softkey level where various step sizes for moving the cursor are offered. The currently selected step size is indicated in brackets in the second label line of the Movement button.



With activated markers and a cursor, the graphical display of the output signal with its harmonics may look like the example shown opposite.

**Step 7: Saving the instrument setup**



This example can also be saved as an instrument setup. Pressing the  $SAVE$  key opens the file window. The file is then saved in the way described in the previous example.



## Loading Predefined Instrument Setups

To make initial measurements easier for new users, example setups for the basic measurements required in audio engineering are supplied with every Audio Analyzer R&S UPV. These setups allow the instrument to be used almost immediately.

The setup files are available for the different domains (analog or digital) of the generator and analyzer. They are stored in the AA to DD subdirectories of the D:\UPV\Applications directory; the generator domain is listed first followed by the analyzer domain. The file name indicates the respective application.

Many of these example measurements (essentially those at the analog interfaces) can be performed using the basic version of the Audio Analyzer R&S UPV. The R&S UPV-B2 option (digital audio interfaces) is required for all measurements at the digital interfaces.

The predefined instrument setups can be loaded in the following way:



The quickest way to load setups is to open the menu bar with the **MENU** key, highlight the **File** button with the rotary knob and actuate it with a rotary-knob click. The item **Load Application** in the fold-down list that then appears must then be highlighted and actuated in the same way.

The file window is opened already displaying the directory in which the example measurements can be selected.



Alternatively, the file window used to select the example measurements can also be opened using the **LOAD** key on the front of the R&S UPV; in this case, however, the appropriate directories must be selected manually.

All of the setups listed here use the same basic settings.

### Basic settings for analog inputs/outputs:

- Both channels of the generator and analyzer are active; the balanced XLR connections with minimum generator impedance and maximum analyzer impedance are used.
- All inputs/outputs are floating; the autorange function is activated.
- Frequency sweeps are usually performed logarithmically from 20 Hz to 20 kHz; the appropriate graphical windows are open on the screen; the X-axis is scaled automatically in the associated configuration panels; the Y-axis is permanently set to standard values.
- Voltages are mostly given in volts; the generator output voltage is set to 0.1 V; distortion and intermodulation values are given in dB.

**Basic settings for digital inputs/outputs:**

- Both channels are active; the generator generates 24 bit words; the analyzer analyzes 24 audio bits. The sampling frequency is set to 48 kHz; the Professional format to AES 3 is used. The digital pulse amplitude of the generator is 1 V at the BNC outputs; this corresponds to 4 V at the XLR sockets.
- Levels are mostly given in dBFS; audio signals are usually generated at a level of –20 dBFS.

Users can, of course, adapt the used basic settings to their own specific measurement tasks at any time. To do this, the respective setup must be loaded and the appropriate changes are then made in the panels. The setup can then be saved again.

The application setups are also updated when new R&S UPV firmware is installed. Modified setups should therefore be saved under a different file name.

Users are also free to create new directories for their customized setups.

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# 3 Manual Operation

## Introduction - Manual Operation

The Audio Analyzer R&S UPV uses the WindowsXP® Embedded operating system. The instrument is therefore operated in largely the same way as other Windows® applications. All panels and display windows have the standard Windows® format and are operated in the same way. The rotary knob, keys and softkeys, or alternatively an external keyboard and/or mouse, allow direct and convenient access to entries and settings. The clearly organized display shows the current state of the audio analyzer.

The instrument can be fully operated using the control elements on the front panel; additional peripherals such as a mouse and keyboard are not essential requirements. They can, however, be connected so that the user is free to decide how he would like to operate the R&S UPV. Mixed operation is also possible.

Numerous online help functions assist the user in making settings.

After being switched on, the instrument is in the same state as it was before it was switched off. This applies to all setting parameters of the R&S UPV, including those not currently displayed on the screen.

The following chapter describes manual operation of the Audio Analyzer R&S UPV. This includes a description of the screen displays, how to operate the panels and how to set parameters. Each of the setting descriptions is accompanied by a table explaining how the different functions are performed via the front panel and using an external PC keyboard or mouse.

An overview of the keys, panels and display windows can be found at the end of this chapter.

The functions of the Audio Analyzer R&S UPV are described in detail in Chapter 4. Chapter 2 contains a description of the general operating concept and a brief introduction in which initial measurements are configured step by step. Remote control of the instrument is described in Chapters 5, 6 and 7.

# Functional Organization of the Audio Analyzer R&S UPV

## Instrument Concept

The Audio Analyzer R&S UPV combines the following components in a single housing:

- generators with analog and (with the R&S UPV-B2 option) digital audio interfaces for generating the various test signals
- analyzers with analog and (with the R&S UPV-B2 option) digital audio interfaces for comprehensive measuring possibilities and
- a computer (PC) with the WindowsXP® Embedded operating system for controlling and operating the entire instrument and with connections for PC peripherals and LAN

## Generators

### Universal generator

The **universal generator** consists of signal processors and generates the various test signals from sinusoidal tones through intermodulation test signals (two-tone signals) to noise signals and multi-tones. Following appropriate conversion, these signals are made available at the analog outputs.

With the R&S UPV-B2 option, they can also be output as digital data streams in various formats at the AES/EBU and SPDIF interfaces and at optical interfaces.

The R&S UPV-B4x options, which can be installed in the expansion slots at the rear of the instrument, provide further interfaces for outputting the test signals.

With the R&S UPV-B2 and -B22 options, the universal generator can also be used to generate **impairment signals** for applying jitter or common-mode interference to the DUT connected to the AES/EBU and SPDIF interfaces.

All test signals can be output on one or two channels. With the R&S UPV-B2 option, two different signals are also available at the digital outputs.

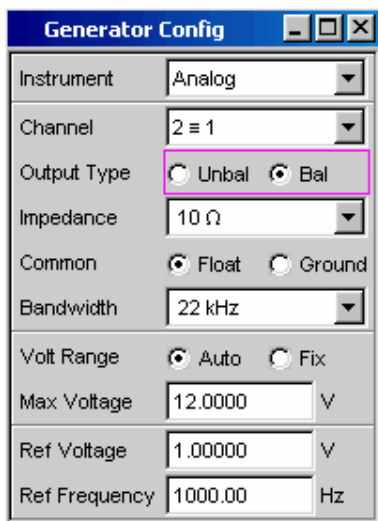
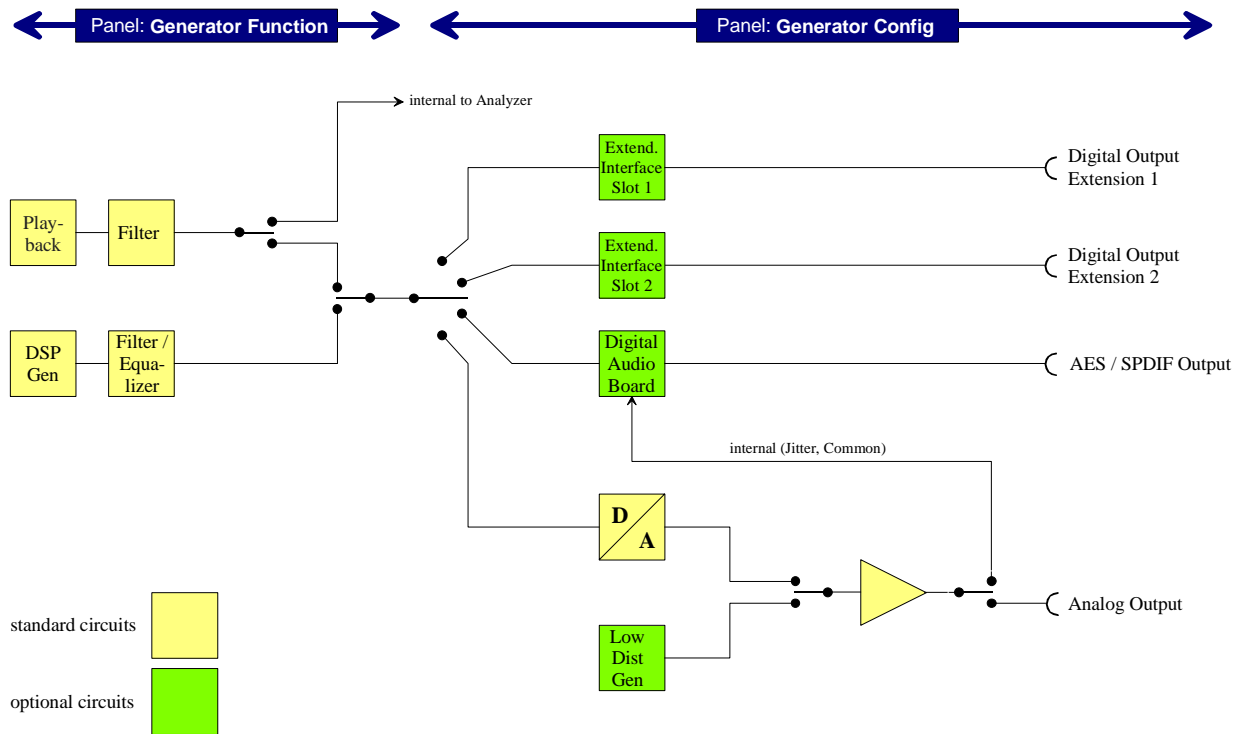
The hardware option R&S UPV-B3 provides the R&S UPV with a **second analog output amplifier**. This allows different signals to be output on the two analog output channels.

### Low-distortion generator

The **low-distortion generator** (R&S UPV-B1 option) is required for all applications where extremely pure analog signals are necessary or an extended frequency range up to 185 kHz is needed. Its intrinsic distortion is considerably less than the already excellent values for the universal generator.

### Function blocks and their assignment to the panels

The diagram below shows the function blocks of the generators in the Audio Analyzer R&S UPV:

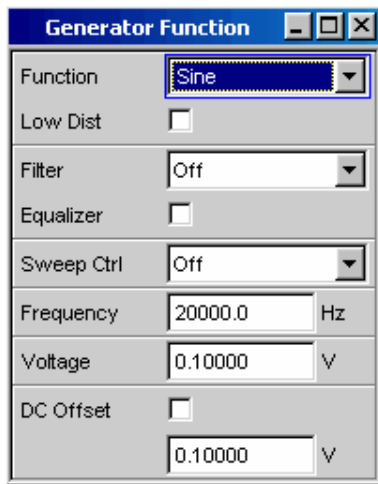


The generators of the R&S UPV are operated in two steps:

In the first step, the following settings are made in the **Generator Config** panel:

- the audio interfaces at which the test signals are to be output
- the channels which are to be active
- maximum level and reference values
- etc

Output as impairment test signals is also set here.



In the second step, the following settings are made in the **Generator Function** panel:

- type of test signal
- output level
- frequencies
- etc

## Analyzers

### Basic concept of the analyzers

The R&S UPV performs all measurements using digital signal processing. Here, analog signals to be measured are first subjected to complex 2-channel **analog preprocessing** on analog measurement modules before they are digitalized and fed to the digital measurement routines.

This concept has the following advantages:

- All audio measurement functions are available at both the analog and the digital interfaces.
- The measurement methods at the analog and digital interfaces are identical.
- Operation at the analog and digital interfaces is always the same.
- The analog preprocessing makes it possible to achieve a higher dynamic response than that provided by the internally used 24-bit converter.
- The R&S UPV can also perform the complex measurement functions simultaneously on both channels; this alone halves the time required for stereo measurements.
- Several measurement functions, e.g. level measurement, FFT analysis, waveform analysis, etc, are calculated simultaneously on separate signal processors and can therefore be displayed at the same time without a delay.
- The digital measurement routines can continuously adapt their speed to the current input frequency and thus achieve high measurement speeds.
- Since the filters are also digital, an almost infinite number of filters is available and can also be used for measurements at analog interfaces.

With the R&S UPV-B2 option, digital audio data streams can also be measured at the AES/EBU and SPDIF interfaces.

The R&S UPV-B4x options, which can be installed in the expansion slots at the rear of the instrument, provide further interfaces for analyzing signals in other formats.



## Function blocks and measurement levels

The analyzer part of the R&S UPV offers a large range of measurement options which are organized in various measurement levels. The measurement results of these levels can also be displayed simultaneously.

The unfiltered input signal is analyzed in the **input level**. The peak level at the input connectors is analyzed here.

The pre-filter, which can be looped into the signal path upstream of all other analyses, is downstream of the **monitor level**. Here the signal to be tested can be analyzed simultaneously in the time and frequency domain (waveform and spectrum). In addition, the RMS and DC voltage component can also be determined. The recording of input signals on the hard disk in order to analyze them at a later time is also initiated here.

Following any additional filtering using up to 3 filters, detailed analysis is initiated in the **function level**. All the usual analysis tools for measuring linear and non-linear distortion, interferences etc can be found here. The FFT analysis with extreme dynamic response and frequency resolution is also here.

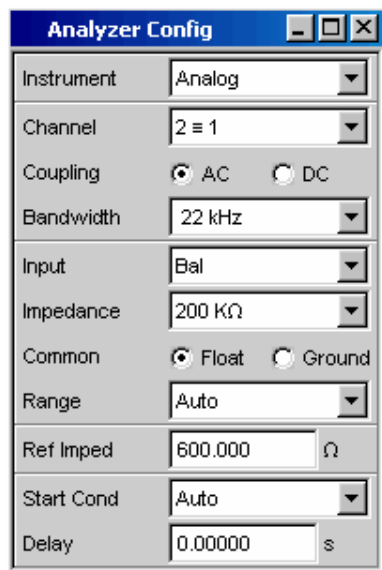
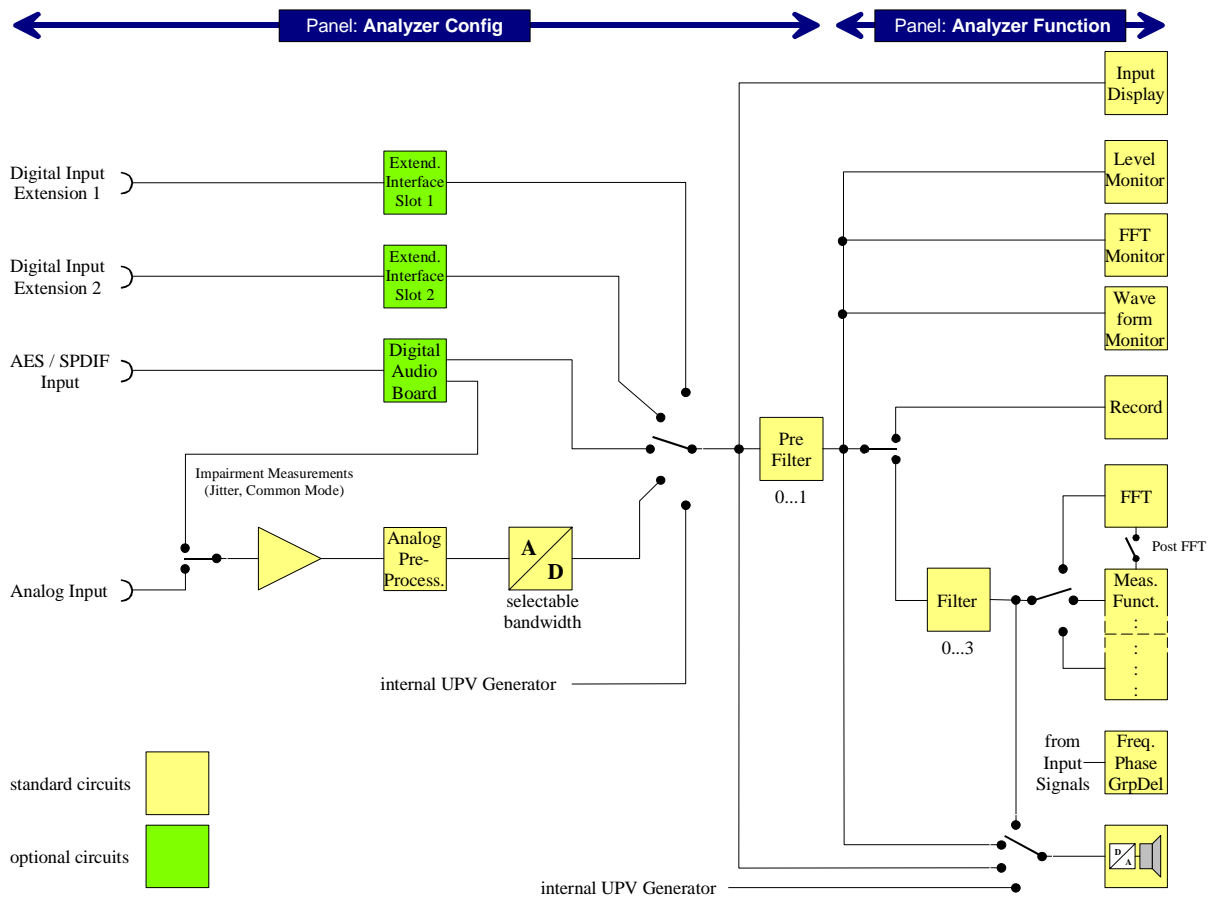
The measurement values for **frequency** and **phase** or **group delay** can be displayed in a different measurement window parallel to the structure described above.

The **audio monitoring output** (integrated loudspeaker or headphones connection) can be activated on each of the three levels and thus permits audio monitoring of analog or digital input signals both directly at the input and in the different analysis levels. The generator signal can also be switched to the loudspeaker / headphones.

With the R&S UPV-B2 and -B22 options, it is also possible to analyze the **digital interface parameters** of DUTs (e.g. jitter, pulse amplitude, sampling frequency, etc) at the AES/EBU and SPDIF interfaces.

The results of these different measurement functions can be displayed in various ways in the **measurement windows**. The type of display, the units used, scaling, etc can be set differently for each measurement function in the associated panels.

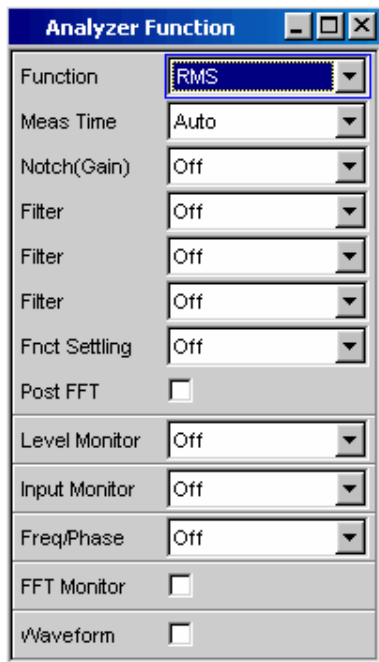
The diagram below shows the function blocks and the analysis levels of the R&S UPV analyzer part:



The analyzer part of the R&S UPV is also operated in two steps:

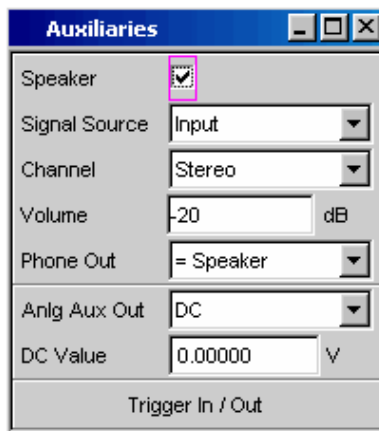
Operation begins in the **Analyzer Config** panel with the selection of of:

- analog or digital input connectors
- number of channels
- AC or DC coupling
- measurement bandwidth
- and a number of other parameters



Following this step, the measurements at the various analysis levels of the R&S UPV are set in the **Analyzer Function** panel. The measurements are set in the order of their importance:

- measurements in the function level, e.g. distortion measurements (possibly with Post-FFT enabled)
- settings in the monitor level, e.g. waveform monitor
- display of the peak value in the input level
- display of frequency, phase / group delay



If audio monitoring using the integrated loudspeaker or with headphones is required, this is set in the **Auxiliaries** panel.

The following settings can be made in other panels:

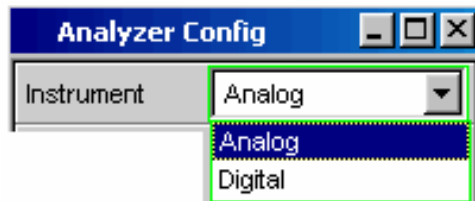
- the way in which the measurement results are to be displayed (numerically or graphically)
- scaling
- limit monitoring
- minimum and/or maximum values
- and many other parameters

# General Information on Operation

## Windows® User Interface

To provide the user with a familiar environment, operation is largely based on the Windows® user interfaces. All panels, entry windows, etc are made up of known elements, for example:

Selection fields with parameter lists



Tick boxes



Radio buttons



Entry fields



A blue, green or magenta selection frame or the highlighting of an entry field (dark background) indicates the current entry focus. Entries can be made in the element with entry focus.

Operation follows the same basic rules which apply to other Windows® programs in use today. It is assumed that the user is familiar with these basic rules. This information is therefore not given in detail in this manual.

## Using the Rotary Knob

Operation is possible using the front-panel keys, an external keyboard and/or a mouse. However, most of the settings can be made with the rotary knob:

- Turning the rotary knob shifts the entry focus to the desired element.
- Pressing the rotary knob (rotary-knob click) opens the parameter list in the selection fields; a parameter can be selected from the list by again turning and then clicking with the rotary knob.
- Tick boxes are activated/deactivated by clicking with the rotary knob.
- The individual radio buttons are selected by turning the rotary knob; they are toggled by clicking with the rotary knob.
- In the entry fields, the numeric values can be changed directly (with immediate effect on the setting) or first edited and then adopted by clicking again with the rotary knob.

## Operation Using the Mouse

Similar to other Windows® programs, the Audio Analyzer R&S UPV can also be operated using a mouse. To permit this, a commercially available mouse (not supplied with the instrument) is connected to one of the 4 USB interfaces at the front or rear of the instrument (see Chapter 1, "[Connecting a Mouse](#)", page 1.24).

The mouse makes it easier to move and resize the panels and graphical windows on the screen and provides alternative operating modes. It allows easy operation of Windows®.

The functions of the mouse correspond to the following front-panel functions:

Mouse	Front panel	Function
Left-click	<b>ENTER</b> key, rotary-knob click	<ul style="list-style-type: none"> <li>– Activates selection fields</li> <li>– Selects parameters</li> <li>– Activates/deactivates tick boxes</li> <li>– Toggles radio buttons</li> <li>– Quits the Edit mode</li> </ul>
Move mouse pointer to left-hand edge of screen	<b>MENU</b> key	Shows the menu bar
Turning mouse wheel	Turning rotary knob	<ul style="list-style-type: none"> <li>– Navigation in panels, parameter lists, etc</li> <li>– Changes numeric values</li> </ul>
Pressing mouse wheel	Rotary-knob click	<ul style="list-style-type: none"> <li>– Selects parameters</li> <li>– Quits the Edit mode</li> </ul>

## Operation Using an External PC Keyboard

A commercially available, external PC keyboard (not supplied with the instrument) can be connected to one of the 4 USB interfaces at the front or rear of the instrument (see Chapter 1, ["Connecting an External Keyboard"](#), page 1.24).

It simplifies the input of list entries, comment texts, file names, etc. A keyboard is required for operating Windows®.

The keys on the front panel of the Audio Analyzer R&S UPV correspond to the following keys and key combinations on the external PC keyboard:

Front panel	PC keyboard
Softkeys F5 ... F12	F5 ... F12
START	CTRL + F5
SINGLE	CTRL + F6
STOP CONT	CTRL + F7
Loudspeaker ON	CTRL + F8
Volume	CTRL + F9
H COPY	CTRL + P
SHUT-DOWN	CTRL + F10
LOCAL	CTRL + F11
OUTPUT OFF	CTRL + F12
SCREEN ◀	CTRL + PAGE UP
SCREEN ▶	CTRL + PAGE DOWN
WINDOW ◀	CTRL + SHIFT + TAB
WINDOW ▶	CTRL + TAB
SCAN ◀	ALT + PAGE UP
SCAN ▶	ALT + PAGE DOWN
PAGE ▼	PAGE DOWN
PAGE ▲	PAGE UP

Front panel	PC keyboard
0 ... 9; A ... Z	0 ... 9; A ... Z
_	SPACE
• ; * ... #	• ; * ... #
+ / -	+ / -
A ↔ a	SHIFT + A ... Z
MENU	CTRL + M
UNDO	BACKSPACE
ESC	ESC
Enter, rotary-knob click	ENTER
Cursor keys	Cursor keys
WINBAR	ALT + W
MODIFY	ALT + M
HIDE	ALT + H
CLOSE	ALT + C
HELP	F1
SAVE	ALT + S
LOAD	ALT + L
PRESET	ALT + P

# Display


## Display and Screens

The display is the central element for operating the R&S UPV. Both the instrument settings in the various panels, and the measurement results are displayed here.

To make the various functions of the Audio Analyzer R&S UPV easier to operate, they were organized in a series of panels.

The measurement results can be displayed as digital numeric values, in data lists, in analog bargraphs or in result graphics. The user can freely choose the number of panels and the number of graphical windows to be shown in the display. The size of the panels can be changed within wide limits, whereby the font size, scaling and so on are adapted automatically according to the type of display window.

5 display windows (or "screens") are provided so that the wealth of information can be better organized. The user can toggle between the individual screens in the following way:

- From front panel** Use the direction keys 
- With PC keyboard** Use the key combinations CTRL + PAGE UP and CTRL + PAGE DOWN
- With mouse** First open the menu bar at the top of the display, then click the **Screen** button and finally select the desired screen.

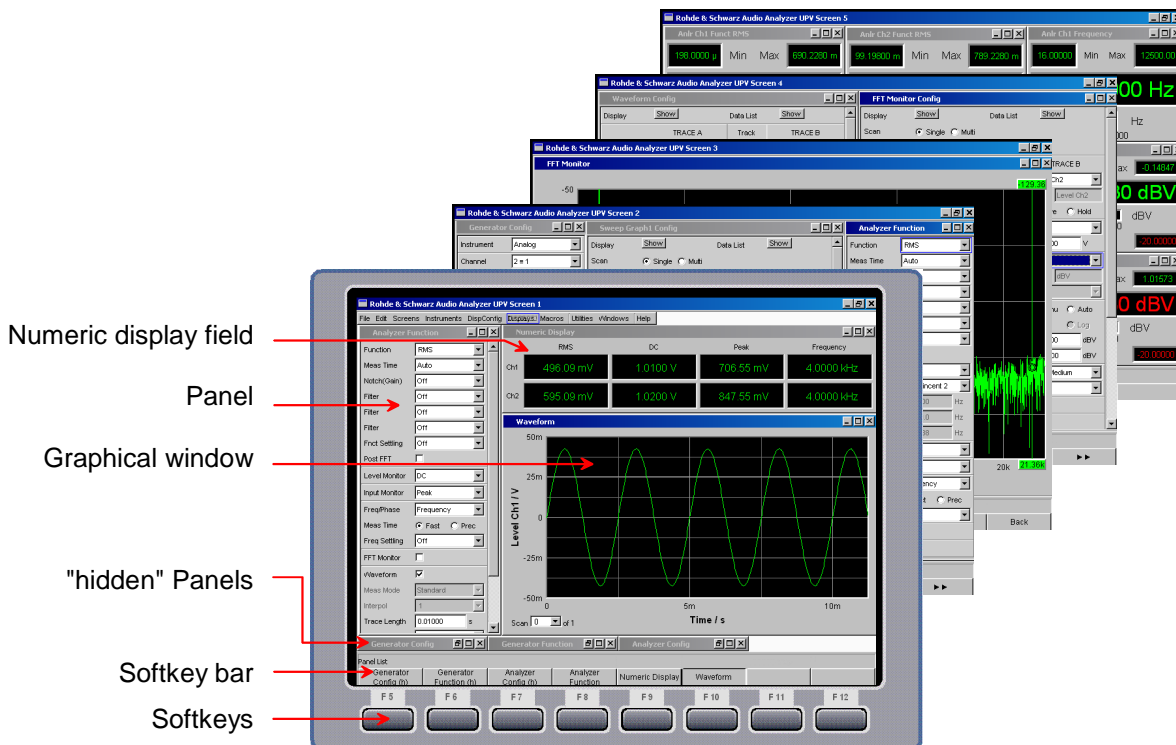
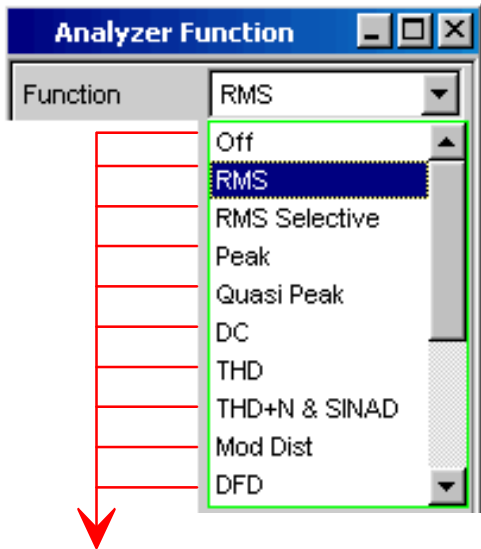


Fig.: 3-1 R&S UPV display with its 5 screens

## WINBAR and Softkeys

One of the two bars (either the softkey bar or the WINBAR) is always displayed at the bottom of the screen.



The **softkey bar** which has a varying range of functions is visible in normal operating mode.

In most cases, the functions available in the selection windows of the panels are displayed in the eight buttons; these functions are displayed even if the parameter lists have not (yet) been opened. The labelling of these buttons indicates the functions of the softkeys underneath them.

The function that has just been selected is indicated by a "pressed" button, as shown in the example below for the "RMS" function.

If there are more than 8 elements to choose from, the hidden elements in the selection list can be displayed by pressing the last softkey containing the ►► symbol or the first softkey containing the ◀◀ symbol.



Pressing the respective softkey permits rapid selection.

Softkeys with an additional tick box are also used for a number of applications. In the example below, the left-hand softkey F5 can be used to activate and deactivate the X cursor in a curve diagram. The other softkeys are used to make other settings affecting this cursor. The advantage of this combination is that the user can activate/deactivate a function (here the cursor) using one button and at the same time use the other softkeys for additional settings.



Another variant is the combination of several softkeys with tick box and softkeys without tick box. The example below shows the softkeys for the MODIFY function, described in detail in the section ["Moving and Resizing Panels and Graphical Windows"](#) on page 3.14. When a softkey with tick box is selected, the softkey bar remains open so that further settings (e.g. moving a panel) can be carried out. Actuating the other softkeys immediately triggers an action (here, for example, fixing the size of the panel), whereupon the softkey bar is hidden.



If an external PC keyboard is used, the softkeys can be operated using the F5 to F12 keys; if a mouse is used, the buttons in the softkey bar can be clicked directly.



When the **WINBAR** key is pressed, the **WINBAR** appears in place of the softkey bar; this is indicated by "Panel List" in the left-hand corner:



The labelled buttons show the names of all panels and graphical windows open in the current screen. Pressing the associated softkey puts the focus on the corresponding panel / graphical window, i.e. it becomes active. At the same time, the system returns to normal operating mode (i.e. the softkey bar). Hidden panels (see *"Opening, Operating, Hiding and Closing Panels"*, page 3.20) are also listed in the WINBAR. If a hidden panel is selected, it is redisplayed on the screen with its previously set size and position; it simultaneously receives the focus.

The panels and graphical windows displayed in the WINBAR can also be selected by pressing the F5 to F12 keys on the PC keyboard or by clicking with the mouse.

The panel with the focus can be recognized by the highlighted title bar (as shown here in the example on the right-hand side):



It is possible to toggle between the softkey bar and WINBAR at any time by pressing the **WINBAR** key.

Function	Front panel	PC keyboard	Mouse
Select softkey function	Press softkey.	Press keys F5 to F12.	Click button of associated softkey.

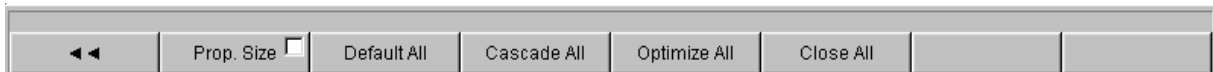
## Moving and Resizing Panels and Graphical Windows

As soon as a panel or display window has the focus, it becomes active and can be moved around the screen or resized. This can be done in the following ways:

- The mouse can be used to move or resize the selected panel directly in the same way as other Windows® applications.
- In the case of operation without mouse, the **MODIFY** key (key combination ALT + M on an external PC keyboard) must be pressed, whereupon the following labels appear on the softkey bar:



Additional hidden functions can be shown by actuating the **▶▶** button:

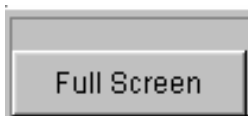


The associated panel can now be resized or moved; this is indicated by the label in the title bar:



Pressing the **MODIFY** key again restores the original operating mode.

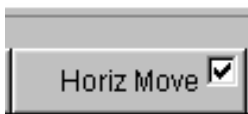
Apart from resizing and moving, the MODIFY mode also offers a number of other functions described in the following list:



This button is particularly useful for graphical windows. When the **Full Screen** button is actuated, the selected panel is enlarged so that it covers the entire screen.

If this command is used for panels, they are enlarged to their full length and width. Panels the length of which exceeds the screen height are reduced to full screen height.

Actuating this softkey quits the MODIFY mode and the selected panel becomes active again.



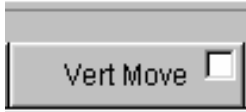
When the **Horiz Move** button is selected, the rotary knob can be used to move the panel/window horizontally without changing the size.

When all modifications to the panel have been made, pressing the **MODIFY** key restores the original operating mode.



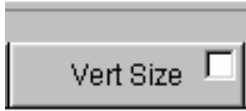
When the **Horiz Size** button is selected, the rotary knob can be used to resize the panel/window (the right-hand edge of the selected panel is moved).

When all modifications to the panel have been made, pressing the **MODIFY** key restores the original operating mode.



When the **Vert Move** button is selected, the rotary knob can be used to move the panel/window vertically without changing the size.

When all modifications to the panel have been made, pressing the **MODIFY** button restores the original operating mode.



When the **Vert Size** button is selected, the rotary knob can be used to resize the panel/window (the bottom edge of the selected panel is moved).

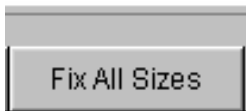
When all modifications to the panel have been made, pressing the **MODIFY** key restores the original operating mode.



Actuating the **Fix Size** button fixes the size of the selected panel/window. If, for example, additional fields appear in the panel when certain functions are selected, the panel is not enlarged (only the scroll bar indicates the presence of additional fields).

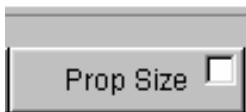
Actuating the button deactivates the size-fixing function.

Actuating this softkey quits the MODIFY mode and the selected panel becomes active again.



Actuating the **Fix All Sizes** button fixes the size of all panels/windows visible on the screen. If, for example, additional fields appear in a panel when certain functions are selected, the panel is not enlarged (only the scroll bar indicates the presence of additional fields).

Actuating this softkey quits the MODIFY mode and the selected panel becomes active again.



When the **Prop Size** button is selected, the rotary knob can be used to resize the panel/window both horizontally and vertically at the same time (the right-hand and bottom edge of the selected panel is moved).

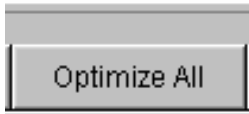
When all modifications to the panel have been made, pressing the **MODIFY** key restores the original operating mode.



Actuating the **Default All** button resizes each panel in the selected display screen so that all of the parameter fields are visible. If the panel is longer than the screen height, it is reduced to full screen height.

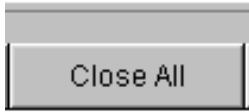
Graphical windows are resized to  $\frac{1}{4}$  screen size.

Actuating this softkey quits the MODIFY mode and the selected panel becomes active again.






If the **Optimize All** button is actuated, the R&S UPV attempts to display all of the panels open in the screen in an optimum format. This function is most effective when only a small number of panels are open.

Actuating this softkey quits the MODIFY mode and the selected panel becomes active again.



When the **Close All** button is selected, all of the panels and measurement windows displayed on the screen are closed. The function corresponds to the **CLOSE** key, except that it affects all panels and measurement windows displayed on the screen.

Actuating this softkey quits the MODIFY mode and the selected panel becomes active again.

Function	Front panel	PC keyboard	Mouse
<b>Enlarge graphical window to full screen size</b>	Press <b>MODIFY</b> key and actuate F5 softkey.	Press key combination ALT + M and then F5 key.	Click  button in title bar of respective graphical window.
<b>Move panel/graphical window</b>	Press <b>MODIFY</b> key, select direction of movement using softkey and move panel using rotary knob.	Press key combination ALT + M, select direction of movement using keys F6 or F8 and move panel using keys TAB and SHIFT + TAB.	Click title bar of panel and drag to resize.
<b>Resize panel/graphical window horizontally and vertically</b>	Press <b>MODIFY</b> key, select resizing direction using softkey and resize panel using rotary knob.	Press key combination ALT + M, select resizing direction using keys F7 or F9 and resize panel using keys TAB and SHIFT + TAB.	Drag top/bottom or side edge of panel.
<b>Resize panel/graphical window proportionally (horizontally and vertically)</b>	Press <b>MODIFY</b> key, change to second level using  button, actuate F6 softkey and resize panel using rotary knob.	Press key combination ALT + M, press F12 key and then F6 key, and resize panel using keys TAB and SHIFT + TAB.	Drag one corner of panel.
<b>Fix size of panel/graphical window</b>	Press <b>MODIFY</b> key and actuate <b>Fix Size</b> or <b>Fix All Sizes</b> button.	Press key combination ALT + M, then press F10 or F11 key.	---
<b>Set all panels/graphical windows to default layout</b>	Press <b>MODIFY</b> key and actuate <b>Default All</b> button.	Press key combination ALT + M and then F7 key.	---
<b>Display all panels/graphical windows with optimum layout</b>	Press <b>MODIFY</b> key and actuate <b>Optimize All</b> button.	Press key combination ALT + M and then F10 key.	---
<b>Close all panels/panel on screen</b>	Press <b>MODIFY</b> key, change to second level using  button and actuate F10 softkey.	Press key combination ALT + M, F12 key and then F10 key.	---

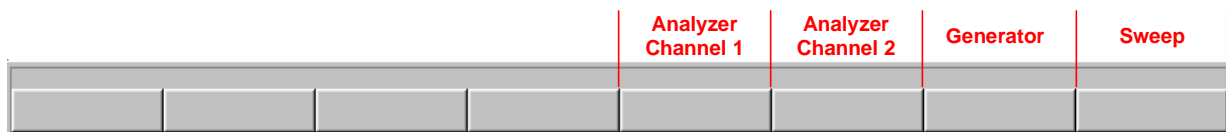
## Status Displays and Messages

In some cases, the user is presented with additional information on the screen. This information includes status messages, messages concerning the value ranges, information on settings, warnings and error messages.

### Status displays

The status of the R&S UPV is continuously displayed for the generator, analyzer, sweep system and other instrument states at the bottom of the screen above the four right-hand softkeys.

Status displays always appear at the same position; they are assigned to the fields above the softkeys as shown in the illustration below. Displays which concern the analyzer in both channels occupy both analyzer fields.



A list of all possible status messages can be found at the end of this chapter (section ["Overview of Status Messages"](#), page 3.116).

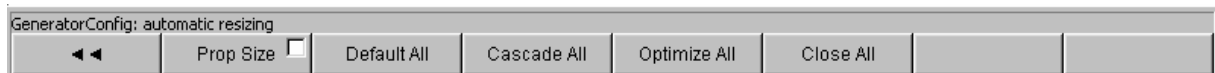
### Valid value range

Information on the possible entries is given at the bottom of the screen above the softkey bar. The ranges for value entries specified here always take the current status of the instrument into consideration and therefore depend on the presets already configured. Below is an example for entry of the generator output voltage:



### Information

Information concerning the panel settings and so on is also given at the bottom of the screen above the softkey bar (only the space above the four left-hand softkeys is used).



## **Warnings**

If the user attempts to make measurement settings which conflict with the usual test specifications, warnings appear on the screen; and remain there until they are acknowledged with ENTER.

Warnings are issued if no measurement results are produced during measuring mode. This is normally the result of unsuitable input signals or settings. For example, input signals may be too low to produce a stable measurement result. In this case, a warning is displayed in the middle of the screen instead of the measurement result. The warning indicates why no measurement result can be displayed and may also list several reasons for this.

## **Error messages**

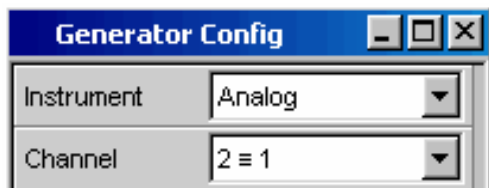
If faults in the instrument occur during operation, an error message appears in the middle of the screen. This message remains on screen until it is acknowledged with ENTER.

# Panels

## Panel and Window Types

In the case of the Audio Analyzer R&S UPV, associated settings and functions are always combined in "panels". Each of these panels has a name (headline in the title bar) by which it is called up.

Only one panel can have the focus, i.e. only one panel can be active at any one time. The panel with the focus can be identified by its blue title bar.



The Audio Analyzer R&S UPV distinguishes between the following panels and display windows:

- **panels** used to make function settings
- **configuration panel** used for configuring how the measurement values are to be displayed
- **numeric display fields** for displaying the measurement values of the various measurement functions
- **combi displays** in which the numeric display of measurement values can be supplemented by bargraphs, min/max values and limit monitoring
- **graphical windows** in which measurement values are displayed in the form of diagrams
- **data lists** in which the measurement values are listed in tabular form

A detailed list of all panels together with the most important setting parameters can be found at the end of this chapter (see ["Overview of Panels and Measurement Displays \(Graphical Windows\)"](#), page 3.112).

## Opening, Operating, Hiding and Closing Panels

Each panel and display window is a separate panel which can be either closed, opened or hidden. All panels/display windows visible on the currently displayed screen are referred to as being "open". If the panel is minimized and moved to the bottom of the screen, it is referred to as being "hidden". In both cases, the panel/window is assigned an entry in the WINBAR at the bottom of the display.

The same panel or display window can be displayed (i.e. opened) in several screens. The display characteristics (position, size) can be different for each of the screens; the content is, however, always the same.



**Open panel**

Panels/display windows are open if they are visible on the currently displayed screen.

A panel is opened on the currently displayed screen by activating the menu bar using the **MENÜ** key, highlighting the **Instruments** or **Disp Config** button with the rotary knob or cursor keys, opening the pulldown menu with the **ENTER** key or rotary-knob click, and highlighting and selecting a panel.

Graphical windows are selected in the same way, except that they are listed under the **Displays** button.

**Activate panel**

Only one panel can be active on the screen at any one time.

Every open or hidden panel can be activated using the softkeys on the WINBAR or using the **Windows** key (active panels are identified by their blue title bar).

**Hide panel**



Open panels/display windows can be minimized and placed at the bottom of the screen. They are referred to as being "hidden".

A panel must be activated before it can be hidden. It is then hidden by pressing the **HIDE** key.

**Close panel**

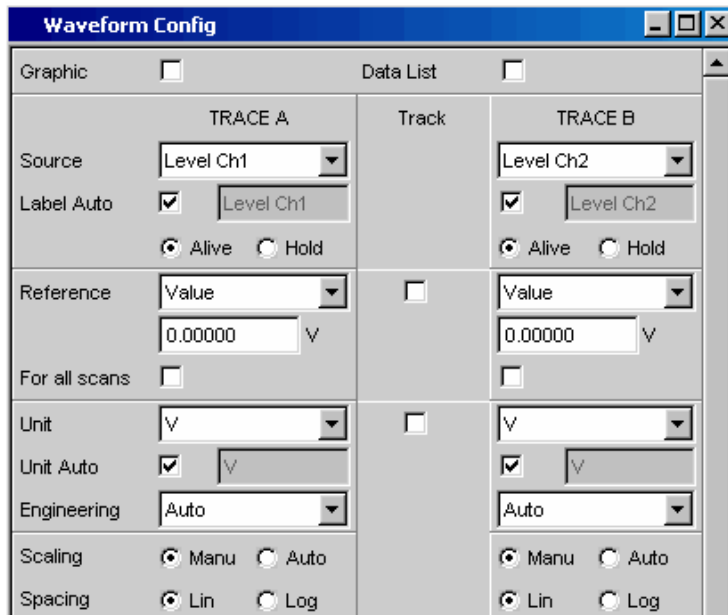
A panel must be activated before it can be closed. It is then closed by pressing the **CLOSE** key and no longer appears on the WINBAR.

The table below shows the alternative operating modes for mouse and external keyboard:

Function	Front panel	PC keyboard	Mouse
<b>Open panel</b>	Press <b>MENÜ</b> key and highlight <b>Instruments</b> , <b>Disp Config</b> or <b>Displays</b> button using rotary knob or cursor keys, open pulldown menu using <b>ENTER</b> key or rotary-knob click, and highlight and select a panel.	Press key combination CTRL + M, then highlight <b>Instruments</b> , <b>Disp Config</b> or <b>Displays</b> button using TAB or SHIFT + TAB keys, open pulldown menu using Enter key, highlight a panel using cursor keys and select using Enter key.	Open menu bar by moving to left edge of screen, actuate <b>Instruments</b> , <b>Disp Config</b> or <b>Displays</b> button and click desired panel.
<b>Activate panel</b>	Press <b>WINBAR</b> key and actuate softkey of desired panel.	Press key combination ALT + F5, then actuate softkey of desired panel using appropriate key F5 to F12.	Click anywhere in desired panel.
<b>Hide panel</b>	Pressing <b>HIDE</b> key hides currently active panel.	Pressing key combination ALT + H hides currently active panel.	Click  button in title bar of respective panel.
<b>Close panel</b>	Pressing <b>CLOSE</b> key closes currently active panel.	Pressing key combination ALT + C hides currently active panel.	Click  button in title bar of respective graphical window.

## Panel Structure

This section describes the panel structure. The section ["Opening, Operating, Hiding and Closing Panels"](#), page 3.20 describes how to operate panels on the screen; the section ["Selecting a Parameter – Selection Fields"](#), page 3.33 describes how to set the parameters. The panels are in Windows® format. They differ in detail depending on their function but they consist of the same main elements.





Panels consist of up to three columns, depending on the function block on which the panel is based. For example, two-channel functions are operated in panels with two columns. When defining graphical windows, settings from Trace 1 can be adopted for Trace 2 in a third column between the two original columns so that Trace 2 does not have to be configured separately.


Each panel contains a selection of different parameter fields which are combined in groups. Various types of parameter fields, which are operated in different ways, are used. The parameter fields have labels indicating their function.

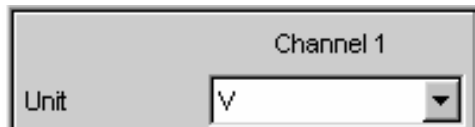
Panels consist of the following elements:



#### Title bar

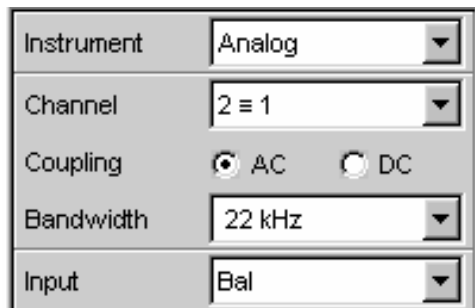
The top field contains the name of the panel ("Analyzer Function" in the example) and the title-bar buttons for hiding  and closing  the menu. The buttons can be operated with the mouse. For operation using the front panel, the **HIDE** and **CLOSE** keys can be used.

The  button maximizes graphical windows so that they cover the entire screen (see "[WINBAR and Softkeys](#)", page 3.12).



#### Headlines in panels

With multi-column panels, each column has a headline.



#### Function groups

In panels, parameter fields which belong together with respect to their function are frequently combined in function groups. Grey lines indicate these groups.



#### Numeric entry field

A numeric value (e.g. the frequency) can be entered in this field.



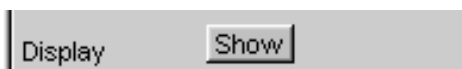
#### Units

The unit of a numeric value is displayed next to the entry field. When the value is entered, all possible units are offered on the softkey bar (on more than one level where necessary). The entry can be completed by selecting the unit using a softkey. The unit can be changed after the entry has been made. In this case, the physical value remains unchanged; however, the value displayed in the entry field is adapted automatically to the changed unit.



#### Text entry field

An alphanumeric value (e.g. a label text) can be entered in this field.



#### Button

Buttons are used to trigger actions; here, for example, to show the display of a measurement graph.



### Tick box

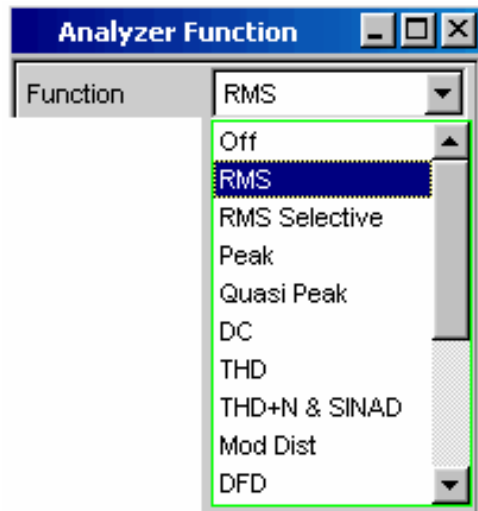
If a tick box is activated, the assigned setting can be disabled or enabled.




### Radio button

With radio buttons, it is possible to toggle between two settings by simply clicking the desired setting.

Only one of the two options can be active at any one time.



### Selection field

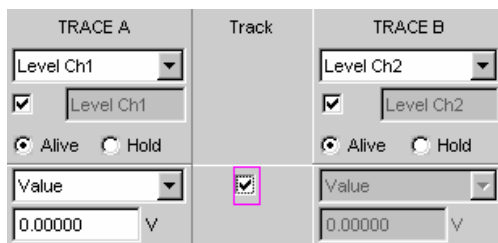
The  button indicates that a parameter list is available. The fold-down parameter list is displayed below the selection field. Depending on the number of items, the full list or only part of it is shown.

Only one item at a time can be selected from the parameter list.



### Display fields

Some settings can only be made in a specific configuration. If the setting is not permitted with the specific configuration selected, the respective item is disabled and displayed in grey and the field cannot be accessed. In this case, the field acts as a display field, i.e. the value displayed there corresponds to the value actually set.



### Track box

With multi-column panels, settings can be transferred from the left-hand to the right-hand column without the parameter having to be entered a second time. If the track box has a checkmark, all of the settings within the function group are applicable to both columns. All fields with transferred settings are shown as display fields and cannot be accessed while the track function is active.

Zooming	<input type="checkbox"/>
Start	<input type="text" value="0.00000"/> Hz



Zooming	<input checked="" type="checkbox"/>
Zoom Fact	<input type="text" value="2"/>
Center	<input type="text" value="10000.0"/> Hz
Span	<input type="text" value="21.94 kHz"/>
Start	<input type="text" value="0.97656"/> Hz



**Hidden parameter fields**

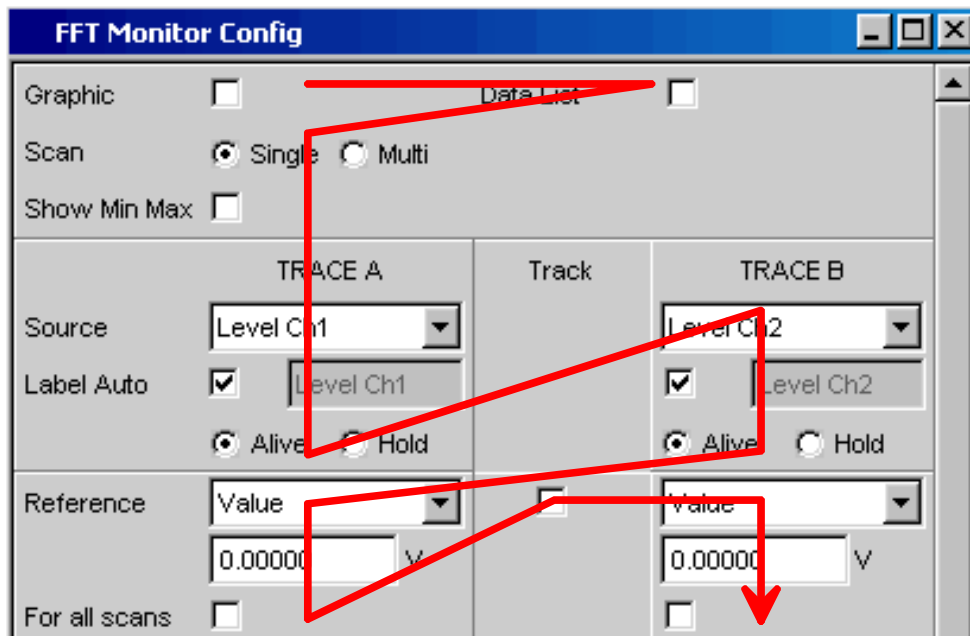
The R&S UPV always attempts to keep the panels as short as possible. For this reason, unneeded fields are hidden. The example to the left demonstrates this more clearly: The fields for Zoom Factor, Center and Span only appear if the Zooming function is activated.

## Navigating in the Panels

If a panel has more fields than can be displayed on the screen or if the size of the panel has been fixed such that its full length cannot be displayed (see ["Moving and Resizing Panels and Graphical Windows"](#), page 3.14), the scroll bar appears along the right-hand side of the panel. The length of the scroll bar symbolizes the overall length of the panel; the dark part of the scroll bar indicates which section of the panel is currently visible.

There are various ways of navigating inside panels, i.e. moving the entry focus:

- With operation via the front panel, the easiest navigation method is using the rotary knob. Turning the rotary knob clockwise moves the focus down or to the right. Here the focus first moves to the right inside a field, then down through the current group, then jumps over to the right-hand column, down again to the end of the group from where the focus then moves to the left-hand column of the following group, and so on.
- Alternatively, the cursor keys  and  can also be used for navigation; the movement sequence is the same as that described for operation using the rotary knob.
- In the case of an external PC keyboard, the cursor keys  $\uparrow$  and  $\downarrow$  can be used to move around a panel. Once again, the movement sequence is the same as that described for navigation using the rotary knob. The TAB and SHIFT + TAB keys on the external keyboard can also be used as an alternative to the cursor keys.
- The mouse can also be used to move inside the panels in the same way as other Windows® applications, i.e. by directly clicking the desired parameter fields or by moving the scroll bar.



## Settings on the Audio Analyzer R&S UPV

The R&S UPV offers several and sometimes alternative options for setting parameters. Operation is possible via the front panel, using a mouse and/or a connected PC keyboard (see the sections ["Using the Rotary Knob"](#), ["Operation Using the Mouse"](#) and ["Operation Using an External PC Keyboard"](#) from page 3.8 onwards). The tables below list the operating options with the available entry media.

Some keys on the front panel of the R&S UPV trigger a setting immediately; for example, the **OUTPUT OFF** key deactivates or reactivates all outputs. An overview showing the function of all keys can be found at the end of this chapter (section ["Overview of Keys"](#), page 3.108).

Most of the parameters are set in the panels. The panels are operated on the screen in the way described in the section ["Opening, Operating, Hiding and Closing Panels"](#) (see page 3.20). How to enter and select setting parameters in the panels is described in the following sections; a detailed description of all setting parameters can be found in Chapter 4, ["Instrument Functions"](#).

Entries for file management tasks, such as saving and loading instrument settings, saving files, and so on, are made in special panels. Refer to the section ["File Management"](#) (see page 3.91) for more detailed information.

A number of settings are made via the menu bar. These include all global configuration settings for the R&S UPV, e.g. setting of the IEC/IEEE-bus address, the function of the H Copy key, etc. More detailed information can be found in the section ["Settings in the Menu Bar"](#) on page 3.82 and in Chapter 4, ["Instrument Functions"](#).

The R&S UPV uses the WindowsXP® Embedded operating system. Settings at system level are only rarely required, e.g. installation of a new printer driver. Connecting a keyboard and mouse makes Windows® easier to use.

## Settings in the Panels



Associated settings and functions are combined in panels of the Audio Analyzer R&S UPV. Each function block has its own panel.

The panels can be set independently of each other; however, there are also a number of interdependencies. For example, the digital measurement function of the protocol analysis only appears in the **Analyzer Function** panel if a digital analyzer has been selected in the **Analyzer Config** panel. If an analog analyzer is selected, the protocol analysis is automatically deactivated in the **Analyzer Function** panel and a message is displayed on the screen.

### Focus

Panels can only be operated if they have the focus (indicated by the blue title bar).

The simplest way of changing from one panel to another in the case of operation via the front panel is

using the direction keys . The  key switches from panel to panel in the sequence in which the panels were opened. Hidden panels are not highlighted. Changing to a different open (or to a hidden) panel is also possible using the WINBAR; this has already been explained in the section ["WINBAR and Softkeys"](#) on page 3.12.

Before settings can be made in a panel, the relevant parameter field must be highlighted, i.e. it must have the focus. This is indicated by a selection frame which is blue, green or magenta depending on the entry mode.

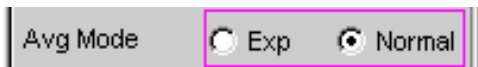
The colors of the selection frame have the following meaning:



A blue selection frame indicates a highlighted field.



A green selection frame highlights fields in which parameters can be selected or in which an entry can be made without the selection / entry having an immediate effect on the hardware of the R&S UPV.



A magenta selection frame indicates that selecting a button, activating a tick box or changing a numeric value will be immediately passed on to the hardware and executed.

When the instrument is switched on, the most recently saved instrument settings are loaded automatically so that the instrument is in the same state as it was before power-off. The focus is placed on the first position of the active panel.

Panels are opened using the menu bar (see the section ["Open panel"](#), page 3.21). How to move the focus is described in the section ["Navigating in the Panels"](#) (see page 3.26).



## Changing the Instrument

The Audio Analyzer R&S UPV can, depending on the installed options, be used at analog and digital interfaces. Optional plug-ins can be installed to allow additional interfaces to be operated. Each of these interfaces determines the basic characteristics of the R&S UPV, whereby these characteristics are separate for generator and analyzer. These interface characteristics define quasi-independent instruments within the R&S UPV. The settings for these instruments are made in the selection field in the first field of the **Generator Config** and **Analyzer Config** panel.



Each of these instruments has its own data set. If a different instrument is selected, this data set is saved. As a result, the previous settings are available when the original instrument is selected again.

The data set has a different content for each instrument. The data sets differ with regard to the following points:

- **Selection of parameter fields / parameters**  
Example: In the case of analog instruments, all settings for configuring the analog interfaces are available (e.g. impedances); all settings for the other instruments, e.g. the digital sampling rate and so on, do not appear in the panel but remain in the background.
- **Valid value range of parameters**  
For example, the frequency ranges can be different in the different instruments.
- **Units used**  
Levels are given in different units in analog and digital applications.
- **Selection of functions**  
A number of measurement functions are only available for digital audio applications; they are therefore not offered in analog instruments. Examples: Digital protocol analysis, jitter, etc.

The examples given above show that the choice of instrument not only affects the Generator Config and Analyzer Config panel, but also has an effect on the other panels.

## Changing Functions

The principles that apply to changing an instrument also apply to changing functions (e.g. from an RMS measurement to a THD measurement or from generating a sinusoidal to a multi-tone signal):

Each measurement function and generator function has its own data set. If a different function is selected, this data set is saved. As a result, the previous settings are available again when a different function is selected.

The data set has a different content for each function. The data sets differ with regard to the following points:

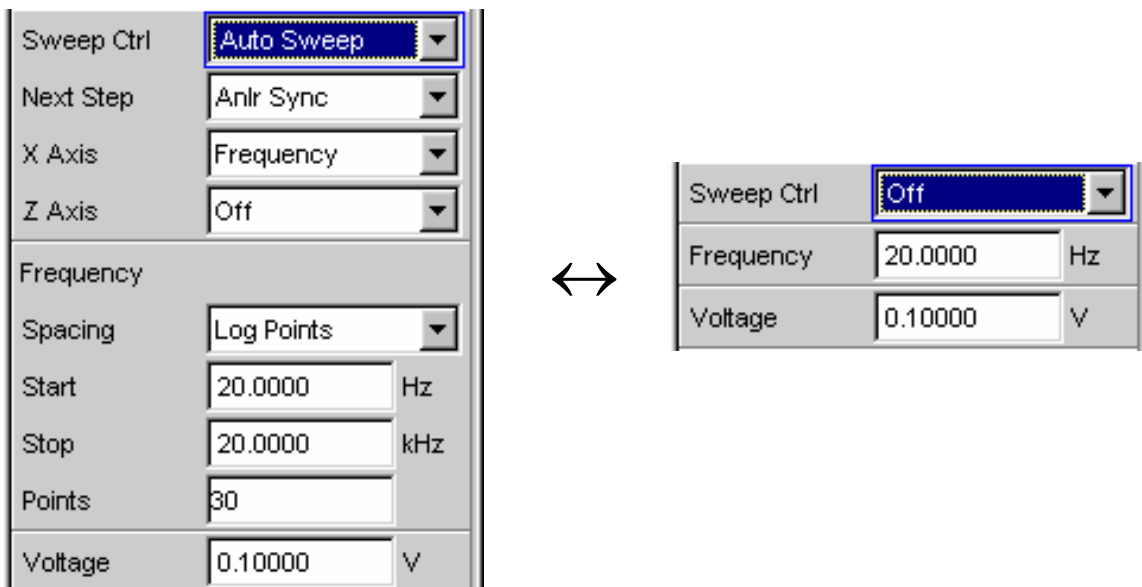
- **Selection of parameter fields / parameters:**  
Example: With the RMS measurement, various measurement times are offered; this is not the case for the FFT analysis.
- **Valid value range of parameters**  
For example, the frequencies which can be set for intermodulation test signals are different to those which can be set for sinusoidal signals.
- **Units used**  
For example, THD measurements and level measurements are given in different units.

The following generally applies: All the settings for the other functions, e.g. filter settings and so on, remain in the background with the function settings and are displayed in the panel and set in the instrument again the next time this function is called up.

## Hiding Parameter Fields

The R&S UPV always attempts to keep the panels as short as possible. For this reason, unneeded fields are hidden.

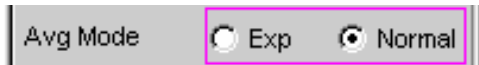
The example below explains this more clearly: As soon as **Auto Sweep** is selected in the **Sweep Ctrl** menu item in the **Generator Function** panel, all of the fields required for configuring the sweep are displayed in the panel (together with the parameters set for the sweep last performed). If the sweep is deactivated, all of the sweep parameter fields are hidden. The user is presented with a shorter panel and is not burdened with parameter fields which are currently not needed.



### Note:

*The sequence of the individual parameter fields in the panel is such that changes to parameters usually only cause changes in the fields below. When making settings in panels, it is therefore recommended to begin at the top of the panel and work down.*

## Highlighting Control Elements



A control element is always selected in the same way, regardless of whether it is a tick box, radio button, entry field and so on.

A control element is activated by shifting the focus to this element. The entry focus is indicated by a blue, green or magenta border.

The entry focus can be moved using the rotary knob, cursor keys or mouse. Refer to the section ["Navigating in the Panels"](#), page 3.26.

## Activating/Deactivating Functions – Tick boxes



A tick box is always used for functions which can be activated and deactivated only. If the tick box is activated (checkmark), the assigned setting can be disabled or enabled.

Before a function can be activated and deactivated, the associated element must be highlighted (see the section ["Highlighting Control Elements"](#), page 3.31). The highlighted element is then activated or deactivated (toggle function) using the ENTER functions of the various entry media (  key, rotary-knob click and so on).

If the mouse is used, functions are activated/deactivated as soon as the tick box is clicked.

Function	Front panel	PC keyboard	Mouse
Activate/deactivate	Highlight desired element using rotary knob or cursor keys, activate/deactivate function with rotary-knob click or <input type="text" value="ENTER"/> key.	Highlight desired element using cursor keys, activate/deactivate function with Enter key.	Click tick box.

## Toggling Functions – Radio Buttons



Radio buttons are used for functions which can be toggled between two settings. A black dot in the appropriate button indicates the selected status.

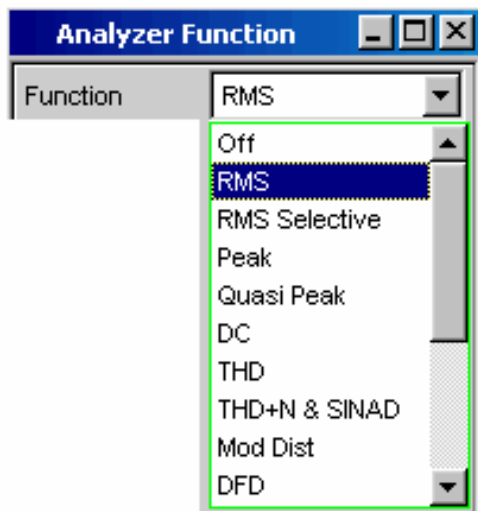
Only one of the two options can be active at any one time.


Before a function can be toggled, the associated element must be highlighted (see the section "[Highlighting Control Elements](#)", page 3.31). The ENTER functions of the various entry media can then be used to switch between the two settings (toggle function).

If the mouse is used, settings are executed as soon as the corresponding radio button is clicked.





Function	Front panel	PC keyboard	Mouse
<b>Toggle</b>	Highlight desired element using rotary knob or cursor keys, toggle function with rotary-knob click or <b>ENTER</b> key.	Highlight desired element using cursor keys, toggle function with Enter key.	Click desired radio button.

## Selecting a Parameter – Selection Fields



Actuating the  button opens a selection field. As soon as a parameter field has the focus, a list for selecting the available parameters can be opened with a rotary-knob click, the **ENTER** key or by clicking with the mouse. The fold-down parameter list is displayed below the selection field.

Selection is made by highlighting the desired item and confirming with **ENTER**; only one item at a time can be selected.

Items in the parameter list are highlighted using the rotary knob, the cursor keys   or the keys  .

If a mouse is used, the items are selected and activated by clicking with the mouse.

The parameter list can be quit without adopting the highlighted parameter by pressing the **ESC** key.




If the list is longer than the displayed window, a scroll bar is available.

**Note 1:**

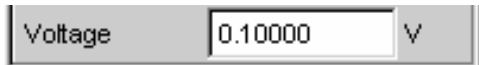
*The contents of the parameter lists are not fixed but vary depending on other settings selected.*

**Note 2:**

*Alternatively, parameters can also be selected using the softkeys (see the section "WINBAR and Softkeys", page 3.12).*

Function	Front panel	PC keyboard	Mouse
Open parameter list	Rotary-knob click or press <b>ENTER</b> key.	Press Enter key.	Click  button.
Scroll	Move displayed section of list using rotary knob or up/down cursor keys.	Move displayed section of list using up/down cursor keys.	Click  or  button in scroll bar until desired item is displayed.
Select parameter	Highlight selection using rotary knob or up/down cursor keys and confirm with rotary-knob click or <b>ENTER</b> key.	Highlight selection using up/down cursor keys and press Enter key.	Click parameter.
Quit parameter list without adopting a setting	Press <b>ESC</b> key.	Press ESC key.	Click anywhere outside parameter list.

## Numeric Entries – Numeric Entry Fields



Numeric values (e.g. the output voltage) can be entered or edited in these fields.

This can be done in various ways. However, the following applies irrespective of the chosen method:

---

**Note:**

*Entries outside the possible value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value. The possible value range is displayed above the softkey bar.*

---



## Value entries in Edit mode – green selection frame



When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame. In addition, the current numeric value is highlighted with a blue background.



If a completely new value is to be entered, simply begin entering digits using the numeric keypad on the front panel or external PC keyboard; the old value is deleted automatically when the first key is pressed. The digit to the left of the cursor can be deleted at any time during entry using the **UNDO** key.

If certain digits only are to be changed, position the digit cursor accordingly using the  or  cursor key and enter the new digits (if the position of the digit cursor is changed before the first digit is entered, the old value will not be deleted). The default setting is insert mode. It is only possible to change between insert and overwrite mode if an external PC keyboard is used.

The numeric entry field is closed with:

**ENTER** The newly entered value is adopted.

**ESC** The old value is retained.

**Softkeys** The selected unit is set and adopted together with the newly entered value.

The entry is set in the hardware as soon as the numeric entry field is closed.

---

**Note:**

*Only the number keys and cursor keys are accepted; the rotary knob, letters and special characters have no effect when numeric values are being entered.*

---

## Value entries in Direct mode – magenta selection frame





When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame.

Changing to the Direct mode is performed by pressing the **ENTER** key or with rotary-knob click, the selection frame is changed to magenta.

The digit cursor then moves to the first digit to the right of the decimal point or, if there is no decimal point, to the digit at the extreme right.

A digit can now be entered using the keypad on the front panel or the external PC keyboard; the digit at the cursor position is replaced. The cursor does not change its position.

The digit cursor can be placed at a different position at any time using the  and  cursor keys. Digits are then entered at the new position.

Entries in Direct mode are always made in overwrite mode (this also applies when an external PC keyboard is used).

In Direct mode, every setting change is immediately passed on to the hardware and executed.

The Direct mode can be quit using the ENTER function, the **ESC** key or by clicking in a different field with the mouse.




---

### Note:

*Only rotary-knob entries, number keys and cursor keys are accepted; letters and special characters have no effect.*

---

## Rotary-knob entries in Direct mode – magenta selection frame

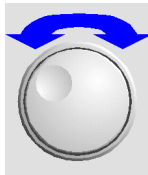


When the focus is moved to a numeric entry field, the system enters Edit mode, which is indicated by a green selection frame.





Changing to the Direct mode is performed by pressing the **ENTER** key or with rotary-knob click, the selection frame is changed to magenta.

The digit cursor then moves to the first digit to the right of the decimal point or, if there is no decimal point, to the digit at the extreme right.





The highlighted digit can then be changed directly using the rotary knob, whereby the numeric value is "carried over", i.e. transferred to the next digit.

The digit cursor can be placed at a different position at any time using the  and  cursor keys so that other digits can be changed using the rotary knob.

This method is ideal for calibration work as every change has an immediate effect in the hardware.

Value entry can be completed with a rotary-knob click or, alternatively, using the ENTER function, the **ESC** key or by clicking in a different field with the mouse.



As an alternative to the rotary knob, the numeric values can also be changed using the  and  cursor keys.

---

### Note:

*Changes made to values using the rotary wheel are not accepted if the entries are outside the possible value range; an audible warning is issued and the entry is changed to its permissible minimum or maximum value. The possible value range is displayed above the softkey bar.*

---



## Entering / changing the unit of a value

v

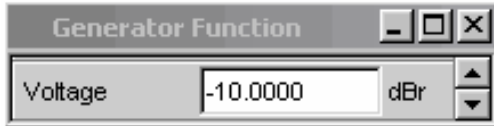
The unit of a numeric value is displayed next to the entry field. When the value is entered, all units available for the respective function are offered on the softkey bar (on more than one level where necessary). The entry can be completed by selecting the unit using a softkey.

This is done differently depending on the selected mode:

- In Edit mode, the newly entered numeric value is adopted and set together with the selected unit.
- In Direct mode, the physical value (number with the previously selected unit) is converted to the newly selected unit and adopted as the new numeric value.

It is possible to change the unit in any highlighted numeric field using the softkeys at a later stage after value entry has been completed and also if the value itself is not to be changed. In this case, the physical value remains unchanged (as in the Direct mode); however, the value displayed in the entry field is adapted automatically to the changed unit. This function allows numeric values to be "converted" to other units very easily.

## Information on using reference values when entering values



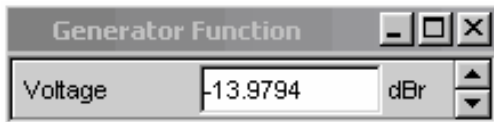
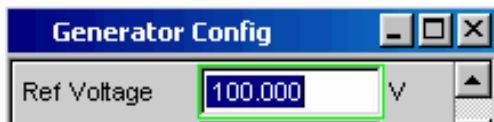
The Audio Analyzer R&S UPV allows reference values to be used when entering various values. These reference values are used as a basis for settings for other parameters.

The example below explains these interdependencies:


















A reference voltage (Ref Voltage) can be set in the **Generator Config** panel. The actual output voltage is set in the **Generator Function** panel where the unit is dBr, i.e. it is possible to enter the output voltage in dB relative to this reference value.

This method is particularly useful if, e.g. with an A/D converter, the clipping level has been determined and other measurements (frequency response, THD+N, etc) have to be performed using test signals which are a certain dB value (defined in the test specifications) below this full-scale level.

However, it is important to note that the maximum values of the R&S UPV cannot be exceeded; this applies to both system-specific maximum values and maximum values which originate from other elements (here for example the Max. Voltage setting).



If by increasing the reference value the maximum output voltage is exceeded, the value for Voltage in the **Generator Function** panel is automatically reduced. In the example shown opposite, the maximum output voltage of 20 V forms the limit; setting the reference value to 100 V results in a reduction of the Voltage value in the bottom window.

Function	Front panel	PC keyboard	Mouse
Enter new value (Edit mode)	Highlight numeric entry field and enter new value directly using numeric keypad.	Highlight numeric entry field and enter new value directly using number keys.	---
Change individual digits (Edit mode)	Highlight numeric entry field, position digit cursor with  or  cursor key and enter new digit directly using numeric keypad.	Highlight numeric entry field, position digit cursor with  or  cursor key and enter new digit directly using number keys.	---
Complete value entry	Complete entry with  key.	Complete entry with ENTER key.	---
Complete value entry with unit selection	Press softkey with desired unit.	Use F5 to F12 keys to select desired unit.	Click softkey button with desired unit.
Quit value entry without adopting value	Press  key.	Press ESC key.	Click in a different entry field.
Change value (Direct mode)	Highlight numeric entry field, switch to Direct mode with  key, position digit cursor with  or  cursor key and enter new digit directly using numeric keypad. All changes are set directly in hardware.	Highlight numeric entry field, switch to Direct mode with ENTER key, position digit cursor with  or  cursor key and enter new digit directly using number keys. All changes are set directly in hardware.	---
Vary value (Direct mode)	Highlight numeric entry field, switch to Direct mode with rotary-knob click; position digit cursor with  or  cursor key. Vary numeric value using rotary knob. All changes are set directly in hardware.	Highlight numeric entry field, switch to Direct mode with ENTER key; position digit cursor with  or  cursor key. Vary numeric value using  or  cursor key. All changes are set directly in hardware.	---
Change unit	Highlight numeric entry field, select unit using appropriate softkey. Physical value is converted to new numeric value with newly selected unit.	Highlight numeric entry field, select unit using F5 to F12 keys. Physical value is converted to new numeric value with newly selected unit.	Highlight numeric entry field, click appropriate softkey button to select unit. Physical value is converted to new numeric value with newly selected unit.

## Alphanumeric Entries – Text Entry Fields



When the focus is moved to a text entry field, the system enters Edit mode, which is indicated by a green selection frame.

If the complete text (e.g. for graph labels) is to be newly entered, simply begin entering characters using the keypad on the front panel; the old text is deleted automatically when the first key is pressed. The keypad on the front panel of the R&S UPV is automatically switched to the mode for entering alphanumeric characters. Text is entered in the same way as on mobile phones: The characters assigned to a key are called up in sequence by repeatedly pressing the key (see also the section ["Overview of Keys"](#), page 3.108). A different key can be pressed immediately to enter the next character; a brief pause must, however, be made when entering characters assigned to the same key. The space character is assigned to the key, special characters are entered using the decimal-point key and the key is used to toggle between upper and lower-case characters.

The character to the left of the cursor can be deleted at any time during entry using the key.

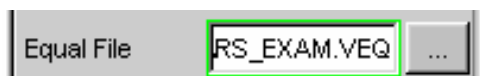
If an external PC keyboard is used, characters can be entered in the usual way.

If certain characters only are to be changed, position the cursor accordingly using the or cursor key and enter the new characters (if the position of the cursor is changed before the first character is entered, the old text will not be deleted). The default setting is insert mode. It is only possible to change between insert and overwrite mode if an external PC keyboard is used.







The text entry field is closed with:

ENTER      The newly entered text is adopted.

ESC        The old text is retained.



A text entry field also appears whenever files saved on the R&S UPV are to be called up (e.g. to load saved scans in a diagram) or special functions are to be adopted from files, and so on. Here, the file name can be typed or the button can be actuated to call up the file directory where the desired file can then be selected (details are given in the section ["File Management"](#) on page 3.91).

Function	Front panel	PC keyboard	Mouse
Enter new text	Highlight text entry field and enter new text directly using front panel keypad.	Highlight text entry field and enter new text directly using keyboard.	---
Change individual characters	Highlight text entry field, position cursor with  or  cursor key and enter new character directly using front panel keypad.	Highlight text entry field, position cursor with  or  cursor keys and enter new character directly using keyboard.	---
Complete character entry	Complete entry with  key.	Complete entry with ENTER key.	---
Quit text entry without adopting entered characters	Press  key.	Press ESC key.	Click in a different entry field.

## Display Fields



Sometimes it is very useful for operators to receive additional information about their settings. For example, the selected FFT parameter directly affects the frequency resolution in the displayed spectrum. Display fields inside the panels are used in such cases. These fields are shown in grey and cannot be accessed. They always contain valid values and therefore always show settings active in the background; the fields are updated as soon as a setting in the associated parameter field is changed.

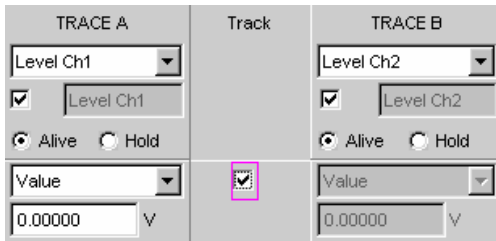
Depending on the settings selected beforehand, it may in some cases no longer be possible to operate certain elements – the entry field then becomes a display field and is shown in grey as described above.



Example: In the case of the analog generator, various impedances can be set for balanced output. If the generator is switched to unbalanced output, the entry field for impedance becomes a display field and shows the impedance that is valid in this case.

Display fields are also used when adopting parameters using track boxes.

## Adopting Parameters – Track Box



In many cases, settings are to apply e.g. to both measurement channels or to both traces. Here the R&S UPV provides multi-column panels which allow settings to be transferred from the left-hand to the right-hand column without the parameter having to be entered a second time.

The track boxes, which are displayed in a separate column, are used for this purpose. Track boxes always apply to an entire function group (information on function groups can be found in the section "[Panel Structure](#)" on page 3.22). If the track box has a checkmark, all of the settings within the function group are applicable to both columns. All fields with transferred settings in the right-hand column are shown as display fields. They appear grey and cannot be accessed while the track function is active. If a setting is changed in the associated setting field in the left-hand column, this change is also shown in the display field in the right-hand column.

## Help Functions

Information on the possible entries is given at the bottom of the screen above the softkey bar. The units offered in the softkey bar and the limits specified in the "Valid Range" field always refer to the highlighted parameter field. The valid value range is given in the unit currently selected.

Entries outside the specified value range are not accepted; an audible warning is issued and the entry is changed to its permissible minimum or maximum value.

### Note:

*The specified ranges for value entries always take the current status of the instrument into consideration. They are therefore not constant and depend on the presets already configured for other parameters.*

Below is an example for entry of the generator output voltage; additional units can be displayed by actuating the ►► button:



## Completing Settings

When numeric values are entered, the R&S UPV makes a distinction between Edit mode (indicated by a green selection frame) and Direct mode (indicated by a magenta selection frame). See also the section "[Numeric Entries – Numeric Entry Fields](#)" from page 3.34 onwards.

- Numeric entries in Edit mode are not adopted and set in the hardware until the ENTER function is actuated ( **ENTER** key or rotary-knob click) or a unit is selected using the softkey bar.
- In Direct mode, numeric values entered or changed using the rotary knob are immediately passed on to the hardware and executed.

With tick boxes, functions are activated and deactivated by the hardware as soon as the status of the tick box is toggled with the ENTER function. In the case of operation using the mouse, functions are activated/deactivated as soon as the tick box is clicked.

With radio buttons, settings are executed by the hardware as soon as the radio button is toggled with the ENTER function. In the case of operation using the mouse, functions are toggled as soon as the corresponding radio button is clicked.

A parameter from a selection field is also executed by actuating the ENTER function. In this case, a simple mouse-click will select and activate the desired parameter.

Most settings are made without any noticeable adjustment or calculation times. If a brief calculation time is necessary (e.g. to calculate a multi-tone signal adapted to the FFT analysis), the calculation is performed in the background while the current measurements are continued.

Function	Front panel	PC keyboard	Mouse
Complete numeric value entry (Edit mode)	Complete entry with <b>ENTER</b> key or  press softkey with desired unit.	Complete entry with ENTER key or  use F5 to F12 keys to select desired unit.	Click softkey button with desired unit.
Adopt changed numeric values in hardware immediately (Direct mode)	Highlight numeric entry field, switch to Direct mode with <b>ENTER</b> key, position digit cursor with <b>▶</b> or <b>◀</b> cursor key and enter new digit directly using numeric keypad.	Highlight numeric entry field, switch to Direct mode with ENTER key, position digit cursor with <b>→</b> or <b>←</b> cursor key and enter new digit directly using number keys.	---
Change numeric values with immediate adoption by hardware (Direct mode)	Highlight numeric entry field, switch to Direct mode with rotary-knob click; position digit cursor with <b>▶</b> or <b>◀</b> cursor key. Vary numeric value using rotary knob.	Highlight numeric entry field, switch to Direct mode with ENTER key; position digit cursor with <b>→</b> or <b>←</b> cursor key. Vary numeric value using <b>↑</b> or <b>↓</b> cursor key.	---
Activate/deactivate function	Highlight desired element using rotary knob or cursor keys, activate/deactivate function with rotary-knob click or <b>ENTER</b> key.	Highlight desired element using cursor keys, activate/deactivate function with Enter key.	Click tick box.

Function	Front panel	PC keyboard	Mouse
Toggle function	Highlight desired element using rotary knob or cursor keys, toggle function with rotary-knob click or <b>ENTER</b> key.	Highlight desired element using cursor keys, toggle function with Enter key.	Click desired radio button.
Select parameter from list	Highlight selection using rotary knob or up/down cursor keys and confirm with rotary-knob click or <b>ENTER</b> key.	Highlight selection using up/down cursor keys and press Enter key.	Click parameter.

## Entries During Measurement / Data Output

Entries can be made at any time.

### Single measurements, spectral displays:

If the entry affects parameters of the current measurement, the current measurement or output is terminated as soon as the entry is confirmed (the newly selected parameters are set and the measurement or output is restarted).

### Sweep activated:

Since changes to parameters during a sweep can influence the measurement and thus have a negative effect on the reliability of the results displayed in the screen graphic, the current sweep is stopped and then after restarted such changes are made.

### Entries which do not affect the measurement process:

Entries which do not affect the current measurement process (e.g. changing a unit) are adopted immediately without the current measurement being interrupted.



## Measurement Displays

The Audio Analyzer R&S UPV offers various types of measurement windows for displaying the results of the numerous measurement functions. The measurement results can be displayed as digital numeric values, in analog bargraphs, in result graphics or in data lists. The user can open any number of measurement windows on the screen. The size of the panels can be changed within wide limits, whereby the font size, scaling and so on are adapted automatically (see also the section ["Moving and Resizing Panels and Graphical Windows"](#) on page 3.14).

### Measurement Functions and Displaying Measurement Results

- **What** (which measurement function) is measured and **how** (which measurement method) measurement is performed, is preset in the **Analyzer Function** panel.
- The **panels for configuring the measurement value display** are used to determine how the measurement results are presented (i.e. which unit, how many digits, etc). A series of panels for the different measurement windows are provided for this purpose.
- The results are finally displayed in the various **measurement windows**.

The basic settings in these configuration panels and measurement windows are described in the following sections. A detailed description of the individual parameter fields can be found in Chapter 4 ["Graphical Display"](#).

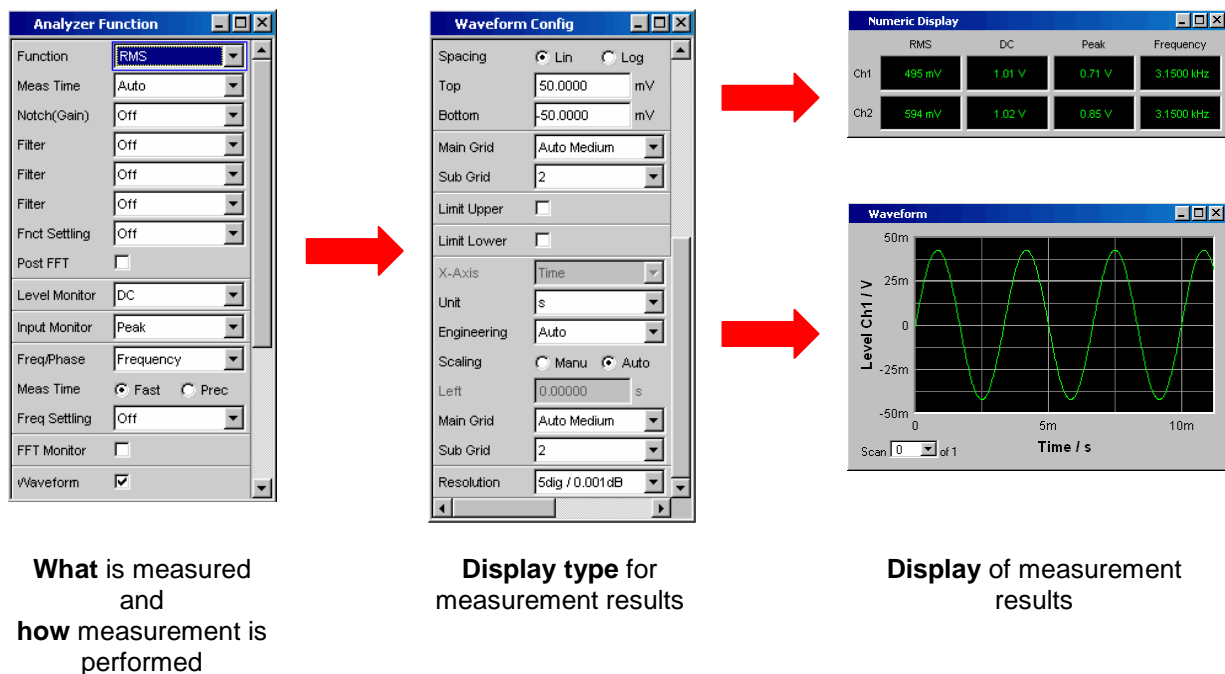


Fig.: 3-2 Measurements and display of results with Audio Analyzer R&S UPV

## Numeric Display Field

The numeric display field provides a clear overview of the numeric values from various analyzer functions and displays a maximum of 8 numeric value results from the **Analyzer Function** panel. The individual columns are permanently assigned, from left to right:

- Column 1:** Measurement results from the function which is set in the **Function** field of the **Analyzer Function** panel.
- Column 2:** Measurement results for the set **Level Monitor** function.
- Column 3:** Measurement results for the **Input Peak** function.
- Column 4:** Display of either the frequency measurement result or, if **Freq & Phase** or **Freq & GrpDel** is set, display of the frequency measurement result in the first row and display of the phase or group delay measurement in the second row.



Each column is labelled with the name of the displayed measurement function, whereby additional, more specific function-related information may also be shown. Example: With difference frequency distortion measurement, the type of measurement and the associated measurement standard, e.g. **DFD d2 (IEC 268)**, is also displayed.

The results from the two measurement channels are shown in both rows (exception: frequency/phase or frequency/group delay measurement).

If not all of the columns are required because one or more of the associated measurement functions is deactivated, the column in question is hidden.

The numeric display field is opened via the menu bar; it is called up using the **Displays** button.

Function	Front panel	PC keyboard	Mouse
Open numeric display field	Press <b>MENU</b> key and highlight <b>Displays</b> button using rotary knob or cursor keys, open pulldown menu with <b>ENTER</b> key or rotary-knob click, and highlight and select numeric display field.	Press key combination CTRL + M, then highlight <b>Displays</b> button using TAB or SHIFT + TAB keys, open pulldown menu using Enter key, highlight numeric display field using cursor keys and select using Enter key.	Open menu bar by moving to left edge of screen, actuate <b>Displays</b> button and click numeric display field.

## Measurement result display in numeric display field

The display of measurement results in the numeric display field is configured in the following panels:

- Funct Config
- Lev Mon Config
- Input Config
- Freq / Phase Config

The following examples of measurement value displays demonstrate the various display options. A number of basic settings made in these configuration panels are described in the following section. A detailed description of the display options can be found in Chapter 4 "[Graphical Display](#)".



If the measurement value is within the preset limits or no limits were specified, the measurement value is displayed in green on a black background.

A measurement value in a linear unit is displayed with 3 to 7 digits; a measurement value in logarithmic units can be displayed with a resolution of 0.1 dB to 0.00001 dB.



If the measurement value overranges or underranges preset limits, the measurement value is displayed in red on a black background.

As soon as the measurement value is within the limits again, it is displayed in green.



If one of the two measurement channels is deactivated, OFF appears in the associated measurement display.



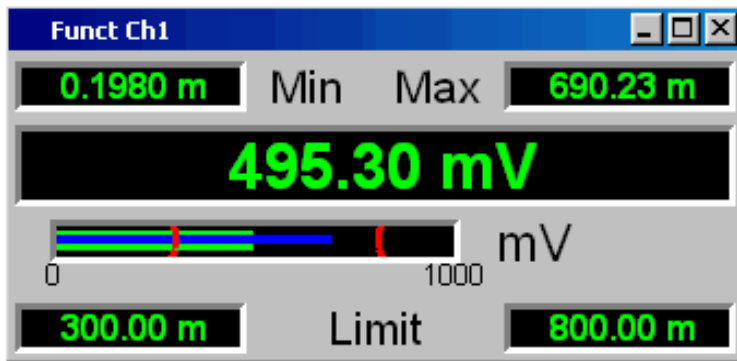
If no measurement result is available (e.g. there is no frequency result during a DC measurement), --- is displayed.

## Combi Display

It is often the case that the numeric value of a measurement result does not contain adequate information. Additional features such as analog bargraphs, limit monitoring or the storage of maximum and minimum values are frequently required.

The combi display is used for this purpose. Additional information can be displayed for every measurement shown in the numeric display field.

The free selection and free scalability mean that especially important or critical results can be monitored and tracked even when viewing the R&S UPV screen from a relatively long distance.



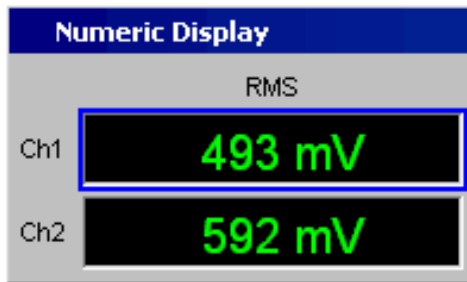
Measured minimum and maximum values

Measurement display

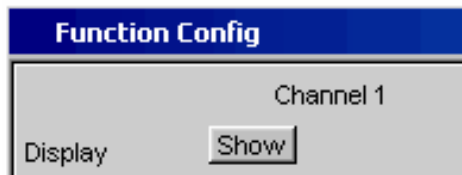
Bargraph

Limit settings

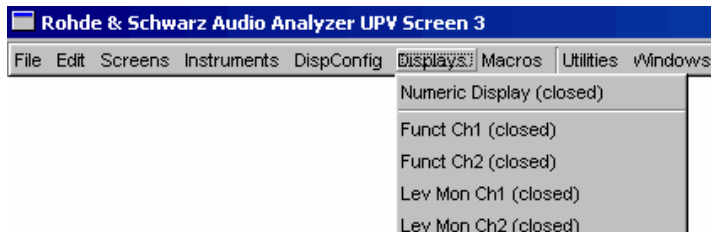
### Opening combi displays



The easiest way to open combi displays is to highlight the respective measurement display in the numeric display field (blue selection frame) and to trigger an ENTER function (ENTER key or rotary-knob click).



Alternatively, the combi displays can also be opened using the associated configuration panel (see the following section). The associated combi display is activated using the Show button in the Display line.



Another way is to open the combi display via the menu bar; they are called up using the Display button.

Function	Front panel	PC keyboard	Mouse
Activate combi display via numeric display field	Highlight desired measurement display in numeric display field and open combi display with <b>ENTER</b> key or rotary-knob click.	Highlight desired measurement display in numeric display field and open combi display with Enter key.	Double-click desired measurement display in numeric display field.
Activate combi display via Config panel	Highlight <b>DISPLAY</b> button in associated Config panel and open combi display with <b>ENTER</b> key or rotary-knob click.	Highlight <b>DISPLAY</b> button in associated Config panel and open combi display with Enter key.	Click <b>DISPLAY</b> button in associated Config panel.

### Settings for measurement result display in combined fields

Since a combi display is available for each measurement display of the numeric display field, up to eight of these displays can be opened. The settings for the combi displays (and for the numeric display field itself) are made in four configuration panels, whereby the two measurement channels are displayed in one panel. This results in the following four panels for configuring the measurement results in the combi displays:

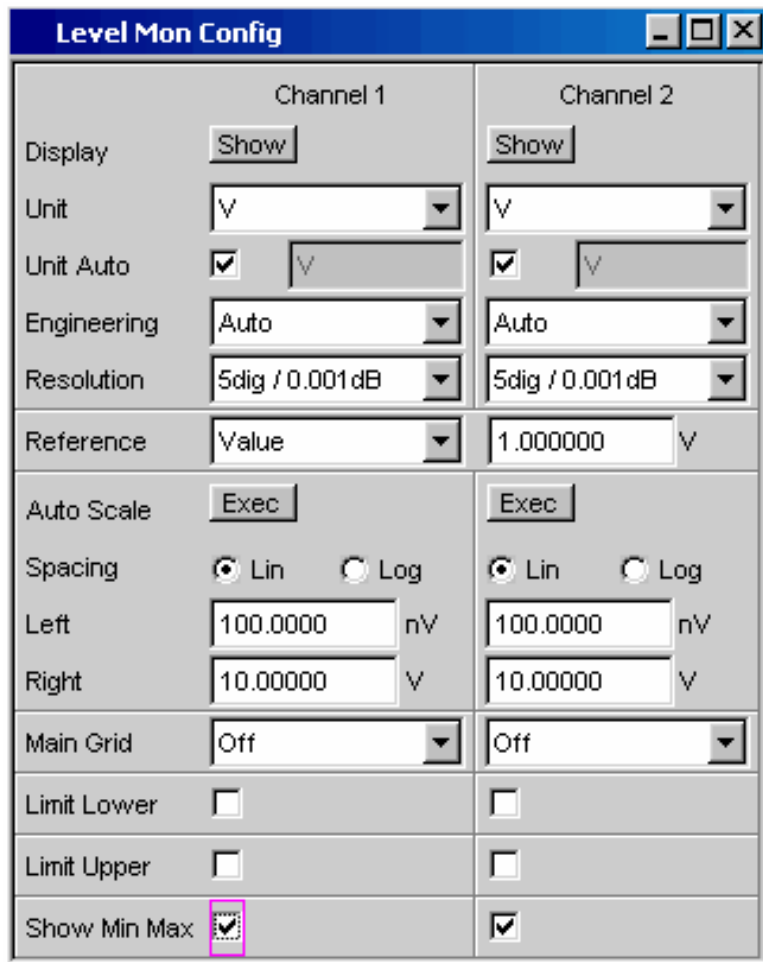
- Funct Config
- Lev Mon Config
- Input Config
- Freq / Phase Config

The associated panels for configuring the combi displays are opened via the menu bar; they are called up using the **Disp Config** button.

Function	Front panel	PC keyboard	Mouse
Open panel for configuring combined field or numeric display field	Press <b>MENU</b> key and highlight <b>Disp Config</b> button using rotary knob or cursor keys, open pulldown menu with <b>ENTER</b> key or rotary-knob click, and highlight and select desired panel.	Press key combination CTRL + M, then highlight <b>Disp Config</b> button using TAB or SHIFT + TAB keys, open pulldown menu using Enter key, highlight desired panel using cursor keys and select using Enter key.	Open menu bar by moving to left edge of screen, actuate <b>Disp Config</b> button and click desired panel.

Some of the basic settings in these panels are described here using the **Lev Mon Config** panel as an example. Since the combi display is an extension of the numeric display field, the settings also influence the numeric display field.

A detailed description of the display options can be found in Chapter 4 *"Instrument Functions"* in the section *"Graphical Display"*.



**Note:**

Some of the settings described below are only visible if the combi display is of adequate size on the screen. For example, scaling and gridlines are hidden automatically and stepwise if the display is reduced in size.

A screenshot of a software interface showing a dropdown menu labeled 'Unit'. The selected option is 'V'.

### Unit of measurement result

This parameter field is used to set the unit for the measurement result display. The units available in the parameter list depend in the type of measurement.

An overview of all units used with the Audio Analyzer R&S UPV and their conversion formulae can be found at the end of this chapter (section ["Units"](#) from page [3.98](#) onwards).

 A screenshot of a software interface showing a dropdown menu labeled 'Engineering'. The selected option is 'Auto'.

Details concerning the numeric value display can be specified here for all linear units.

For example, it is possible to select whether voltage is to be given in V, mV,  $\mu$ V, and so on. If "Auto" is set, these unit prefixes are automatically adapted to the measurement value.

 A screenshot of a software interface showing a dropdown menu labeled 'Reference'. The selected option is 'Value'.

### Reference values

The reference value for relative measurement values can be set here.

This can be a fixed preset value; however, values measured at a different location or values based on the generator settings and so on can also be adopted automatically as reference values.

 A screenshot of a control panel for bargraph scaling. It includes an 'Auto Scale' button labeled 'Exec', a 'Spacing' section with radio buttons for 'Lin' (selected) and 'Log', and two input fields: 'Left' with the value '200.000' and unit 'mV', and 'Right' with the value '10.00000' and unit 'V'.

### Bargraph scaling

If the **Autoscale** button is actuated, the extreme values that have so far occurred are used for scaling the left-hand and right-hand scale end value. The scaling can, however, also be set manually.

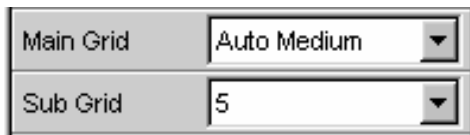
The axis can be displayed with linear or logarithmic subdivisions.

If manual scaling was selected, the start and end value of the bargraph must be entered in the two fields.



If the selected scaling does not encompass all measurement values, a red arrow indicates the end of the scale at which the measurement value is beyond the range of the bargraph.

**Gridlines**



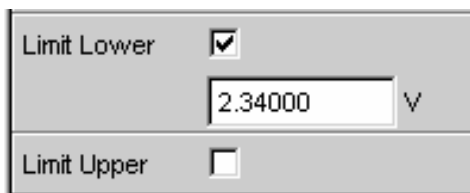
The settings **Main Grid** and **Sub Grid** are used to subdivide the bargraph.

Main gridlines which are labelled with the associated numeric values can be added with different intervals.

Subgridlines are used for further subdivisions; these lines are not labelled.

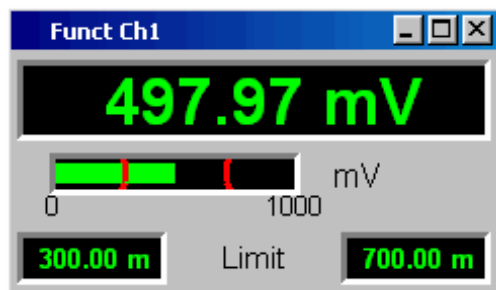


**Limits**



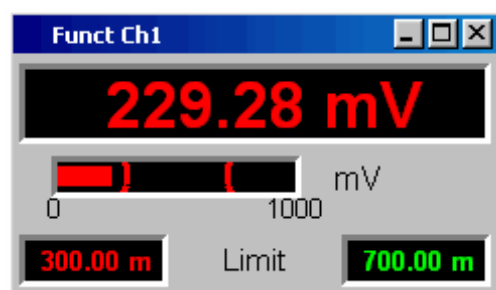
A lower and/or upper limit can be defined for each measurement result.

If the limit is activated, each measurement value is compared with the limit.



The set limits are shown in the bottom part of the combi display and appear as a red limit marking on the bargraph.

As soon as one of the limits is exceeded, the measurement display and measurement bar changes from green to red. If the measurement value is within the limits, the measurement display and measurement bar are displayed in green.



In order to monitor limit violations over a long period of time without having to watch the measurement displays continuously, the lower and/or upper limit is displayed permanently in red as soon as it is exceeded. Pressing the **START** key again or entering a new limit resets the limit to green.

The measurement display in the numeric display field always behaves in the same way as the measurement display in the combined field; current limit violations can therefore also be monitored in the numeric display field.

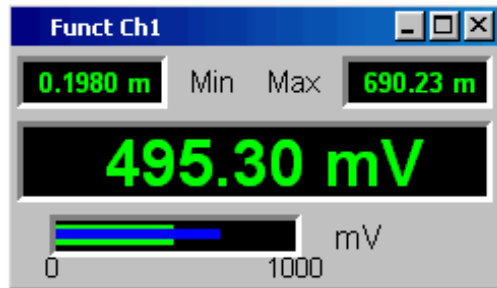


Show Min Max

### Extreme values

If this tick box is activated, the lowest and highest measurement value is displayed.

Display of the Min/Max values can be set separately for each measurement display and for the two measurement channels.



The minimum and maximum values which have been measured are shown in the top part of the combi display; an additional blue bar which records the span between the extreme values is also displayed.

The Min/Max values can thus also be recorded over a long period of time without the measurement displays having to be monitored continuously.

Pressing the **START** key again resets the Min/Max values.

Resolution

5 dig. / 0.001dB

### Number of displayed digits

The **Resolution** field is used to set the number of digits used when displaying the measurement values, Min/Max values and limits.

Values in linear units can be displayed with 3 to 7 digits; values in logarithmic units can be displayed with a resolution of 0.1 dB to 0.00001 dB.

65.38600 V

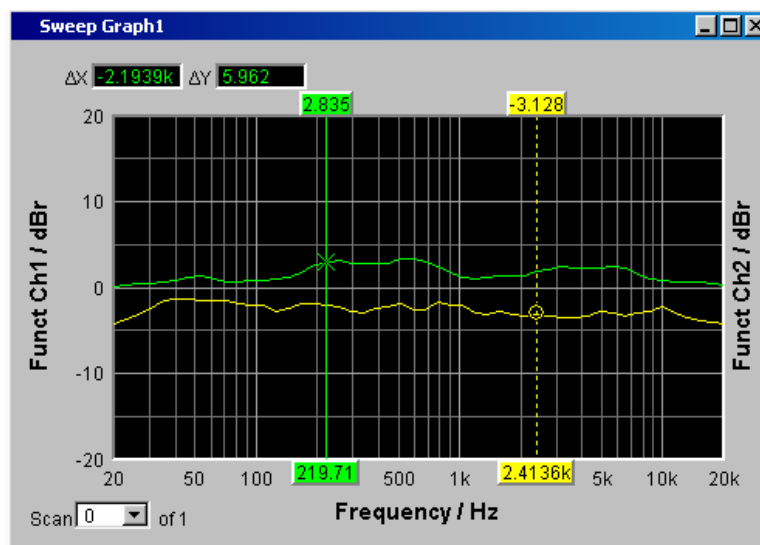
36.30970 dBV

## Graphical Windows

The most informative method of displaying measurement results is usually a two-dimensional graph. Measurement values as a function of frequency, measurements over a time axis and so on are just a few examples of the many possible applications. The Audio Analyzer R&S UPV makes a distinction between the graphical windows (shown in the following sections) which can be set and modified using the associated configuration panels.

All graphical displays can be evaluated using horizontal and vertical cursors; markers are used to identify important measurement points. A broad range of softkey control functions can be used to scale graphs, to display sections of graphs, and to perform many other tasks.

### Sweep graph



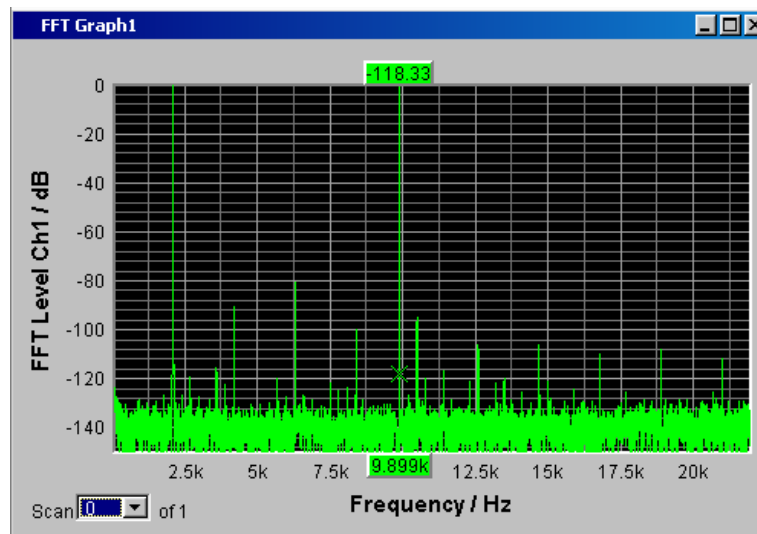
Here, the measurement values of a measurement sequence (sweep) can be displayed as a line diagram in a co-ordinate system. One or two traces (TRACE A and TRACE B) can be recorded along an X-axis. Each trace can consist of a large number of scans. The traces can be saved and saved traces, reference curves and/or limit curves can be imported into the graph.

Up to four sweep graphs can be displayed at the same time and can all be configured differently. As a result, it is possible to display different measurement functions or display the same measurement function in a different way.

### FFT Monitor

If the **FFT Monitor** function is activated in the **Analyzer Function** panel, the frequency spectrum is displayed in this graph. The options are identical to those for the FFT graphs shown below. This graph can be displayed once only.

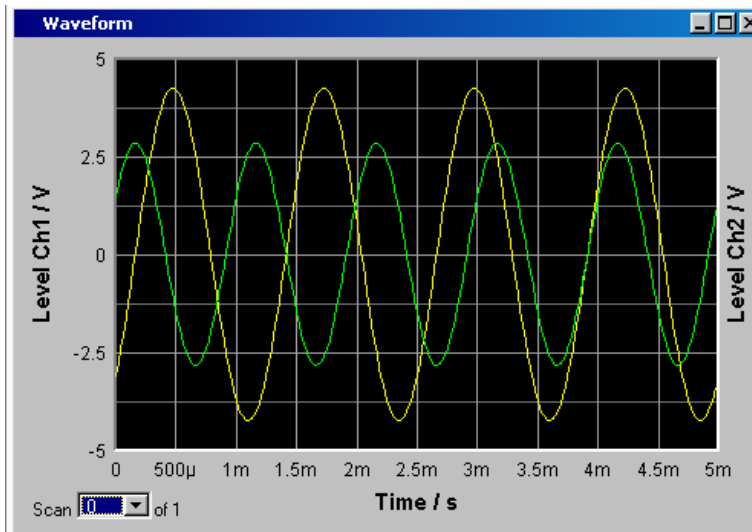
## FFT graph



The frequency spectrum of the **FFT** measurement function and of the **Post FFT** which follows a different measurement function is displayed in these panels. One or two traces (TRACE A and TRACE B) can be recorded along a frequency axis. Each trace can consist of a large number of scans. The traces can be saved and saved traces, reference curves and/or limit curves can be imported into the graph.

Up to two FFT graphs can be displayed at the same time and can both be configured differently.

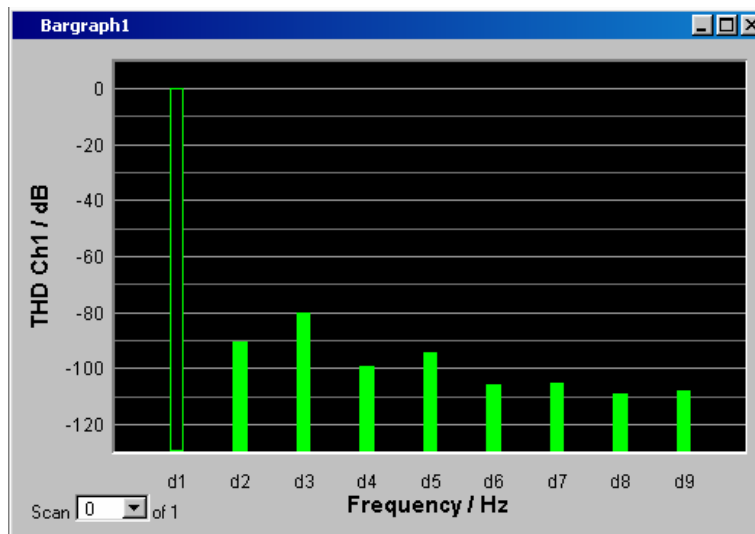
## Waveform



The waveform display is a type of oscillogram in which the signal characteristic of the analyzed audio signal over time is displayed. One or two traces (TRACE A and TRACE B) can be recorded along a time axis. The traces can be saved and saved traces, reference curves and/or limit curves can be imported into the graph.

This graph can be displayed once only; it is linked to the **Waveform Monitor** function in the **Analyzer Function** panel.

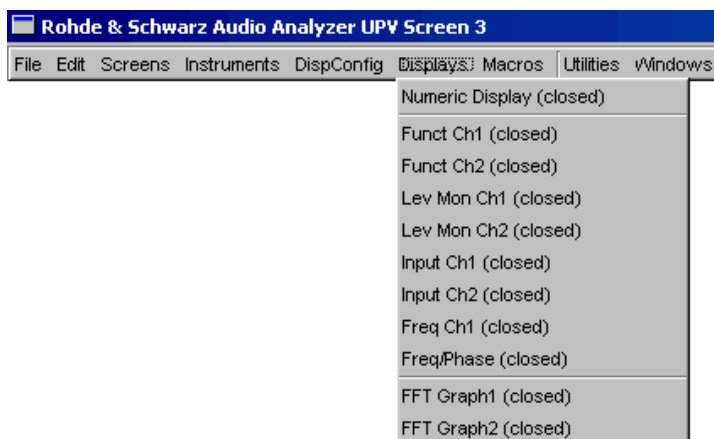
## Bargraph



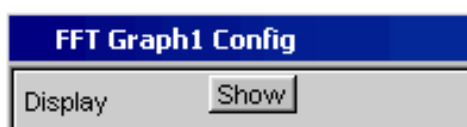
If one of the functions THD, Mod Dist, DFD or DIM is selected in the **Analyzer Function** panel, the function measurement result can be displayed broken down into its frequency components on a bargraph. The individual distortion products are recorded along a frequency axis. The structure of the distortion products (2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, ... harmonic, DFD of 2<sup>nd</sup> or 3<sup>rd</sup> order, etc) can be recognized at a glance. The bargraph can display one or two channels; once again, the results can be saved and saved results can be imported into the graph.

Two bargraphs are available so that, for example, THD values at two different measurement points can be displayed or the measurement values of both input channels can be shown on two separate graphs.

## Opening graphical windows



The graphical windows can be opened via the menu bar; they are called up using the **Displays** button.



Alternatively, the graphical windows can also be opened using the associated configuration panels (see the following section). The associated graphical window is activated using the **Show** button.

Function	Front panel	PC keyboard	Mouse
Open graphical window via menu bar	Press <b>MENU</b> key and highlight <b>Displays</b> button using rotary knob or cursor keys, open pulldown menu with <b>ENTER</b> key or rotary-knob click, and highlight and select desired graphical window.	Press key combination CTRL + M, then highlight <b>Displays</b> button using TAB or SHIFT + TAB keys, open pulldown menu using Enter key, highlight desired graphical window using cursor keys and select using Enter key.	Open menu bar by moving to left edge of screen, actuate <b>Displays</b> button and click desired graphical window.
Open graphical window via Config panel	Highlight <b>Show</b> button in associated Config panel and open graphical window with <b>ENTER</b> key or rotary-knob click.	Highlight <b>Show</b> button in associated Config panel and open graphical window with Enter key.	Click <b>Show</b> button in associated Config panel.

## Settings for measurement result display in the graphical windows

The settings for configuring the graphical displays are made in the following panels:

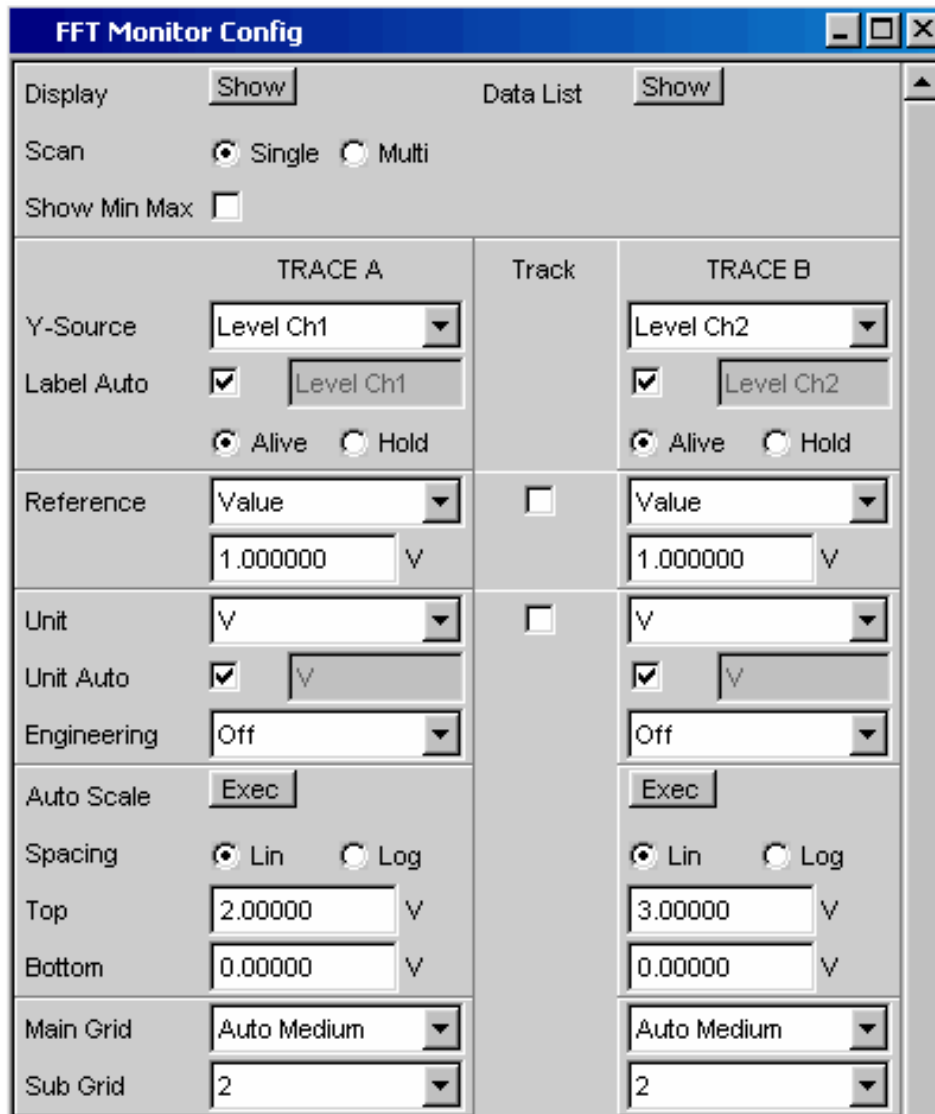
- Sweep Graph1 ... 4 Config
- FFT Monitor Config
- FFT Graph 1 ... 2 Config
- Waveform Config
- Bargraph1 ... 2 Config

The associated panels for configuring the graphical windows are opened either using the **Disp Config** button in the menu bar or using the **Settings** softkey in the graphical window.

Function	Front panel	PC keyboard	Mouse
Open panel for configuring a graphical window	Press <b>MENU</b> key and highlight <b>Disp Config</b> button using rotary knob or cursor keys, open pulldown menu with <b>ENTER</b> key or rotary-knob click, and highlight and select desired panel.	Press key combination CTRL + M, then highlight <b>Disp Config</b> button using TAB or SHIFT + TAB keys, open pulldown menu using Enter key, highlight desired panel using cursor keys and select using Enter key.	Open menu bar by moving to left edge of screen, actuate <b>Disp Config</b> button and click desired panel.
Open panel for configuring a graphical window via softkeys in graphical window	Press <b>Settings</b> softkey of respective graphical window.	Press F12 key for <b>Settings</b> softkey in respective graphical window.	Click <b>Settings</b> softkey in respective graphical window.

Some of the basic settings in these panels are described here using the **FFT Monitor Config** panel as an example.

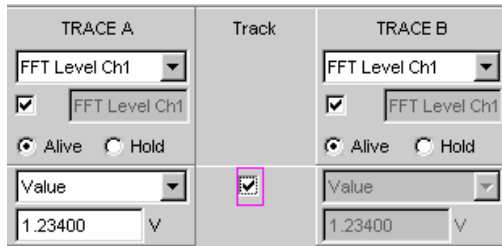
A detailed description of the display options can be found in Chapter 4 *"Graphical Display"*.



**Note:**

*Some of the settings described below are only visible if the graphical window is of adequate size on the screen. For example, scaling and gridlines are hidden automatically and stepwise if the display is reduced in size.*

### Settings for the Y-axis



All the panels used for configuring graphical windows have three columns.

In all graphical windows, two traces (TRACE A and TRACE B) can be recorded along an X-axis. Each trace can consist of several scans.

In many cases, settings are to apply to both traces. The track boxes provide multi-column panels which allow settings to be transferred from the left-hand to the right-hand column without the parameters having to be entered a second time.

If the track box has a checkmark, all of the settings within the function group are applicable to both columns. All fields with transferred settings are shown in the right-hand column as grey display fields. These fields cannot be accessed while the track function is active. If a setting is changed in the associated parameter field in the left-hand column, this change is also shown in the display field in the right-hand column.

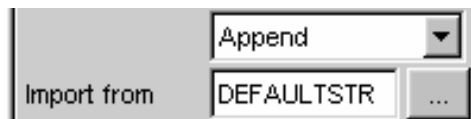


#### Values to be displayed

The data which is to be graphically displayed can be determined for each trace. Usually this data comes from the selected measurement functions; however, saved data (reference data) can also be displayed.

With **Label Auto**, the Y-axis of the graph can be labelled with the data name selected under **Source** (see example below), or users can define their own label.

The **Hold** radio button is used to "freeze" the graphical display.



Additional scans can be added to a graph ("Append"), or existing scans in a graph can be replaced by new ones.

Furthermore, it is also possible to load previously measured and saved scans and append them to the current measurement or replace individual scans with saved ones.

Reference Value  
1.23400 V

**Reference values**

The reference value for relative measurement values can be set here.

This can be a fixed preset value; however, values measured at a different location or entire scans from files, from the other measurement channel and so on can also be used automatically as reference values / reference curves.

Unit Anlr Track  V

**Units of measurement values**

This parameter field is used to set the unit for the trace. The units available in the parameter list depend in the type of measurement.

Alternatively, if the tick box is selected, the unit used in the analyzer will be used.

An overview of all units used with the Audio Analyzer R&S UPV and their conversion formulae can be found at the end of this chapter (section "Units" from page 3.98 onwards).

Engineering Auto

Details concerning the numeric value display can be specified here for all linear units.

For example, it is possible to select whether voltage is to be given in V, mV,  $\mu$ V, and so on. If "Auto" is set, these unit prefixes are automatically adapted to the measurement value.

Unit Auto  V

The used unit will appear on the Y-axis of the graph (see example below). Sometimes it is better to use a label defined by the user; this label can be entered in the parameter field.

Auto Scale Exec  
Spacing  Lin  Log  
Top 10.00000 dBV  
Bottom -170.000 dBV

**Y-axis scaling**

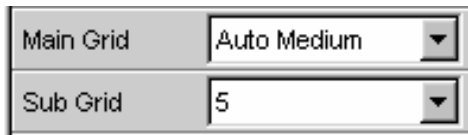
If the button for automatic scaling is selected, the Audio Analyzer R&S UPV uses the minimum and maximum values of the available measurement cycle to automatically determine a suitable value range for the graph to be displayed. This scaling is determined once and retained until the autoscale function is triggered again.

If manual scaling is required, the upper and lower end value of the Y-axis must be entered in the two fields.

If a linear unit has been selected for the Y-axis, this axis can be displayed with linear or logarithmic subdivisions.



**Gridlines**

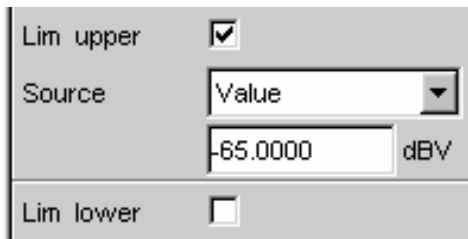


The settings **Main Grid** and **Sub Grid** are used to subdivide the graph with horizontal gridlines.

Main gridlines which are labelled on the Y-axis with the associated numeric values can be added with different intervals.

Subgridlines are used for further subdivisions; these lines are not labelled.

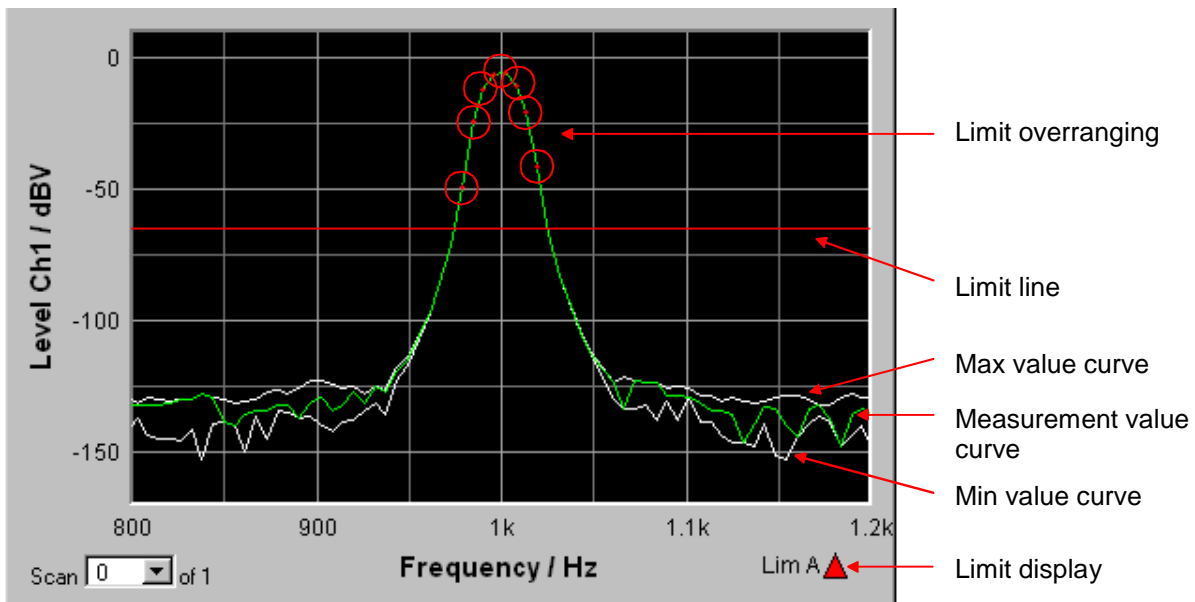
**Limits**



Lower and/or upper limits can be defined for each trace; these limits can be different or the same for the two traces.

The limits can be fixed preset values; however, values measured at a different location or entire scans from files, from the other measurement channel and so on can also be used automatically as limits / limit curves.

If the limits are activated, each measurement value is compared with the limits.



Limit curves appear as a red line on the graph.

Each measurement value which violates a limit is highlighted by a red dot on the curve.

In addition, a red arrow pointing up/down in the bottom right-hand corner of the graph provides a permanent indication of limit overranging/underranging.

Limit monitoring is reset each time the  key is pressed.

Limit monitoring can also be reset using a softkey; see the section ["Restart Min/Max, Lim Viol function"](#) on page 3.77.

#### Extreme values

Show Min Max

If this tick box is activated, the lowest and highest measurement value is displayed.

Two additional grey lines which represent the measured extreme values (see the example above) then appear in the graph.

Extreme value recording is reset each time the  key is pressed.

Extreme value recording can also be reset using a softkey; see the section ["Restart Min/Max, Lim Viol function"](#) on page 3.77.

## Settings for the X-axis

 A screenshot of a software interface showing a dropdown menu for 'X-Axis'. The selected option is 'Frequency'.

The quantity displayed on the X-axis is normally determined by the type of measurement; it can be seen in the display field shown opposite.

 A screenshot of a software interface showing a dropdown menu for 'Unit'. The selected option is 'Hz'.

### Units for the X-axis

The units available in the parameter list depend in the type of measurement.

An overview of all units used with the Audio Analyzer R&S UPV and their conversion formulae can be found at the end of this chapter (section ["Units"](#) from page 3.98 onwards).

 A screenshot of a software interface showing a checked checkbox for 'Unit Auto' and a dropdown menu for 'Unit' with 'Hz' selected.

Usually it is the used unit that is displayed on the X-axis of the graph.

Sometimes it is better to use a label defined by the user; this label can be entered in the parameter field.

 A screenshot of a software interface showing a dropdown menu for 'Engineering'. The selected option is 'Auto'.

Details concerning the numeric value display can be specified here for all linear units.

For example, it is possible to select whether frequency is to be given in Hz, mHz, kHz, and so on. If "Auto" is set, these unit prefixes are automatically adapted to the measurement value.

 A screenshot of a software interface showing a checked checkbox for 'Label Auto' and a dropdown menu for 'Label' with 'Frequency' selected.

With **Label Auto**, the X-axis of the graph can be labelled with the data name selected under **X-Axis**, or users can define their own label in the entry field.

 A screenshot of a software interface showing a text input field for 'Ref Value' containing '1000.00' and a unit dropdown menu set to 'Hz'.

### Reference values

A reference value can be set here for labels of X-values with relative units.

Scaling	<input checked="" type="radio"/> Manu	<input type="radio"/> Auto
Spacing	<input checked="" type="radio"/> Lin	<input type="radio"/> Log
Left	<input type="text" value="800.000"/>	Hz
Right	<input type="text" value="1.20000"/>	kHz

Main Grid	<input type="text" value="Auto Medium"/>
Sub Grid	<input type="text" value="2"/>

### X-axis scaling

If automatic scaling is selected, the Audio Analyzer R&S UPV uses the minimum and maximum values defined for the measurement, e.g. by the start/stop values of a sweep, by the measurement bandwidth of an FFT analysis, and so on.

If manual scaling has been selected, the upper and lower end value of the X-axis must be entered in the two fields.

If a linear unit has been selected for the X-axis, this axis can be displayed with linear or logarithmic subdivisions.

### Gridlines

The settings **Main Grid** and **Sub Grid** are used to subdivide the graph with vertical gridlines.

Main gridlines which are labelled on the X-axis with the associated numeric values can be added with different intervals.

Subgridlines are used for further subdivisions; these lines are not labelled.

## X and Y-value display

Resolution	3 dig. / 0.1dB	▼
------------	----------------	---

The **Resolution** field is used set how many digits the values on the X and Y-axis and at the cursor are to have.

Values in linear units can be displayed with 3 to 7 digits; values in logarithmic units can be displayed with a resolution of 0.1 dB to 0.00001 dB.

## Loading and saving traces / scans

Save Trace	MYTRACE.TRC	...
------------	-------------	-----

The current trace together with all scans can be saved in this parameter field by calling up the file directory using the **...** button (details are given in the section "[File Management](#)" on page 3.91).

Source	File	▼
	DEFAULTSTR	...

Here, saved traces together with all of their scans can be loaded and displayed in the current graph by calling up the file directory using the **...** button (details are given in the section "[File Management](#)" on page 3.91).

Import from	Append	▼
	DEFAULTSTR	...

On a graph, it is possible to replace individual scans with saved scans; it is also possible to add (append) additional saved scans. Once again, this is done by calling up the file directory using the **...** button (details are given in the section "[File Management](#)" on page 3.91).

## Evaluating Graphical Displays with Cursors and Markers

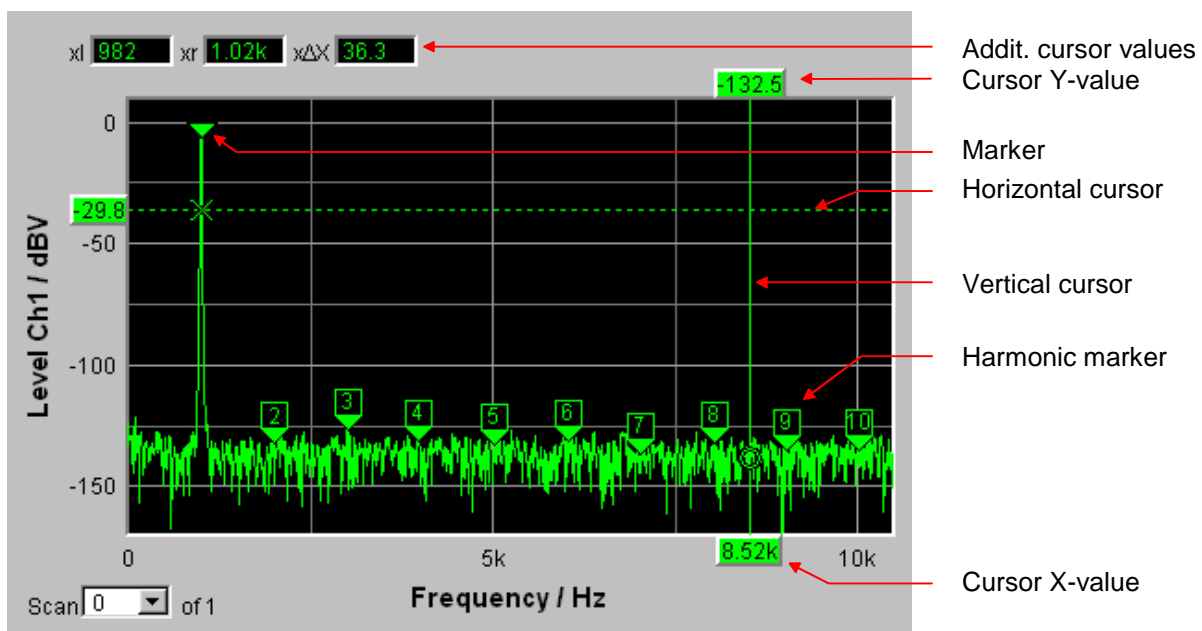
All graphical displays can be evaluated using horizontal and vertical cursors; the X and Y-values shown in the display fields associated with the cursors are always current values.

Markers are used to identify important measurement points.

The cursors and markers can only be operated using the softkey bar; the softkeys can be operated from the front panel, using the keys F5 to F12 on the external PC keyboard or by clicking with the mouse.

As an alternative and in a slightly different way to operation via the panels, the softkeys can also be used to scale the graphs or to zoom sections of the displays.

The basic settings in these functions are described here using examples.  
A detailed description of the display options can be found in Chapter 4 "Graphical Display".



As soon as the graphical window has the focus, the softkey bar for operating the graphical elements is shown at the bottom of the screen.



The softkeys are arranged in several levels; the lower levels are accessed by actuating the respective button. Actuating the Back button redisplay the higher level.

The level currently displayed is indicated in the info line above the softkey.

The desired function is executed by actuating the buttons displayed in the lowest level.

## Showing and hiding traces – Trace function



Actuating the **Trace** button opens another softkey level.



The two buttons **Show A** and **Show B** are used to show and hide the associated trace. These buttons only affect the curve display; the measurement values are retained in the background even when the curve is hidden, and can be used as reference values, for example.

## Scaling graph – Autoscale function



Actuating the **Autoscale** button opens another softkey level.



The softkeys available here are used to rescale the selected axes (if required, it is also possible to rescale the axes for certain traces only). The action triggered with these buttons corresponds to that of the **Autoscale** button for the X and Y-axis in the associated configuration panels. The **All** button scales both the X and Y-axis simultaneously.

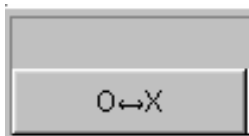
Operating the cursor



Actuating the **Cursor** button displays the cursor softkeys:



The Audio Analyzer R&S UPV uses two cursors which are identified by the O and X symbols. These symbols indicate the measured point in the graph (see the example graph above).



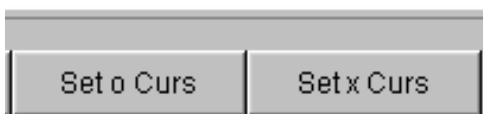
Only one cursor is active and can be moved in the graph at any one time. The active cursor is displayed with a solid line; the inactive cursor is displayed with a broken line.

The **O<->X** button is used to activate the O and X-cursor alternately.

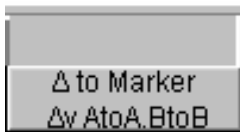
Alternatively, the Enter key or a rotary-knob click can also be used to toggle between the two cursors.



The two buttons **O-Cursor** and **X-Cursor** activate the associated cursor and display the next softkey level.



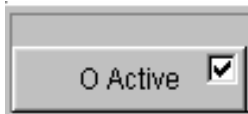
The two buttons **Set O Curs** and **Set X Curs** open the next softkey level where the associated cursor can be set to certain values, e.g. maximum, minimum, etc.



This button is used to display a further level. A large selection of differential values can be displayed using the softkeys on this level.



If, for example, the cursor was activated with the **O-Cursor** button, the following softkeys appear:

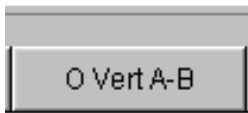


Here a softkey with an additional tick box is used. The softkey indicates that the O-cursor is active and that further settings for this cursor are available under the adjacent softkeys.

Activating/deactivating the tick box shows/hides the cursor in the graph.



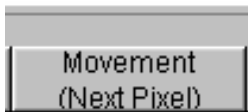
The two buttons **O Vert A** and **O Vert B** activate vertical cursors and place them on TRACE A and TRACE B. Both the cursor and its label fields are displayed in the color of the associated trace.



Actuating the **O Vert A-B** button displays a grey cursor which represents the difference between the values for TRACE A and TRACE B.



The two buttons **O Hor A** and **O Hor B** activate horizontal cursors and place them on TRACE A and TRACE B. Both the cursor and its label fields are displayed in the color of the associated trace.



The **Movement** button opens the next softkey level where it is possible to set how the cursor is moved with the rotary knob (see the next section). The second line of the label shows the currently set step size in brackets.

## Moving cursor

Only one cursor is active and can be moved in the graph at any one time. The active cursor is displayed with a solid line; the inactive cursor is displayed with a broken line.

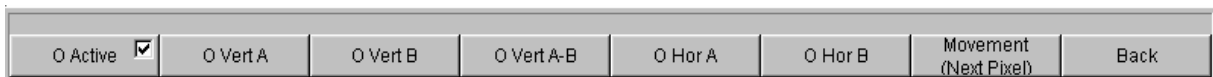
The  $O \leftrightarrow X$  button is used to activate the  $O$  and  $X$ -cursor alternately. Alternatively, the Enter key or a rotary-knob click can also be used to toggle between the two cursors.

In the case of operation using the mouse, the desired cursor or one of its display fields can be activated and moved by simply clicking with the mouse.

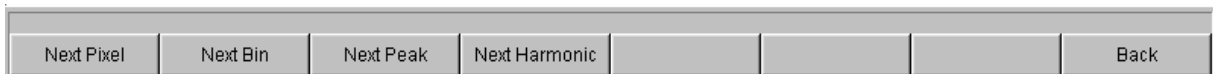
A cursor can be moved in a number of different ways:

- The active cursor is linked to the rotary knob and can be moved directly using the rotary knob.
- On the external PC keyboard, the keys **TAB** / **CTRL** + **TAB** move the cursor to the right / left.
- In the case of operation using the mouse, the cursor can be clicked and moved by holding down the mouse key.

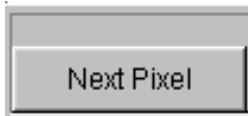
The step size with which a cursor is moved can be set using softkeys. To do so, the softkey of the desired  $O$  or  $X$ -cursor must first be selected:



The **Movement** button opens the next softkey level where various step sizes for moving the cursor are offered irrespective of the graph currently being used. This is described in greater detail below. The currently selected step size is indicated in brackets in the second label line of the **Movement** button.



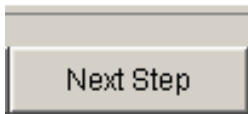
## Sweep graph:



If the **Next Pixel** button is selected, the cursor is moved in the graph by one pixel with each increment (rotary knob, mouse or **TAB** key).

If in the graphical display there is not a measurement value at every pixel (because only a few measurement points were recorded relative to the size of the displayed graph), the cursor value is interpolated linearly at the pixels between the measurement values.

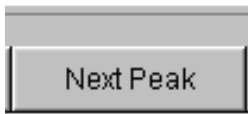
If in the graph the number of recorded measurement points is greater than the number of pixels available for display, the largest measurement value in each case is displayed at the corresponding pixel with X and Y-value.



If the **Next Step** button is selected, the cursor is moved to the next measurement value with each increment (rotary knob, mouse or **TAB** key).

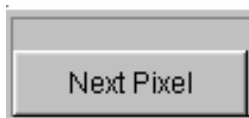
The cursor is therefore moved in smaller or larger steps depending on the number of measurement points.

If the graph is displayed relatively small or the number of recorded measurement values displayed is greater than the number of pixels available in the graphical field, the cursor sometimes does not appear to move (it remains on the same pixel). However, the associated display fields always show the currently selected measurement point with X and Y-value.



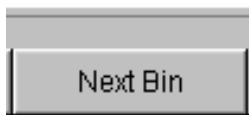
If the **Next Peak** button is selected, the cursor is moved to the next measured peak with each increment (rotary knob, mouse or **TAB** key).

## FFT monitor and FFT graph:



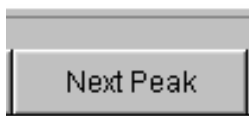
If the **Next Pixel** button is selected, the cursor is moved in the graph by one pixel with each increment (rotary knob, mouse or **TAB** key).

With FFT analyses, the number of recorded measurement points (bins) is usually much greater than the number of pixels available for display in the graph; the cursor then indicates the bin with the largest measurement value at the pixel in question and displays this bin with its X and Y-values.

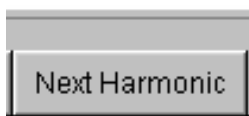


If the **Next Bin** button is selected, the cursor is moved to the next measured bin with each increment (rotary knob, mouse or **TAB** key).

Since with FFT analyses the number of recorded measurement points (bins) is usually much greater than the number of pixels available for display, the cursor sometimes does not appear to move (it remains on the same pixel). However, the associated display fields always show the currently selected measurement point with X and Y-value.



If the **Next Peak** button is selected, the cursor is moved to the next measured peak with each increment (rotary knob, mouse or **TAB** key).



If the **Next Harmonic** button is selected, the cursor is moved to the next marked harmonic with each increment (rotary knob, mouse or **TAB** key).

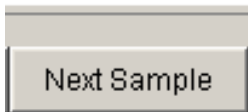
This button is also available if the harmonic marker is not active (see the next section "[Operating the markers](#)"). In this case, the button activates the harmonic marker.

**Waveform:**

If the **Next Pixel** button is selected, the cursor is moved in the graph by one pixel with each increment (rotary knob, mouse or **TAB** key).

If in the graphical display there is not a measurement value at every pixel (because only a few measurement points were recorded relative to the size of the displayed graph), the cursor value is interpolated linearly at the pixels between the measurement values.

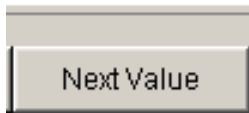
If in the graph the number of recorded measurement points is greater than the number of pixels available for display, the largest measurement value in each case is displayed at the corresponding pixel with X and Y-value.



If the **Next Sample** button is selected, the cursor is moved to the next measurement value with each increment (rotary knob, mouse or **TAB** key).

If the graph is displayed relatively small or the number of recorded measurement values (samples) displayed is greater than the number of pixels available in the graphical field, the cursor sometimes does not appear to move (it remains on the same pixel). However, the associated display fields always show the currently selected measurement point with X and Y-value.

**Bargraph:**



Only the **Next Value** setting is available here; the cursor moves to the next measured distortion point (harmonic or intermodulation product) with each increment (rotary knob, mouse or **TAB** key).

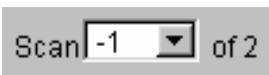
This button does not open a further softkey level; actuating the **Movement** softkey displays the step size without further settings being made.

All of the step-size settings for cursor movement described here only affect the currently selected cursor and are only applicable in the selected graphical window. This means that when a different cursor is activated or a different graphical window is selected, the cursor is moved using the settings applicable there.

The selected step size applies equally to vertical and horizontal cursors.

Function	Front panel	PC keyboard	Mouse
Move cursor	Activate desired cursor via softkeys and move using rotary knob.	Activate desired cursor via softkeys and move using keys <b>TAB</b> and <b>CTRL + TAB</b> .	Click desired cursor or associated display field and move cursor with mouse key held down.
Select active cursor via softkey	Actuate <b>O&lt;-&gt;X</b> softkey; this softkey toggles between <b>O</b> and <b>X</b> -cursor.	Press <b>F5</b> function key for <b>O&lt;-&gt;X</b> softkey; this softkey toggles between <b>O</b> and <b>X</b> -cursor.	Click desired cursor or one of its display fields.
Select active cursor via Enter function	If desired graph has focus, <b>ENTER</b> key or rotary-knob click toggles between both cursors.	If desired graph has focus, <b>Enter</b> key toggles between both cursors.	Click desired cursor or one of its display fields.


**Cursor in traces with several scans**



If a trace consists of several scans, the cursors only move along one scan and indicate the X and Y-values of this scan. The scan number displayed in the bottom left-hand corner of the graph in the respective display field indicates which scan is being analyzed.

In order to analyze individual scans with cursors, the cursor is switched to the desired scan in the following way:



- Front panel: with the  keys
- External PC keyboard: with the keys **ALT** + **PAGE UP** and **ALT** + **PAGE DOWN**
- Mouse: by clicking the "Scan" field shown above

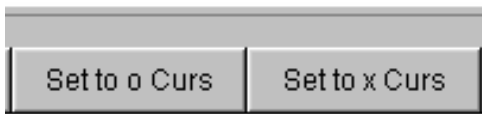
### Operating the markers



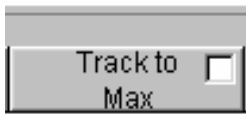
Actuating the **Marker** button displays the marker softkeys:



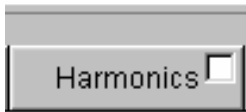
The user must then first select the trace on which a marker is to be set. The next softkey level appears simultaneously:



The two buttons **Set to O-Curs** and **Set to X-Curs** set the marker to the value of the currently selected cursor.

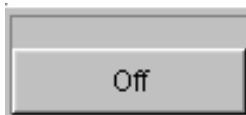


The **Track to Max** button is used to set a marker at the maximum value of the curve. If the maximum value changes, the marker is set at the new maximum value.



The **Harmonics** button marks harmonics of the frequency indicated by the marker.

If no marker has been set, actuating the **Harmonics** button sets the marker to the maximum value of the trace and calculates and marks the harmonics from this frequency.

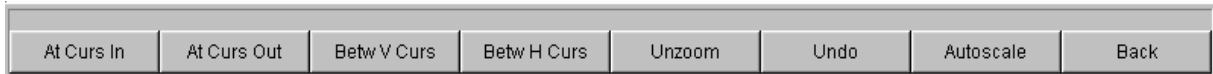


The **Off** button deactivates the marker and indication of the harmonics.

### Zooming the graph

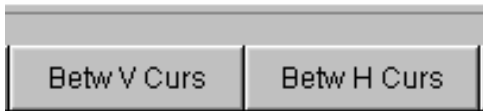


Actuating the **Zoom** button displays the zoom functions.

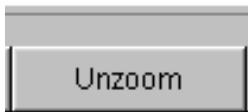


The **Act Curs In** button zooms in on the section of graph on either side of the active X-cursor.

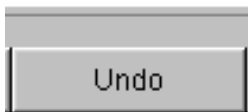
The **Act Curs Out** button zooms out from the section of graph on either side of the active X-cursor.



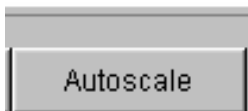
The **Betw V Curs** or **Betw H Curs** button zooms in on the area between the two X or Y-cursors. The zoomed display is fitted to the size of the set graph.



The **Unzoom** button restores the original axis, i.e. undoes all of the zoom operations performed.



The **Undo** button undoes the zoom operation last performed.



The **Autoscale** button displays the next softkey level. The softkeys available here are used to rescale the selected axes (if required, it is also possible to rescale the axes for certain traces only). The action triggered with this button corresponds to that of the **Autoscale** button in the associated configuration panels, as described in the section ["Scaling graph – Autoscale function"](#) on page 3.67.



## Restart Min/Max, Lim Viol function



Actuating the **Restart Min/Max, Lim Violation** button displays another softkey level.



If the **Show Min Max** function was selected in the associated configuration panel, actuating the appropriate button in the softkey bar reactivates indication of the lowest and highest measurement value.

If the **Lim upper** or **Lim lower** function was selected in the associated configuration panel, actuating the appropriate button in the softkey bar reactivates limit monitoring.

## Config function



The **Config** softkey allows the user to open or close the configuration panel while operating the associated graphical window.

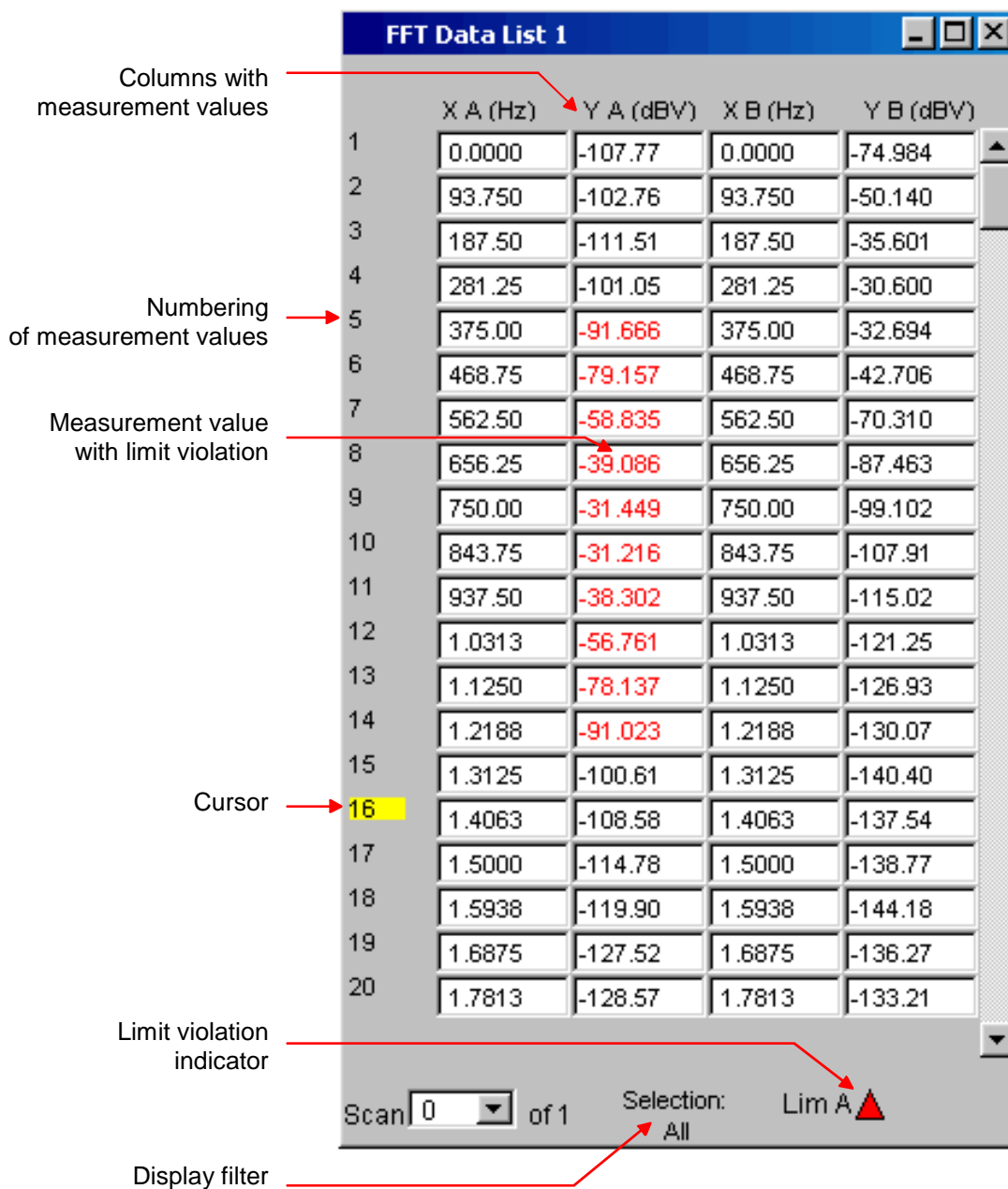
## Data Lists

The measurement values can also be displayed in lists instead of or in combination with the graphical windows.

Measurement values which have violated the preset limits are display in red.

In addition, a red arrow pointing up/down in the bottom right-hand corner of the graph provides a permanent indication of limit overranging/underranging.

Pressing the **[START]** key and actuating the **Start Min/Max, Lim** button (see *"Restart Min/Max, Lim Viol function"* on page 3.77) resets the limit monitoring function.



## Opening data list



Data lists can be opened using the associated configuration panel (see "[Data Lists](#)"). The associated graphical window is activated using the **Data List** button.

Function	Front panel	PC keyboard	Mouse
Open data list	Highlight <b>Data List</b> button in associated Config panel and open graphical window with <b>ENTER</b> key or rotary-knob click.	Highlight <b>Data List</b> button in associated Config panel and open graphical window with Enter key.	Click <b>Data List</b> button in associated Config panel.

## Data list settings

The settings for configuring the data lists are made in the same panels used to configure the graphical windows:

- Sweep Graph1 ... 4 Config
- FFT Monitor Config
- FFT Graph 1 ... 2 Config
- Waveform Config
- Bargraph1 ... 2 Config

The panels for configuring the data lists are opened via the menu bar; they are called up using the **Disp Config** button.

Function	Front panel	PC keyboard	Mouse
Open panel for configuring a data list	Press <b>MENU</b> key and highlight <b>Disp Config</b> button using rotary knob or cursor keys, open pulldown menu with <b>ENTER</b> key or rotary-knob click, and highlight and select desired panel.	Press key combination CTRL + M, then highlight <b>Disp Config</b> button using TAB or SHIFT + TAB keys, open pulldown menu using Enter key, highlight desired panel using cursor keys and select using Enter key.	Open menu bar by moving to left edge of screen, actuate <b>Disp Config</b> button and click desired panel.

A detailed description of the setting options in these panels can be found in Chapter 4 "[Graphical Display](#)".





A number of basic settings for the data lists are described here using examples.

The measurement values displayed in the lists are always linked to the values in the result graphics. This means that all settings in the configuration panels, e.g. unit, engineering, set limits and so on, are also applied to the measurement values in the lists.

The position of the cursor is also shown in the lists; the highlighted measurement number indicates the location of the cursor. Similarly, the step size of cursor movement set via the softkey bar (see the previous section) also affects the movement of the cursor in the data list.

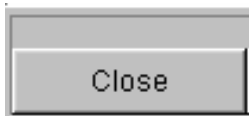
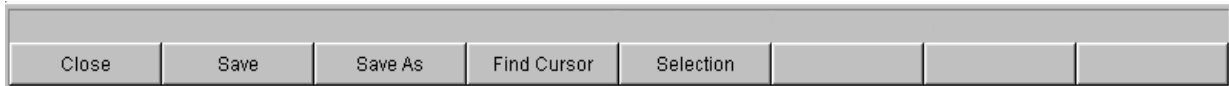
There are three ways of navigating in the lists:

- As soon as a value has been highlighted in the list (blue selection frame), it is possible to use the rotary knob to move from value to value within the column. The cursor keys can also be used to move around in the lists.

The keys  and  are used to navigate through columns and the keys  and  to navigate through rows.

- If an external PC keyboard is used, the keys **TAB** / **CTRL** + **TAB** can also be used to move down/up within the column. Once again, the cursor keys **↑** and **↓** are used to navigate through the columns and the cursor keys **←** and **→** to navigate through the rows.
- If a mouse is used, you can either click the desired value or navigate using the scroll bar.

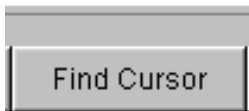
As soon as the data list has the focus, softkeys appear at the bottom of the screen.



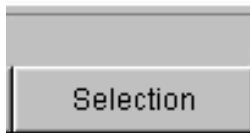
The **Close** button closes the data list.



The **Save** and **Save As** buttons are used to save the data list.

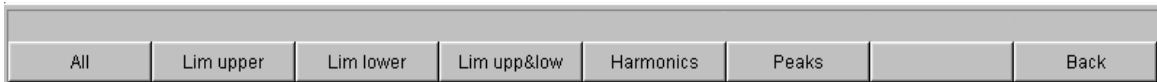


If the **Find Cursor** button is actuated, the displayed section of the data list changes so that the value highlighted with the cursor is in the middle of the list. If both cursors are activated, this button is used to toggle between the two cursor values.



Using the Selection button, it is possible to filter the list of displayed measurement values, i.e. to list only selected rows.

If this button is actuated, a further softkey level appears containing softkeys for selecting the displayed values:

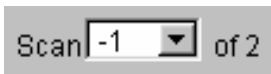


Depending on the selected softkey,

- all
- only the values which exceed the upper, lower or both limits
- only harmonics or
- only peaks


are listed in the data list.

### Cursor in lists with several individual scans

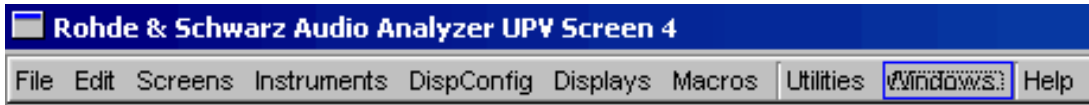


If a trace consists of several scans, only the values of one scan can be displayed in the list at any one time. The scan number displayed in the bottom left-hand corner of the data list in the respective display field indicates which scan is entered in the list.

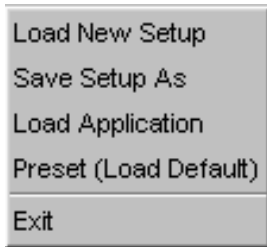
In order to list individual scans, the desired scan is selected in the following way:

- Front panel: with the  keys
- External PC keyboard: with the keys **[ALT] + [PAGE UP]** and **[ALT] + [PAGE DOWN]**
- Mouse: by clicking the "Scan" field shown above

## Settings in the Menu Bar



The menu bar of the Audio Analyzer R&S UPV is used in a similar way to other Windows® applications. The following settings are made in the menu bar:



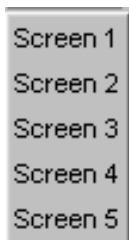
### File button

- To load instrument settings (same function as the **[LOAD]** key on the front panel, see the section ["Loading and Saving Instrument Settings"](#), page 3.94).
- To save instrument settings (same function as the **[SAVE]** key on the front panel, see the section ["Loading and Saving Instrument Settings"](#), page 3.94). To load instrument settings already prepared by Rohde & Schwarz for a broad range of typical measurements and available on the instrument as example applications; these setups are divided into various application areas (AA, AD, DD, DA) depending on whether the generator or analyzer is operated with analog or digital interfaces.
- To load default factory presets (same function as the **[PRESET]** key on the front panel, see the section ["Loading and Saving Instrument Settings"](#), page 3.94). To exit the R&S UPV measurement program.



### Edit button

- To copy characters, character strings, data, etc to the clipboard.
- To paste characters, character strings, data, etc from the clipboard.



### Screens button

- To select one of the five display options (screens), see the section ["Display and Screens"](#), page 3.11.

Generator Config  
 Generator Function (closed)  
 Analyzer Config (closed)  
 Analyzer Function (closed)  
 Filter (hidden)  
 Auxiliaries (closed)

### Instruments button

- To select the panels for configuring the generators, analyzers, filters and supplementary functions.
- The desired panel must first be highlighted and is then displayed in the currently selected screen (see the section "[Opening, Operating, Hiding and Closing Panels](#)", page 3.20). In the list, open panels are displayed without a suffix, closed panels are identified by the suffix "closed", and open minimized panels by the suffix "hidden".

Sweep Graph1 Config  
 Sweep Graph2 Config (closed)  
 Sweep Graph3 Config (closed)  
 Sweep Graph4 Config (closed)  
 FFT Monitor Config  
 FFT Graph1 Config (closed)  
 FFT Graph2 Config (closed)  
 Waveform Config (hidden)  
 Bargraph1 Config (closed)  
 Bargraph2 Config (closed)

### Disp Config button

- To select the panel used to configure the measurement display windows.
- The desired panel must first be highlighted and is then displayed in the currently selected screen (see the section "[Opening, Operating, Hiding and Closing Panels](#)", page 3.20). In the list, open panels are displayed without a suffix, closed panels are identified by the suffix "closed", and open minimized panels by the suffix "hidden".

Sweep Graph1 (closed)  
 Sweep Graph2 (closed)  
 Sweep Graph3 (closed)  
 Sweep Graph4 (closed)  
 FFT Monitor (closed)  
 FFT Monitor 2 (closed)  
 Bargraph1 (closed)  
 Bargraph2 (closed)

### Displays button

- To select the measurement display windows.
- The desired measurement window must first be highlighted and is then displayed in the currently selected screen (see the section "[Opening, Operating, Hiding and Closing Panels](#)", page 3.20). In the list, open windows are displayed without a suffix, closed windows are identified by the suffix "closed", and open minimized windows by the suffix "hidden".

Run Sequence  
 SCPI Recording

### Sequence button

- To select sequences (macros) used to automate previously programmed measurement procedures, to perform certain routines, etc (see Chapter 5, "[Remote Control – Basics](#)").
- To record remote-control commands used to simplify the creation of measurement programs (see Chapter 5, "[Remote Control – Basics](#)").

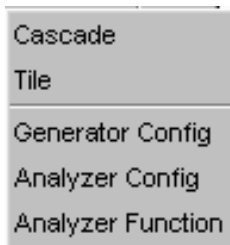


Diagnostic Panel (closed)  
Install Options...

### Utilities button

A series of settings for configuring the Audio Analyzer R&S UPV are grouped under this button:

- To install software options (see Chapter 8, "[Maintenance and Interfaces](#)").
- To select the remote-control interface (see Chapter 4, "[Instrument Functions](#)").
- To select the help text language (see Chapter 4, "[Instrument Functions](#)").
- To configure calibration routines for automatic zeroing of the A/D converters (see Chapter 4, "[Instrument Functions](#)").
- Service functions (see Chapter 8, "[Maintenance and Interfaces](#)").



Cascade  
Tile  
Generator Config  
Analyzer Config  
Analyzer Function

### Windows button

- To cascade all open panels / measurement windows.
- To tile all open panels / windows.
- To display and select all panels / measurement windows which are open and displayed in the current screen.



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### Help button

- To call up the help system of the Audio Analyzer R&S UPV (see the section "[Help System](#)", page [3.89](#)). To call up information about the firmware version installed on the instrument.



## Settings in the Operating System

The R&S UPV uses the WindowsXP® Embedded operating system. Settings at system level are only rarely required, e.g. installation of a new printer driver.

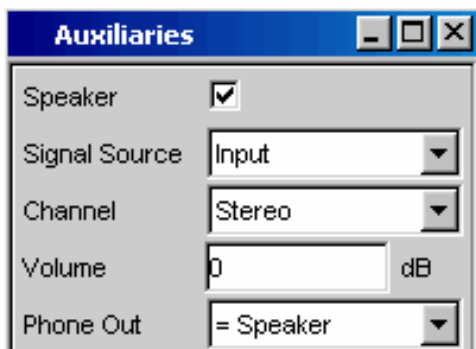
Connecting a keyboard and mouse makes Windows® easier to use.

### "Auxiliaries" Panel

A number of supplementary functions can be selected in the **Auxiliaries** panel. It is divided into the following sections:

- **Speaker,**  
for configuring the audio-monitoring functions
- **Anlg Aux Out,**  
the auxiliary analog output at the rear of the R&S UPV can be configured here
- **Trigger In / Out,**  
for configuring the trigger inputs and outputs at the rear of the instrument

### "Speaker" Function



The audio monitoring output (integrated loudspeaker or headphone connection) permits audio monitoring of analog or digital input signals both directly at the input of the Audio Analyzer R&S UPV and at the various analysis levels downstream of any filters that may be active. Audio monitoring of the generator signal is also possible.

The required settings are made in the Auxiliaries panel; the settings described here are intended as examples.

A detailed description of the options can be found in Chapter 4 "[Instrument Functions](#)".



The tick box is used to activate the audio monitoring function.



The **Signal Source** field is used to select which signal is to be monitored. This can be the measurement signal switched to the analysis path either in the input level, monitor level or function level, i.e. with or without filtering.

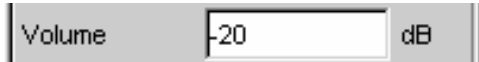
Alternatively, the generator signal can also be monitored.

The individual levels of the analyzer are explained in greater detail in the section ["Function blocks and measurement levels"](#) on page 3.5.



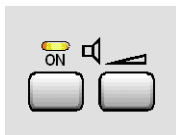
Either the signal of a single channel (Mono) or the stereo signal can be applied at the audio monitoring output.

If Stereo is set, both channels are applied separately at the two headphone outputs; the loudspeaker outputs the signal from both channels.



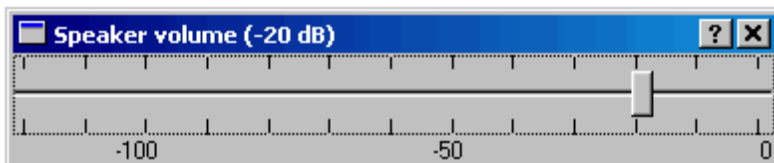
The volume at the loudspeaker or connected headphones can be set in two ways:

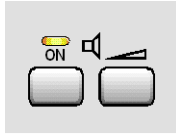
- By entering or changing the numeric value in the associated field of the panel (permitted range: 0 dB to -120 dB).



- Pressing the volume key on the front of the instrument opens a window containing a volume control which can be operated directly using the rotary knob, the cursor

keys and or using the mouse. The ENTER function or pressing the volume key again confirms the setting and closes the window.

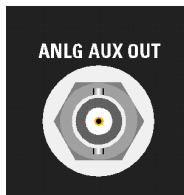
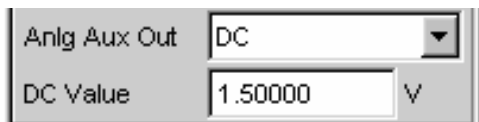




The headphone connection can be configured in two ways:

- **Phone Out = Speaker:**  
When headphones are connected, the integrated loudspeaker is disabled automatically, i.e. audio signals cannot be output at the loudspeaker and headphones simultaneously. The loudspeaker key on the front of the instrument is used to enable/disable the loudspeaker and headphones, depending on whether the loudspeaker is used or headphones are connected.
- If **Phone Out Permanent** is set, the headphone output is permanently enabled; the loudspeaker key on the front of the instrument only affects the integrated loudspeaker. The internal loudspeaker therefore remains active even when headphones are connected.

## Auxiliary Analog Output

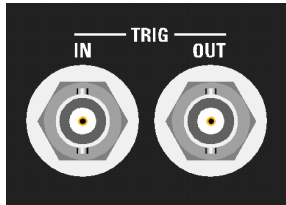


An auxiliary analog output for the following special applications is provided at the rear of the R&S UPV:

- Output of a DC signal, e.g. for supplying power to hearing aids
- Auxiliary output for the analog generator signal via an integrated amplifier for the direct actuation of small loudspeakers
- Output for single-channel audio monitoring

Details are given in Chapter 4 "[Instrument Functions](#)".

## Trigger Input, Trigger Output



A trigger input and trigger output for the following applications are provided at the rear of the R&S UPV:

- Input for triggering measurements
- Output for a measurement-event-dependent signal that can be used to trigger external instruments / circuits
- Alternatively, clock signals can also be output at the TRIG OUT socket

Details are given in Chapter 4 "[Instrument Functions](#)".

## Rapid Deactivation of the Outputs



In the event of faults, all outputs of the R&S UPV can be deactivated by pressing the **Output OFF** key. This means:

- the levels of all digital outputs are set to 0 V
- the levels of all analog outputs are set to 0 V; the outputs remain terminated (i.e. the impedance is retained)

The deactivated lines can only be reactivated by pressing the OUTPUT OFF key again.

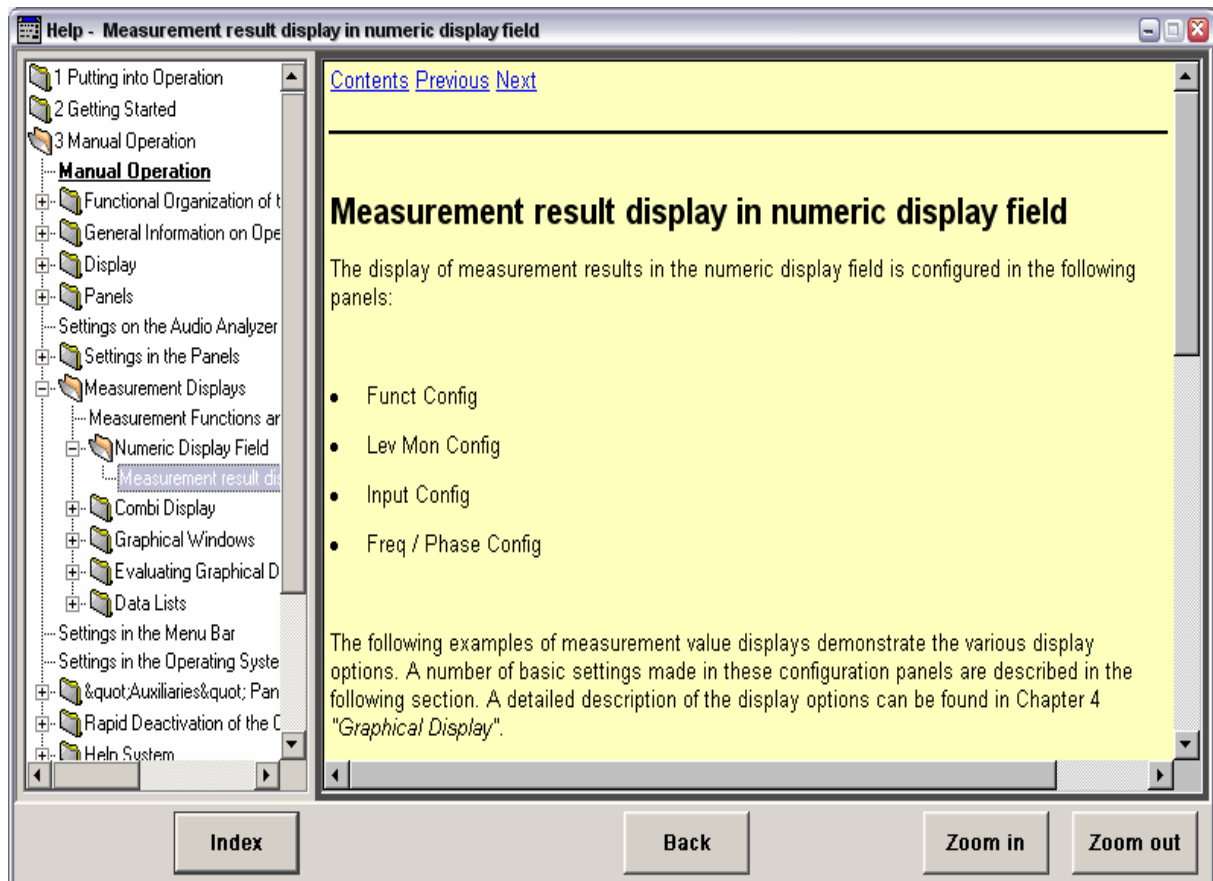
The status of the key is indicated by an LED. Illumination of the LED means OUTPUT OFF.

In order to protect the analyzer input, the generator output is also deactivated automatically if the analyzer inputs are overloaded (input voltage at 300  $\Omega$  or 600  $\Omega$  is higher than 25 V), and the OUTPUT OFF LED lights up as if the OUTPUT OFF key has been pressed. After the analyzer inputs have been overloaded in this way, measurements can be resumed provided that the overvoltage has been rectified or the input impedance has been switched to 200 k $\Omega$ .

## Help System

The R&S UPV has a context-sensitive help system. The help system provides a help page for every parameter and can be called up at any time while the instrument is being operated.

The help system has a navigation bar, i.e. starting from the context-sensitive page it is possible to move to other help pages using the contents list, the index, scroll arrows and page-internal links.



In addition to the context-sensitive help, online help for all functions of the R&S UPV is compiled on the supplied CD-ROM. This help can be called up on any computer using the Internet Explorer (version 4.0 and higher).

## Help Text Language

Both the context-sensitive help and the online help are available in English and German. The language in which the help texts are to appear can be set under the **Utilities** button on the menu bar.

Operating the context-sensitive help

Function	Front panel	PC keyboard	Mouse
<p><b>Open help</b></p> <p>Help page for selected parameter is displayed.</p>	Press <b>HELP</b> key.	Press F1 key.	---
Close help	Press <b>HELP</b> key again.	Press F1 key again.	---
<p><b>Activate link</b></p> <p>Help opens linked page.</p>	Highlight link using rotary knob or arrow keys and activate with rotary-knob click or <b>ENTER</b> key.	Highlight link using cursor keys and activate with Enter key.	Click link.
Scroll through help	Highlight <b>Previous</b> or <b>Next</b> in help window using cursor keys and activate with rotary-knob click or <b>ENTER</b> key.	Highlight <b>Previous</b> or <b>Next</b> in help window using cursor keys and activate with Enter key.	Click <b>Previous</b> or <b>Next</b> .
<p><b>Select item from contents list</b></p> <p>Help page for selected item is displayed.</p> <p>REALISIERUNG</p>	Press <b>Focus</b> button below contents list. Highlight desired item using rotary knob or cursor keys and then press rotary knob or <b>ENTER</b> key.	Highlight <b>Focus</b> button below contents list using cursor keys and activate with Enter key. Highlight desired item using cursor keys and then press Enter key.	Click item.
<p><b>Select index item</b></p> <p>Help page for selected item is displayed.</p>	Press <b>Focus</b> button below index. Type desired term in entry field and then press rotary knob or <b>ENTER</b> key or highlight item using rotary knob or cursor keys and then press rotary knob or <b>ENTER</b> key.	Highlight <b>Focus</b> button below index using cursor keys and activate with Enter key. Type desired term in entry field and press Enter key or highlight item using cursor keys and press Enter key.	Click item.
Select help text language	Press <b>MENU</b> key and highlight <b>Utilities</b> button using rotary knob or cursor keys, open pulldown menu with <b>ENTER</b> key or rotary-knob click, highlight and select <b>Language</b> button, and highlight and select desired language in next level.	Press key combination CTRL + M, then highlight <b>Utilities</b> button using keys TAB or SHIFT + TAB, open pulldown menu with Enter key, highlight <b>Language</b> button using cursor keys, select with Enter key and highlight desired language in next level using cursor keys and select with Enter key.	Click top of screen to open menu bar, actuate <b>Utilities</b> button, click <b>Language</b> button and click desired language in next level.

## File Management

The R&S UPV uses files to store all instrument data, i.e. system and user data. User data includes stored instrument settings, data for equalizer files, lists for sweeps, and so on.

The files are stored on the instrument's hard disk. The D:\ drive is available for storing user-defined data and can have any number of directory structures. A number of default directories are preconfigured; they can, however, be changed at any time.

The C:\ drive is a protected system drive. The files on this drive contain data which should not be modified. This drive should therefore not be accessed, otherwise reconstruction of the system partition will not be possible without loss of data. To prevent system files from being deleted or overwritten inadvertently, the C:\ drive is not displayed in the File menu. It can be accessed by disabling a protection level (see Protection Level in the Setup menu).

Files can be transferred either using a USB stick or via a connected network.

The USB stick is inserted into one of the USB interfaces and is assigned the drive letter E:\.

If the instrument is connected to a network, all network drives for which the user has access authorization are also available (see Chapter 1, section "[Accessing Directories in the Network](#)", page 1.32). The files are distinguished by their extension; each file type has a certain content. Normally, the extension is of no importance to the user since the files are accessed in the associated panels where only the relevant file type is available. For example, the files with equalizer settings can only be loaded in the **Generator Function** and **Analyzer Function** panels if the appropriate function settings have been made.

To load loaded settings or to store results, the **File Manager** must be called up using the  button in the respective panel; a **File Select** window then appears.

## File Select Window

The **File Select** window has several sections.

The files last used are listed in the top section **Recent Data Sets**; a maximum of ten files are displayed.

The available drives and directories are shown underneath on the left-hand side, and the files in the selected directory are shown on the right-hand side. The currently selected path is displayed above the window. Only the relevant files (without file extensions) are shown. If several files are opened, the path selected last is displayed.

Any file name can be used when saving and creating files; the file extension is, however, assigned automatically and cannot be entered. The file is saved on the selected path.

This panel is operated in the same way as other panels, whereby each section of the File Select window is treated as a separate panel: The rotary knob or cursors are used to highlight the desired section and the entry focus is moved to this section by pressing the rotary knob or the Enter key. The rotary knob and up/down cursors then only navigate within this section. The left/right cursor can be used to toggle between the directory tree and the file list. After a brief delay, the subdirectories of the selected directory are displayed to permit fast navigation in the directory tree. Pressing the ESC key moves the entry focus up again by one level. The button used to save or load the file can be highlighted and actuated. After the desired operation has been completed, e.g. selection of the file, the menu is closed automatically.

- **Loading file:**  
Highlight the file and load by pressing the rotary knob or actuating the **Select** button/softkey.
- **Saving file:**  
Enter the file name in the **File Name:** field. Highlight the directory in which the file is to be saved and then actuate the **Save** button/softkey.
- **Creating file:**  
Enter the file name in the **File Name:** field. Highlight the directory in which the file is to be saved and then actuate the **Create** button/softkey. The created file is empty; it has to be filled with the desired values using the associated editor.



## File Manager

The **File Manager** is used to perform general file management tasks, such as copying, moving, renaming and deleting files and creating new directories. It can also be used to save externally created files in the R&S UPV by copying them from a USB stick, from a CD ROM or from a network to the internal hard disk.

The **File Manager** can be called up in all panels in which files can be loaded. It is called up using the **File Manager...** button in the **File Select** window.



Additionally, it is also possible to call up the File Manager via the menu bar.

The file types which are to be displayed can be selected in the **File Type** section at the top of the **File Manager**. All files (All Files (\*.\*)) or specific file types (e.g. Waveforms (\*.wav)) can be selected. A list of file types is given in the panel at the end of this section.

The available drives and directories are shown underneath on the left-hand side, and the files in the selected directory are shown on the right-hand side. The currently selected path is displayed above the window. If several files are opened, the path selected last is displayed. Unlike the **File Select** window, the **File Manager** displays the complete file name including the extension.

The buttons/softkeys trigger the assigned action, e.g. copying, moving or deleting the highlighted file. In addition, it is possible to create a new directory in the level below the highlighted directory.

The File Manager is operated in the same way as other panels, whereby each section of the File Manager is treated as a separate panel: The rotary knob or cursors are used to highlight the desired section and the entry focus is moved to this section by pressing the rotary knob or the Enter key. The rotary knob and up/down cursors then only navigate within this section. The left/right cursor can be used to toggle between the directory tree and the file list. After a brief delay, the subdirectories of the selected directory are displayed to permit fast navigation in the directory tree. Pressing the ESC key moves the entry focus up again by one level. The buttons/softkeys can be selected and actuated.

- **Moving file:**  
Highlight the file and then actuate the **Cut** button/softkey. Highlight the directory to which the file is to be moved and then actuate the **Paste** button/softkey. If a file with the same name already exists in the target directory, a confirmation query appears which the user must acknowledge before the file is overwritten.
- **Copying file:**  
Highlight the file and then actuate the **Copy** button/softkey. Highlight the directory to which the file is to be copied and then actuate the **Paste** button/softkey. If a file with the same name already exists in the target directory, a confirmation query appears which the user must acknowledge before the file is overwritten.
- **Renaming file:**  
Highlight the file and then actuate the **Rename** button/softkey. A window opens in which the new file name can be entered. Enter the name and press the Enter key. If a file with the same name already exists, a confirmation query appears which the user must acknowledge before the file is overwritten.
- **Deleting file:**  
Highlight the file and then actuate the **Delete** button/softkey. A confirmation query then appears which the user must acknowledge before the file is deleted.
- **Creating a new directory:**  
Highlight the drive or directory level under which the new directory is to be created, and then actuate the **Create New Directory** button/softkey. A window opens in which the new directory name can be entered. Enter the name and press the Enter key.

## Loading and Saving Instrument Settings

Instrument settings are loaded and saved in the same way as described for loading and saving files in the previous section. The File Select window is opened using the **File** button in the menu bar.

Instrument settings can also be loaded/saved directly using the **LOAD** / **SAVE** keys on the front of the instrument. Pressing these keys opens the File Select window.

Every Audio Analyzer R&S UPV has a range of instrument settings which have been prepared by Rohde & Schwarz for a broad selection of typical measurements and which are available on the instrument as example setups. These setups are divided into various application areas (AA, AD, DD, DA) depending on whether the generator or analyzer is operated with analog or digital interfaces.

This allows users to make settings for their own specific measurement tasks very simply by modifying these example setups.

All of these example settings can be found in the **Applications** directory.

The default factory presettings are also available on every R&S UPV. These can be called up directly using the **File** button on the menu bar or by pressing the **PRESET** key on the front of the instrument.

## List of Used File Extensions

List of the user-file extensions which are assigned automatically in the R&S UPV:

File type	File extension	Meaning
<b>Instrument settings</b>		
	.SET	Setup file for saving and loading the instrument parameters set by the user
<b>Equalizer settings</b>		
	.FTF	Amplitude/frequency table for noise generation in the frequency range
	.VEQ	Precorrector file; loaded in the "Equal File" parameter field of the <i>Generator Function</i> and <i>Analyzer Function</i> panels
<b>Sweep settings</b>		
	.DWL	Dwell-time list for automatic generator sweeps, loaded in the "Dwell File" field of the <i>Generator Function</i> panel
	.SPF	Sweep list for frequency of the generator or of the selective RMS measurement; loaded in the <i>Generator Function</i> panel ("Freq File", "Mean Freq File", "Upper Freq File" fields) or in the <i>Analyzer Function</i> panel ("File Name" field)
	.SPI	Sweep list for burst interval; loaded in the "Interval File" field of the <i>Generator Function</i> panel
	.SPO	Sweep list for burst duration; loaded under the "On Time File" menu item of the <i>Generator Function</i> panel
	.SPV	Sweep list for generator voltage; loaded in the "Volt File" or "Tot Volt File" field (depending on the function) of the <i>Generator Function</i> panel
<b>Files for measurement or limit lists</b>		
	.LER	Error file for limit overranging, loaded in the configuration panels for measurement windows
	.LIM	Limit curve, loaded in the configuration panels for measurement windows under "Limit Upper" and "Limit Lower"
	.TRC	Trace lists for measurement values, loaded in the configuration panels for measurement windows

<b>Settings for the digital audio protocol</b>		
	.AES	Protocol information, AES/EBU + S/P DIF
	.PAC	Protocol analysis (AES/EBU, S/P DIF) screen control file for channel status data
	.PAU	Protocol analysis (AES/EBU, S/P DIF) screen control file for user data
	.PGC	Protocol generation (AES/EBU, S/P DIF) channel status data, file for channel status data
	.PGU	Protocol generation (AES/EBU, S/P DIF) user data, file for user data
	.PPC	Protocol generation (AES/EBU, S/P DIF) channel status data, file for definable protocol panel
<b>Graphic files</b>		
	.BMP	Pixel graphic
	.EMF	Vector graphic
<b>Other instrument files</b>		
	.ARB	Time table for generating arbitrary signals
	.WAV	Standard format for audio signals to allow processing with PC sound cards


## Manual Remote Operation

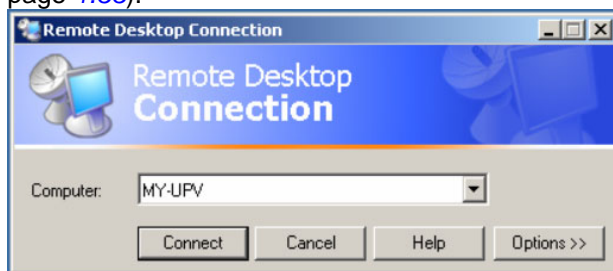
The R&S UPV permits manual remote operation using an external computer. As a result, the audio analyzer can be operated conveniently from the user's desk even if, for example, the audio analyzer is installed in a rack in a different room.

Unlike **remote control** where remote-control commands are used, **manual remote operation** requires separate Windows® software which is installed on the external computer. When launched, the Windows® software **Remote Desktop Connection** simulates the R&S UPV user interface. This allows the instrument to be manually operated at the external computer in the same way as at the instrument itself.

Manual remote operation is only possible if the audio analyzer and computer are connected via LAN and the Windows® software is installed on the computer.

How to set up a connection and install the remote operation software on the external computer is described in Chapter 1 in the section "[Configuration for Manual Remote Operation](#)" on page 1.33.

Manual remote operation is started on the external computer by calling up the **Remote Desktop Connection** program and clicking the **Connect** button. The R&S UPV must be selected as the remote operation device, i.e. its computer name must be displayed in the **Computer:** field. If the computer has been configured for remote operation of more than one instrument, the desired instrument can be selected from the list which is displayed by clicking the  button. The user ID and password (**instrument** in both cases) can be stored when the software is first installed. The entries are made in the extended menu "Options>>" (see Chapter 1, section "[Configuration for Manual Remote Operation](#)", page 1.33).

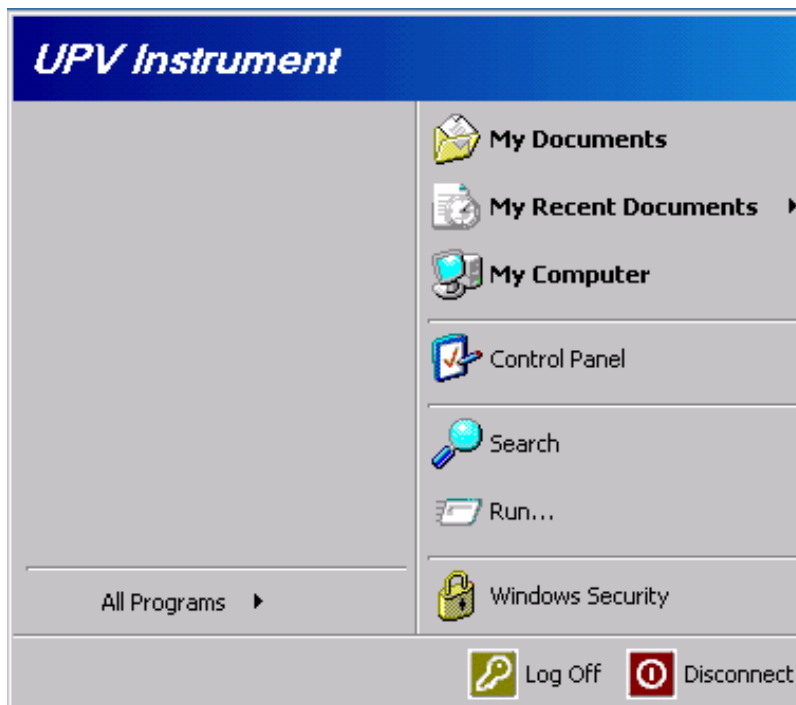


After login, the instrument firmware of the R&S UPV boots on the external computer. After booting is completed, the audio analyzer screen appears and the R&S UPV is ready for manual remote operation from the external computer. The starting configuration is that which was active before the connection was set up. The individual functions are operated using the mouse and panel. Front panel keys which are not directly available on the panel may be replaced by key combinations (see the section "[Overview of Keys](#)" starting on page 3.108).

The instrument firmware on the R&S UPV is terminated when the connection is set up. Operation at the R&S UPV itself is not possible during manual remote operation. Access by an external computer and the identity of the remote user is indicated on the login display of Windows® Embedded.

To enable direct operation at the R&S UPV again, the external user must first log out and then log in as the local user.

The external user can log out at the external computer in the **Start** menu of the R&S UPV window by clicking **Disconnect** in the bottom right-hand corner of the menu.



It is also possible to log off directly at the R&S UPV in the remote operation window.

The local user must press the key combination Ctrl + Alt + Del before logging in at the remote operation screen on the R&S UPV. The default name of the local user on the R&S UPV is "**instrument**"; the password is also "**instrument**".

After login, the instrument software starts with the settings used for manual remote operation.

## Units

There are two types of unit in the R&S UPV:

- **Units for measurement result display:**  
In the configuration panels for the measurement displays, a display unit must be selected for each measurement function. This unit is then used for the measurement result displayed in the measurement display windows. The unit is selected in the *Unit* fields of the respective panel.
- **Units for value entries (e.g. reference values, frequencies, levels, etc):**  
When data is entered, the available units are displayed on the softkeys. This allows value entries to be adopted by selecting the unit without a further entry window having to be opened.

## Units in Measurement Result Displays

To simplify matters:

- in the following conversion formulae the entry values are designated by the unit only.  
Example: "dBu" means "value in dBu".
- the conversions into  $\mu$ , m, k, M, etc are omitted.

### Units for analog level measurement results:

**Measurement functions:** RMS, RMS Selective, Peak, Quasi Peak, DC

**Basic unit:** Volt

Table 3-1 Units for analog level measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
V	V	
dBV	DBV	$20 * \lg(V)$
dBu	DBU	$20 * \lg(V/0.7745967)$
dBm	DBM	$10 * \lg(V^2 * 1000/R_{REF})$
W	W	$V^2/R_{REF}$
$\Delta\%V$	DPCTV	$(V/U_{REF}-1)*100$
$\Delta V$	DV	$V-U_{REF}$
V/Vr	VVR	$V/U_{REF}$
$\%V/Vr$	PCTVVR	$100 * V/U_{REF}$
$\Delta\%W$	DPCTW	$((V^2/R_{REF}-P_{REF}) * 100)/P_{REF}$
$\Delta W$	DW	$(V^2/R_{REF}) - P_{REF}$
P/Pr	PPR	$(V^2/R_{REF})/P_{REF}$
$\%P/Pr$	PCTPPR	$(V^2/R_{REF})/P_{REF} * 100$
dBr	DBR	$20 * \lg(V/U_{REF})$

$R_{ref}$  = Value of reference impedance (Ref Imped) from *Analyzer Config* panel

$U_{ref}$  = Reference value (Reference) from *Analyzer Config* panel for measurement functions RMS, RMS Selective, Peak, Quasi Peak, DC

$P_{ref}$  =  $(U_{REF})^2/R_{ref}$

## Units for digital level measurement results:

**Measurement functions:** RMS, RMS Selective, Peak, Quasi Peak, DC

**Basic unit:** Full Scale FS 0 ... 1

Table 3-2 Units for digital level measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
FS	FS	
%FS	PCTFS	$FS \times 100$
dBFS	DBFS	$20 \times \lg (FS)$
Hex *)	HEX	$FS \times 65535$
$\Delta\%$	DPCT	$(FS/U_{REF}-1) \times 100$
dBr	DBR	$20 \times \lg (FS/U_{REF})$
LSBs	LSBS	$FS \times 2^{\text{Audio bits}-1}$
bits	BITS	$\lg (FS \times 2^{\text{Audio bits}-1} + 1)$

$U_{REF}$  = Reference value (Reference) from *Analyzer Config* panel for measurement functions RMS, RMS Selective, Peak, Quasi Peak, DC

\*) Level measurement result in hex

The FS value (FS = Full Scale) measured at the digital interface as the result of a digital analyzer measurement function is displayed as a 6-digit hexadecimal number (6 digits = 24 bits = 23 bits mantissa + 1 sign bit) in the measurement result window, e.g.:

Table 3-3 Level measurement results in FS/Hex

FS value	Hex display
1.0	7FFFFFF Hex
0.9	733333 Hex
0.5	400000 Hex
0.0001	000347 Hex
0.0	000000 Hex
-0.0001	FFFCB9 Hex
-0.5	C00000 Hex
-0.9	8CCCCD Hex
-1.0	800000 Hex

All digital analyzer measurement functions deliver FS values ranging from 0 to 1. Exception: The peak measurement functions Peak and Quasi Peak can, depending on the selected peak mode, deliver FS values  $< 0$  or  $> 1$ . All values  $< -1$  are displayed as 80000 hex; all values  $> 1$  are displayed as 7FFFFFF hex.

FS values  $> 1$  can occur

- in the case of the peak measurement function with Meas Mode Pos Peak when a squarewave signal is applied since this signal is limited with respect to bandwidth, whereby overshoots occur at the edges (Gibbs phenomenon). The overshoots are also measured using peak analysis.
- in the case of the peak measurement function with Meas Mode Peak to Peak or Abs Peak.



FS values < 0 can occur

- in the case of the peak measurement function with Meas Mode Neg Peak.

### Units for analog and digital distortion measurement results:

**Measurement functions:** THD, THD+N & SINAD, Mod Dist, DFD, DIM  
**Basic unit:** %

Table 3-4 Units for analog and digital distortion measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
%	PCT	
dB	DB	$20 * \lg (\% / 100)$

### Unit for analog and digital S/N measurement results:

**Measurement functions:** RMS, Peak, Quasi Peak with activated S/N measurement

Table 3-5 Unit for analog and digital S/N measurement results

Value in	IEC/IEEE-bus notation	Formula
dB	DB	$20 * \lg (S/N)$

S: Measurement level with activated generator

N: Measurement level with deactivated generator

### Units for analog and digital frequency measurement results:

**Basic unit:** Hz

Table 3-6 Units for analog and digital frequency measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
Hz	HZ	
$\Delta$ Hz	DHZ	$\text{Hz} - F_{\text{REF}}$
$\Delta\%$ Hz	DPCTHZ	$100 * (\text{Hz} - F_{\text{REF}}) / F_{\text{REF}}$
Toct *	TOCT	$\lg (\text{Hz} / F_{\text{REF}}) * 9.96578$
Oct	OCT	$\lg (\text{Hz} / F_{\text{REF}}) / 0.30103$
Dec	DEC	$\lg (\text{Hz} / F_{\text{REF}})$
f/fr	FFR	$\text{Hz} / F_{\text{REF}}$

\*) Toct = Third octave

$F_{\text{REF}}$  = "Ref Freq" parameter from *Freq Phase Config* panel for frequency measurement

**Units for phase measurement results:****Basic unit:** Degrees

Table 3-7 Units for phase measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
°	DEG	
RAD	RAD	$P[°] * (\pi/180)$
$\Delta^\circ$	DDEG	$P[°] - D_{REF}$
$\Delta$ RAD	DRAD	$(P[°] - D_{REF}) * (\pi/180);$

$D_{REF}$  = "Ref Phase" parameter from *Freq Phase Config* panel for phase measurement

**Units for group delay measurement results:****Basic unit:** s

Table 3-8 Units for group delay measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
s	S	
$\Delta$ s	DS	$\tau[s] - D_{REF}$

$D_{REF}$  = "Ref Grp Del" parameter from *Freq Phase Config* panel for group delay measurement

**Units for digital jitter measurement results:****Basic unit:** UI

Table 3-9 Units for digital jitter measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
UI	UI	
%UI	PCTUI	$100 \times UI$
dBUI	DBUI	$20 \times \log (UI)$
ppm	PPMUI	$10^6 \times UI$
ns	NS	$10^9 \times UI / (128 \times \text{sampling frequency})$
dBr	DBR	$20 \times \log (UI/U_{REF})$

**Unit for digital phase measurement results (Phase to Ref):****Basic unit:** UI

Table 3-10 Units for digital phase measurement results

Value in	IEC/IEEE-bus notation	Conversion formula
UI	UI	
%FRM	PCTFRM	$100 \times \text{UI} / 128$
°FRM	DEGFRM	$360 \times \text{UI} / 128$
ns	NS	$10^9 \times \text{UI} / (128 \times \text{sampling frequency})$

The magnitude of the jitter and delay fault is normally given in UI (unit interval). One UI corresponds to the clock period with which the digital signal is clocked (biphase clock). With digital audio signals, one UI corresponds to 128<sup>th</sup> of the sampling period; at 48 kHz, one UI is 162.5 ns.

## Units for Value Entries

To simplify matters:

- in the following conversion formulae the entry values are designated by the unit only.  
Example: "dBu" means "value in dBu".
- the conversions into  $\mu$ , m, k, M, etc are omitted.

Table 3-11 Absolute analog level units (without reference voltage)

Conversion formulae	IEC/IEEE-bus notation
Vpp = Depends on generator function (see respective generator function)	VPP, VPP, UVPP
dBu = $20 \cdot \lg(V/0.7746)$	DBU
dBV = $20 \cdot \lg(V)$	DBV
dBm = $10 \cdot \lg(V^2 \cdot 1000/R_{REF})$ *)	DBM
$W = V^2/R_{REF}$	W, mW, uW

\*) In the case of the generator, the reference impedance  $R_{REF}$  is always 600 Ohm.

Table 3-12 Relative analog level units (with reference voltage)

Conversion formulae	IEC/IEEE-bus notation
$\Delta V = V - U_{REF}$	DV, Dm, V, DuV
$\Delta\%V = (V/U_{REF} - 1) \cdot 100$	DPCTV
$V/V_r = V/U_{REF}$	VVR
$\%V/V_r = V/U_{REF} \cdot 100$	PCTV/Vr
$\Delta W = (V^2 - U_{REF}^2)/R_{REF}$	DW
$\Delta\%W = (V^2 - U_{REF}^2) \cdot 100/U_{REF}^2$	DPCTW
$P/Pr = V^2/U_{REF}^2$	P/PR
$\%P/Pr = (V^2/U_{REF}^2) \cdot 100$	PCTPPR
$dBr = 20 \cdot \lg(V/U_{REF})$	DBR
$V/on = V/\text{Burst amp}[V]$	V/VON
$\%on = 100 \cdot V/\text{Burst amp}[V]$	PCTON
$dBon = 20 \cdot \lg(V/\text{Burst amp}[V])$	DBON

Table 3-13 Absolute digital level units (without reference)

Conversion formulae		IEC/IEEE-bus notation
bits = - 3.322 * lg (FS)	$FS = \frac{2^{bits-1}}{2^{Audio\ bits-1}}$	BITS PCTFS DBFS LSBS
%FS = 100 * FS	FS = %FS/100	
dBFS = 20 * lg (FS)	FS = 10 (dBFS/20)	
LSBS = FS * 2 <sup>Audio bits-1</sup>	$FS = 2^{\frac{LSBS}{Audio\ bits-1}}$	

Table 3-14 Relative digital level units (with reference)

Conversion formulae		IEC/IEEE-bus notation
dBr = 20 * lg (FS/U <sub>REF</sub> )	FS = 10 <sup>(dBr/20)</sup> * U <sub>REF</sub>	DBR
Δ% = 100 * (FS/U <sub>REF</sub> - 1)	FS = (Δ% / 100 + 1) * U <sub>REF</sub>	DPCT
%on = 100 * FS/Burst amp[FS]	FS = %on * Burst amp[FS]/100	PCTON
dBon= 20 * lg (FS/Burst amp[FS])	FS =10 <sup>(dBon/20)</sup> * Burst amp[FS]	DBON

Table 3-15 Absolute time units

Conversion formulae		IEC/IEEE-bus notation
s		S, MS, US
min = 60 s	s = min / 60	MIN
cyc = s * signal frequency	s = cyc / signal frequency	CYC, KCYC, MCYC

Table 3-16 Relative time units

Conversion formulae		IEC/IEEE-bus notation
Δs = s -T <sub>REF</sub>	s = Δs +T <sub>REF</sub>	DS, DMS, DUS
min = 60 s	s = min / 60	MIN
cyc = s * signal frequency	s = cyc / signal frequency	CYC, KCYC, MCYC

Table 3-17 Absolute frequency units

Conversion formulae		IEC/IEEE-bus notation
Hz		HZ KHZ

Table 3-18 Relative frequency units (with reference)

Conversion formulae		IEC/IEEE-bus notation
$\Delta\text{Hz} = \text{Hz} - F_{\text{REF}}$	$\text{Hz} = \Delta\text{Hz} + F_{\text{REF}}$	DHZ, DKHZ
$f/\text{fr} = \text{Hz}/F_{\text{REF}}$	$\text{Hz} = f/\text{fr} * F_{\text{REF}}$	FFR
$\Delta\%\text{Hz} = 100 * (\text{Hz} - F_{\text{REF}})/F_{\text{REF}}$	$\text{Hz} = \Delta\%\text{Hz} * F_{\text{REF}}/100 + F_{\text{REF}}$	DPCTHZ
$\text{Toct}^*) = \lg(\text{Hz}/F_{\text{REF}}) * 9.96578$	$\text{Hz} = 2^{(\text{Toct}/3)} * F_{\text{REF}}$	TOCT
$\text{Oct} = \lg(\text{Hz}/F_{\text{REF}}) * 3.32193$	$\text{Hz} = 2^{(\text{Oct})} * F_{\text{REF}}$	OCT
$\text{Dec} = \lg(\text{Hz}/F_{\text{REF}})$	$\text{Hz} = 10^{(\text{Dec})} * F_{\text{REF}}$	DEC
*) Toct = Third octave		

Table 3-19 Absolute phase units

Conversion formulae		IEC/IEEE-bus notation
$\text{rad} = \text{°} * (\text{PI}/180)$	$\text{°} = \text{rad} * (180/\text{PI})$	RAD

Table 3-20 Relative phase units

Conversion formulae		IEC/IEEE-bus notation
$\Delta\text{°} = \text{°} - D_{\text{REF}}$	$\text{°} = \Delta\text{°} + D_{\text{REF}}$	DDEG
$\Delta \text{RAD} = (\text{°} - D_{\text{REF}}) * (\pi / 180)$	$\text{°} = (\Delta \text{RAD} * 180 / \pi) + D_{\text{REF}}$	DRAD

Table 3-21 Deviations (tolerance) relative to previous measurement values in settling function

Conversion formulae		IEC/IEEE-bus notation
$\% = (10^{\text{dB}/20} - 1) * 100$	$\text{dB} = 20 * \lg(\%/100 - 1)$	DB, PCT

Table 3-22 Step size of a logarithmic level sweep

Conversion formulae		IEC/IEEE-bus notation
$\text{MLT} = 10^{\text{dB}/20}$	$\text{dB} = 20 * \lg(\text{MLT})$	MLT, DB

Table 3-23 Absolute resistance unit

Conversion formulae		IEC/IEEE-bus notation
$\Omega$		OHM, KOHM











**Legend:**

FS:	Abbreviation for Full Scale = Ratio 0...1
$U_{Ref}$ :	Level reference value in V or FS
$R_{Ref}$ :	"Ref Imped" parameter from Analyzer Config panel
$F_{Ref}$ :	Frequency reference value in Hz
Burst amp:	High level from generator burst signal
Signal frequency:	Frequency of generator burst signal or pulse signal
$D_{Ref}$ :	Phase reference value in °
















## Overview of Keys










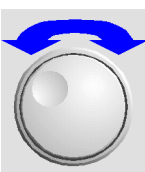


The following table gives an overview of the key functions on the front panel. The table also gives the PC keyboard key combinations which can be used to trigger the functions of the keys on the front of the instrument. Details regarding mouse operation are also included in this column.










The table is sorted according to the function blocks on the front panel.

Key on front panel	Key on PC keyboard <i>Mouse operation</i>	Function
<b>Softkeys</b>		
	F5 ... F12	Triggers the function assigned to the softkey.
<b>CONTROL panel</b>		
	CTRL + F5	<ul style="list-style-type: none"> <li>- Starts continuous measurements and sweeps</li> <li>- Resets the Min/Max values for bargraph displays, averaging for measurement results, and limit overranging</li> </ul>
	CTRL + F6	Starts a single measurement or a single sweep
	CTRL + F7	Measurement / sweep is stopped or continued (toggle function)
	CTRL + F8	Switches the loudspeaker or connected headphones on and off (toggle function)
	CTRL + F9	Opens / closes the window for adjusting the audio monitoring volume
	CTRL + P	Depending on the settings under Utilities, printout of the screen contents on the connected printer is started or the screen contents are stored in a file
	CTRL + F10	Stores the current settings on the hard disk and then shuts down the Windows® operating system
	CTRL + F11	Switches the instrument from remote operation to manual operation
	CTRL + F12	Switches all outputs of the measuring instrument off or on again (toggle function)



Key on front panel	Key on PC keyboard <i>Mouse operation</i>	Function
<b>Navigation keys</b>		
	CTRL + PAGE UP	Switches to the previous display setting (screen)
	CTRL + PAGE DOWN	Switches to the next display setting (screen)
	CTRL + SHIFT + TAB	Switches the focus to the previous panel open in the visible screen (the panel with the focus is active)
	CTRL + TAB	Switches the focus to the next panel open in the visible screen (the panel with the focus is active)
	ALT + PAGE UP	Changes to the previous scan in graphical displays so that, for example, measurement values can be read off using the cursor
	ALT * PAGE DOWN	Changes to the next scan in graphical displays so that, for example, measurement values can be read off using the cursor
	PAGE DOWN	Scrolls to the next page in tables
	PAGE UP	Scrolls to the previous page in tables
<b>Data entry keys</b>		
	1 p, q, r, s	Entry of numeric value: 1 Entry of letters: p, q, r, s
	2 t, u, v	Entry of numeric value: 2 Entry of letters: t, u, v
	3 w, x, y, z	Entry of numeric value: 3 Entry of letters: w, x, y, z
	4 g, h, i	Entry of numeric value: 4 Entry of letters: g, h, i
	5 j, k, l	Entry of numeric value: 5 Entry of letters: j, k, l
	6 m, n, o	Entry of numeric value: 6 Entry of letters: m, n, o
	7	Entry of numeric value: 7

Key on front panel	Key on PC keyboard <i>Mouse operation</i>	Function
	8 a, b, c	Entry of numeric value: 8 Entry of letters: a, b, c
	9 d, e, f	Entry of numeric value: 9 Entry of letters: d, e, f
	0 SPACE	Entry of numeric value: 0 Entry of a space
	. * ... #	Entry of a dot / decimal point; entry of special characters
	- (SHIFT +) A ... Z	Entry of sign; switchover between uppercase and lowercase letters
<b>VARIATION panel</b>		
	CTRL + M	Displays the menu bar on the screen
	BACKSPACE	Deletes the character to the left of the cursor; undoes the action last performed
	ESC	Closes the open panel; the old value or parameter is retained
	ENTER  Click with left-hand mouse key Press mouse wheel	Completes the data entry (the new value is adopted); confirms and closes open entry windows
	TAB (to right) SHIFT + TAB (to left) <i>Turn mouse wheel</i>	<ul style="list-style-type: none"> <li>- Moves the focus in the panels, selection windows and tables</li> <li>- Varies the entry value at the cursor position</li> <li>- Moves the active cursor in the graphical windows</li> <li>- Switches the measuring steps forwards and backwards for manual sweeps</li> </ul>
	ENTER	Pressing the rotary knob has the same effect as pressing the ENTER key
	UP/DOWN cursor keys	<ul style="list-style-type: none"> <li>- Move the focus in the panels, selection windows and tables</li> <li>- Vary the entry value at the cursor position</li> </ul>

Key on front panel	Key on PC keyboard <i>Mouse operation</i>	Function
	LEFT/RIGHT cursor keys	<ul style="list-style-type: none"> <li>- Move the active cursor inside the graphical windows</li> <li>- Move the cursor position in entered values</li> <li>- Switch the measuring steps forwards and backwards for manual sweeps</li> </ul>
<b>WINDOW and SETUP panels</b>		
	ALT + W	Toggles between the softkey bar and the WINBAR
	ALT + M	Opens a selection of functions on the softkey bar; these functions can be used in conjunction with the rotary knob to move or resize the active panel or graphical window
	ALT + H	Minimizes ("hides") the active panel or graphical window
	ALT + C	Closes the active panel or graphical window
	F1	Opens and closes the context-sensitive help function
	ALT + S	Opens a panel for storing instrument settings
	ALT + L	Opens a panel for loading predefined instrument settings
	ALT + P	Loads the factory settings of the instrument

# Overview of Panels and Measurement Displays (Graphical Windows)

Panels which can be selected via the **Instruments** menu bar button:

<b>Generator Config</b>	<ul style="list-style-type: none"> <li>• Selection of instrument (analog or digital interfaces)</li> <li>• Configuration of channels</li> <li>• Bandwidth and sampling rate</li> <li>• Reference values</li> <li>• Synchronization settings and wordwidth (for digital interfaces)</li> </ul>
<b>Generator Function</b>	<ul style="list-style-type: none"> <li>• Selection of test signals</li> <li>• Sweep function</li> <li>• Frequency and level settings</li> <li>• Filter and equalizer</li> </ul>
<b>Analyzer Config</b>	<ul style="list-style-type: none"> <li>• Selection of instrument (analog or digital interfaces)</li> <li>• Configuration of channels</li> <li>• Measurement bandwidth and sampling rate</li> <li>• Reference impedance</li> <li>• Start and trigger conditions</li> </ul>
<b>Analyzer Function</b>	<ul style="list-style-type: none"> <li>• Selection of measurement functions</li> <li>• Measurement speed and accuracy</li> <li>• Activation of filter and equalizer</li> <li>• Activation of Post-FFT</li> <li>• Selection and settings for level monitor</li> <li>• Selection and settings for input monitor</li> <li>• Selection and settings for frequency, phase, group delay measurement</li> <li>• Selection and settings for FFT monitor</li> <li>• Selection and settings for waveform monitor</li> </ul>
<b>Filter</b>	<ul style="list-style-type: none"> <li>• Definition of filter properties</li> </ul>
<b>Auxiliaries</b>	<p><b>Audio monitoring function</b></p> <ul style="list-style-type: none"> <li>• Settings for integrated loudspeaker and connected headphones</li> <li>• Signal source and channels</li> <li>• Volume</li> <li>• ON/OFF and volume control also possible using keys in CONTROL panel</li> </ul> <p><b>Auxiliary Analog Output</b></p> <ul style="list-style-type: none"> <li>• Function selection and settings</li> </ul> <p><b>Trigger Input, Trigger Output</b></p> <ul style="list-style-type: none"> <li>• Function selection and settings</li> </ul>

## **R&S UPV Overview of Panels and Measurement Displays (Graphical Windows)**

Panels which can be selected via the **Disp Config** menu bar button:

<b>Function Config</b>	<ul style="list-style-type: none"><li>• Settings for measurement values of active measurement function in numeric display field</li><li>• Settings for associated combi displays</li><li>• Settings for limits, minimum values and maximum values</li></ul>
<b>Level Monitor Config</b>	<ul style="list-style-type: none"><li>• Settings for numeric measurement values of level monitor in numeric display field</li><li>• Settings for associated combi displays</li><li>• Settings for limits, minimum values and maximum values</li></ul>
<b>Input Config</b>	<ul style="list-style-type: none"><li>• Settings for measurement values of input monitor in numeric display field</li><li>• Settings for associated combi displays</li><li>• Settings for limits, minimum values and maximum values</li></ul>
<b>Freq Phase Config</b>	<ul style="list-style-type: none"><li>• Settings for measurement values of frequency, phase and group delay measurement in numeric display field</li><li>• Settings for associated combi displays</li><li>• Settings for limits, minimum values and maximum values</li></ul>
<b>Sweep Graph 1...4 Config</b>	<ul style="list-style-type: none"><li>• Four of these panels are available so that up to 4 sweep graphical windows can be displayed simultaneously</li><li>• Setting of all details for one-channel or two-channel graphical display of sweep functions, e.g. units, scaling, gridlines, etc</li><li>• Evaluation of minimum values and maximum values</li><li>• Entry of limit curves</li><li>• Settings for cursors and markers</li></ul>
<b>FFT-Monitor Config</b>	<ul style="list-style-type: none"><li>• Setting of all details for one-channel or two-channel graphical display of FFT monitor, e.g. units, scaling, gridlines, etc</li><li>• Evaluation of minimum values and maximum values</li><li>• Entry of limit curves</li><li>• Settings for cursors and markers</li></ul>
<b>FFT Graph 1...2 Config</b>	<ul style="list-style-type: none"><li>• Two of these panels are available so that up to 2 FFT graphical windows can be displayed simultaneously</li><li>• Setting of all details for one-channel or two-channel display of FFT graph, e.g. units, scaling, gridlines, etc</li><li>• Evaluation of minimum values and maximum values</li><li>• Entry of limit curves</li><li>• Settings for cursors and markers</li></ul>
<b>Waveform Config</b>	<ul style="list-style-type: none"><li>• Setting of all details for graphical display of waveform analyzer, e.g. number of curves, units, scaling, gridlines, etc</li><li>• Entry of limit curves</li><li>• Settings for cursors and markers</li></ul>

<p><b>Bargraph1...2 Config</b></p>	<ul style="list-style-type: none"> <li>• Two of these panels are available so that up to 2 bargraph windows can be displayed simultaneously</li> <li>• Setting of all details for one-channel or two-channel display of bargraphs, e.g. units, scaling, gridlines, etc</li> <li>• Evaluation of minimum values and maximum values</li> <li>• Entry of limits</li> <li>• Settings for cursors and markers</li> </ul>
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Measurement windows which can be selected via the **Displays** menu bar button:

<p><b>Numeric Display</b></p>	<ul style="list-style-type: none"> <li>• Display of one-channel or two-channel measurement results of measurement function selected in Analyzer Function panel</li> <li>• Display of one-channel or two-channel measurement results of level monitor selected in Analyzer Function panel</li> <li>• Display of one-channel or two-channel measurement results of input monitor selected in Analyzer Function panel</li> <li>• Display of one-channel or two-channel frequency measurement results, or display of frequency measurement result and phase or group delay measurement result</li> <li>• The measurement results are displayed in the way defined in the configuration panel</li> </ul>
<p><b>Funct Ch1...2</b></p>	<ul style="list-style-type: none"> <li>• These combi displays are extensions to the numeric measurement displays of the measurement function selected in the Analyzer Function panel; they show the respective numeric value plus the following additional features:</li> <li>• Analog bargraphs</li> <li>• Monitoring and display of limits</li> <li>• Storage of minimum and maximum values</li> <li>• The measurement results are displayed in the way defined in the configuration panel</li> </ul>
<p><b>Lev Mon Ch1...2</b></p>	<ul style="list-style-type: none"> <li>• These combi displays are extensions to the numeric measurement display of the level monitor selected in the Analyzer Function panel; they show the respective numeric value plus the following additional features:</li> <li>• Analog bargraphs</li> <li>• Monitoring and display of limits</li> <li>• Storage of minimum and maximum values</li> <li>• The measurement results are displayed in the way defined in the configuration panel</li> </ul>
<p><b>Input Ch1...2</b></p>	<ul style="list-style-type: none"> <li>• These combi displays are extensions to the numeric measurement display of the input monitor selected in the Analyzer Function panel; they show the respective numeric value plus the following additional features:</li> <li>• Analog bargraphs</li> <li>• Monitoring and display of limits</li> <li>• Storage of minimum and maximum values</li> <li>• The measurement results are displayed in the way defined in the configuration panel</li> </ul>

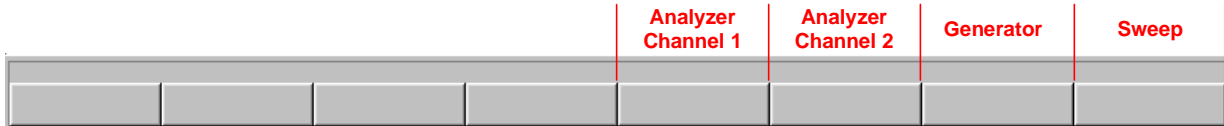
## **R&S UPV Overview of Panels and Measurement Displays (Graphical Windows)**

<b>Freq Ch1 Freq/Phase</b>	<ul style="list-style-type: none"><li>• These combi displays are extensions to the numeric measurement display for one-channel or two-channel frequency measurement results or for the frequency measurement result and the phase or group delay measurement result; they show the respective numeric value plus the following additional features:</li><li>• Analog bargraphs</li><li>• Monitoring and display of limits</li><li>• Storage of minimum and maximum values</li><li>• The measurement results are displayed in the way defined in the configuration panel</li></ul>
<b>Sweep Graph 1...4</b>	<ul style="list-style-type: none"><li>• Up to four of these display windows can be open simultaneously to display scans from sweep measurements</li><li>• One-channel or two-channel graphical display</li><li>• The measurement results are displayed in the way defined in the Sweep Graph 1...4 Config panel</li></ul>
<b>FFT-Monitor</b>	<ul style="list-style-type: none"><li>• This display window shows the spectrum of the FFT monitor</li><li>• One-channel or two-channel graphical display</li><li>• The measurement results are displayed in the way defined in the FFT-Monitor Config panel</li></ul>
<b>FFT Graph 1...2</b>	<ul style="list-style-type: none"><li>• Up to two of these display windows can be open simultaneously to display the FFT analyses of the selected measurement function or of the Post-FFT</li><li>• One-channel or two-channel graphical display</li><li>• The measurement results are displayed in the way defined in the FFT Graph 1...2 Config panel</li></ul>
<b>Waveform</b>	<ul style="list-style-type: none"><li>• This display window shows the characteristic of the measurement signal over time</li><li>• One-channel or two-channel graphical display</li><li>• The measurement results are displayed in the way defined in the Waveform Config panel</li></ul>
<b>Bargraph 1...2</b>	<ul style="list-style-type: none"><li>• Up to two of these display windows can be open simultaneously to display bargraphs of the selected measurement function</li><li>• One-channel or two-channel graphical display</li><li>• The measurement results are displayed in the way defined in the Bargraph 1...2 Config panel</li></ul>

# Overview of Status Messages

The status of the R&S UPV is continuously displayed for the generator, analyzer, sweep system and other instrument states at the bottom of the screen in four fields above the four right-hand softkeys.

Status displays always appear at the same position; they are assigned to the fields above the softkeys as shown in the illustration below. Displays which concern the analyzer in both channels occupy both analyzer fields.



The following overview shows the possible status messages and their meaning:

## Analyzer status:

### Status information which applies to both channels

Anlr Wait for Trigger	Analyzer is waiting for set trigger condition
Anlr Overload	Analyzer has been switched off owing to overload
Anlr Wait for Cal	Analyzer requires internal offset calibration; this is, however, not possible at present because: <ul style="list-style-type: none"> <li>• either cyclic DC-offset calibration has been deactivated</li> <li>• or cyclic DC-offset calibration is disabled owing to a currently active sweep</li> </ul>

### Status information which applies to both channels

Off	Measurement channel is deactivated
Over	Measuring range has been overranged; this can occur if: <ul style="list-style-type: none"> <li>• <b>Range Fix</b> setting is being used</li> <li>• a signal with a level at range limit is applied with a crest factor &gt; 2</li> <li>• common-mode voltage is applied in BAL input configuration</li> </ul>
Under	Measuring range has been underranged; this can occur if <b>Range Fix</b> or <b>Lower</b> setting is being used
Single	Single measurement is being performed



Cont	Continuous measurement is being performed
Terminated	Single measurement has been terminated
Stopped	Measurement has been stopped
Calibrating	Cyclic, internal DC-offset calibration of A/D converter is being performed

**Generator status:**

Gen Off	Generator is deactivated
Gen Running	Generator signals are being output
Gen Output Off	All output lines are deactivated
Gen Overload	Generator has been deactivated owing to overload

**Sweep status:**

Sweep Off	No sweep is being performed
Sweep Waiting	Sweep has been defined but not yet started
Sweep Terminated	Single sweep has been terminated
Sweep Stopped	Sweep has been stopped but can be continued
Sweep Run Cont	Continuous sweep is being performed
Sweep Run Single	Single sweep is being performed
Sweep Run Manual	Manual sweep is being performed

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# 4 Instrument Functions

## Selecting the Generator

### Generator Configuration Panel

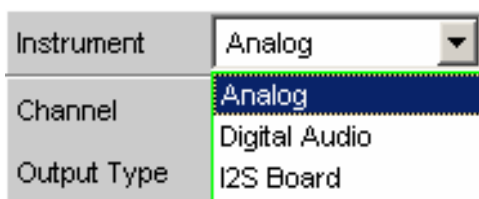
The Generator Config panel enables you to define settings for the analog or digital generator.

To adapt the R&S UPV generator to the measurement task at hand, first define the settings in the Generator Config panel. These settings will determine which capabilities are available in the Generator Function panel.

The first step is to select one of the two generators (analog or digital).

#### Instrument

Used to select the generator.



#### Analog

In the Generator Function panel, the user can choose between the universal generator for virtually any signal shape (up to max. 80 kHz) and a low-distortion sinewave generator (R&S UPV-B1 option "Low-Distortion Generator" up to max. 185 kHz). The sinewave generator can be activated for the generator function "Sine".

Remote-control command:  
`INSTRument[1][:SElect] ANLG`

#### Digital Audio

Either audio data, a jitter signal or a common signal can be used as the source mode, see section ["Configuring the Digital Generator"](#) on page 4.14.

Remote-control command:  
`INSTRument[1][:SElect] DIG`

#### I<sup>2</sup>S Board

The I<sup>2</sup>S generator can generate audio data in I<sup>2</sup>S format.

Remote-control command:  
`INSTRument I2SB`

# Configuring Analog Generator

## Analog Generator Config Panel

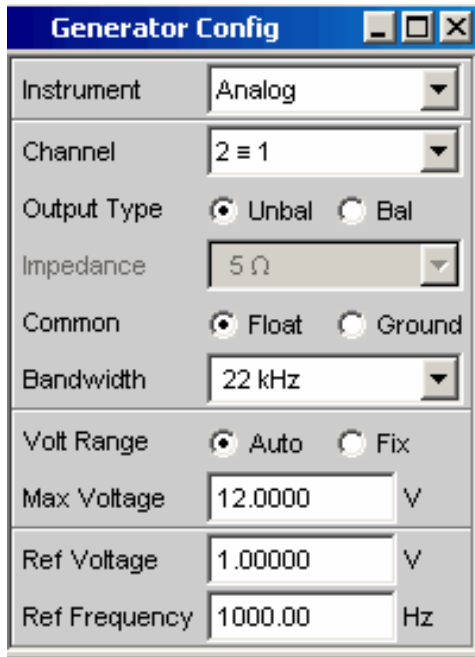
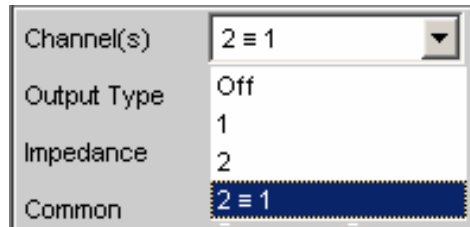


Figure 4-1 Analog generator configuration panel

The Config panel is used to set up the analog and digital generator. The configuration options for the analog generator are described below.

**Channel**

Used to select the signal-carrying XLR plugs in the bottom right-hand part of the R&S UPV front panel.



- OFF** Both XLR plugs are deactivated.
- Remote-control command:  
OUTput:CHANnel OFF
- 1** XLR plug 1 supplies the generator signal; XLR plug 2 is deactivated.
- Remote-control command:  
OUTput:CHANnel CH1
- 2** XLR plug 2 supplies the generator signal; XLR plug 1 is deactivated.
- Remote-control command:  
OUTput:CHANnel CH2
- 2 ≡ 1** Both XLR plugs supply an output signal.

**Note:**

*If the generator function "Stereo Sine" is selected (in the Generator Function panel; the R&S UPV-B3 option is required for this), the level and frequency can be different for each channel of the output signal.*

Remote-control command:  
OUTput:CHANnel CH2Is1



**Output Type**

The generator output can be configured to be unbalanced (Unbal) or balanced (Bal). The setting always applies to both outputs.

**Unbal**

The RMS of the generator signal can be max. 10 V.  
The output impedance is 5  $\Omega$ .  
If commercially available BNC cables are to be used, it is recommended to use an XLR/BNC adapter R&S UPL-Z1.

Remote-control command:  
OUTPut:TYPE UNBalanced

**Bal**

The RMS of the generator signal can be max. 20 V.  
The user can choose between three different output impedance values.

Remote-control command:  
OUTPut:TYPE BALanced

**Impedance**

This field can only be operated if "Bal" has been selected as the Output Type in the field above. If "Unbal" has been selected, only a field showing a fixed impedance (5  $\Omega$  in this case) is displayed.

Impedance	10 $\Omega$
Common	10 $\Omega$
Bandwidth	200 $\Omega$
	600 $\Omega$

**10  $\Omega$** 

The output impedance is 10  $\Omega$ .

Remote-control command:  
OUTPut:IMPedance R10

**200  $\Omega$** 

The output impedance is 200  $\Omega$ . If the R&S UPV-U1 option is installed, the output impedance is 150  $\Omega$ . After the R&S UPV-U1 option has been installed, the R&S UPV must be informed of this via the diagnostics panel so that "150  $\Omega$ " is then displayed in the selection box. The installation instructions supplied with the option explain which entries are required for this.

Remote-control command:  
OUTPut:IMPedance R200

**600  $\Omega$** 

The output impedance is 600  $\Omega$ .

Remote-control command:  
OUTPut:IMPedance R600

**Common**

The generator ground can be floating or connected to the instrument ground. XLR Pin 1 always remains unconnected, regardless of the selected configuration.



**Float**

The generator ground is not electrically connected to the instrument ground. With the default configuration "Unbal", a capacitance of approx. 25 nF is connected between the two ground connections. With "Bal", the capacitance is approx. 2 nF and is primarily determined by the layout and coupling capacitance inside the toroidal transformer which delivers the supply voltages for the generator.

Remote-control command:  
 OUTPut:LOW FLOat

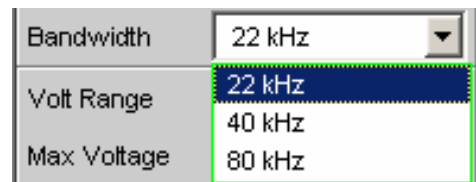
**Ground**

The generator ground is electrically connected to the instrument ground with approx. 50 Ω.

Remote-control command:  
 OUTPut:LOW GROund

**Bandwidth**

If the universal generator is selected, the user can choose between three different frequency ranges.



**22 kHz**

The maximum output frequency is 22 kHz. The generator D/A converter is then clocked at 48 kHz.

Remote-control command:  
 OUTPut:BANDwidth:MODE B22

**40 kHz**

The maximum output frequency is 40 kHz. The generator D/A converter is then clocked at 96 kHz.

Remote-control command:  
 OUTPut:BANDwidth:MODE B40

**80 kHz**

The maximum output frequency is 80 kHz. The generator D/A converter is then clocked at 192 kHz.

Remote-control command:  
 OUTPut:BANDwidth:MODE B80

## Volt Range

Two different modes are available for generator level control.

**Auto**

The internal signal paths are optimally driven; the output voltage is adjusted using the analog hardware.

**Advantage:**

Optimum noise and distortion values.

Remote-control command:  
 SOURce:VOLTage:RANGe AUTO

**Fix**

The analog hardware is permanently set to the specified maximum voltage. The actual output voltage is obtained by controlling the level of the D/A converter; the analog hardware settings remain unchanged.

**Advantage:**

Faster level changes and better settling. Voltage dips when switching over the attenuator are avoided as no relays are connected.

**Note:**

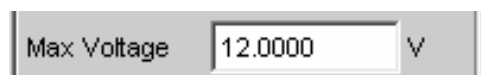
*This setting is ignored if the "Low-Distortion Generator" option (R&S UPV-B1) is used. In this case, level control is always performed according to the **Auto** algorithm.*

Remote-control command:  
 SOURce:VOLTage:RANGe FIX

## Max Voltage

Maximum value for the output voltage; prevents excessively high voltage values from being entered inadvertently in the Generator Function panel.

The voltage set in the Generator Function panel cannot be higher than the voltage specified here.



The RMS for sinewave signals is entered, i.e. the maximum peak value is higher by a factor of  $\sqrt{2}$ .

Remote-control command:  
 SOURce:VOLTage:MAXimum <nu>

**Ref Voltage**

Reference value for the relative voltage units.

If the reference level is changed, all voltage settings linked to the reference value also change. The relative voltage of the generator signal remains unchanged.

By varying the reference voltage, a level sweep defined with relative start and stop levels, for example, can be shifted by a constant "gain factor".

A screenshot of a control panel for 'Ref Voltage'. It features a label 'Ref Voltage' on the left, a numerical input field containing '1.00000', and a unit selector dropdown menu set to 'V'.

Remote-control command:

```
SOURce:VOLTage:REFerence <nu>
```

**Ref Frequency**

Reference value for the relative frequency units.

If the reference frequency is changed, all frequency settings linked to the reference value also change. The relative frequency of the generator signal remains unchanged.

By varying the reference frequency, the fundamental of a distortion spectrum set using a multi-sinewave, for example, can thus be shifted without the harmonics having to be calculated and set again by the user.

A screenshot of a control panel for 'Ref Frequency'. It features a label 'Ref Frequency' on the left, a numerical input field containing '1000.00', and a unit selector dropdown menu set to 'Hz'.

Remote-control command:

```
SOURce:FREQuency:REFerence <nu>
```

## Generator Outputs

Each output of the analog R&S UPV generator can be configured differently (see the panel description under "Channel", "Output Type", "Impedance" and "Common"). The circuit diagrams for the generator output are shown below.

### Unbalanced Output (Output Type "Unbal")

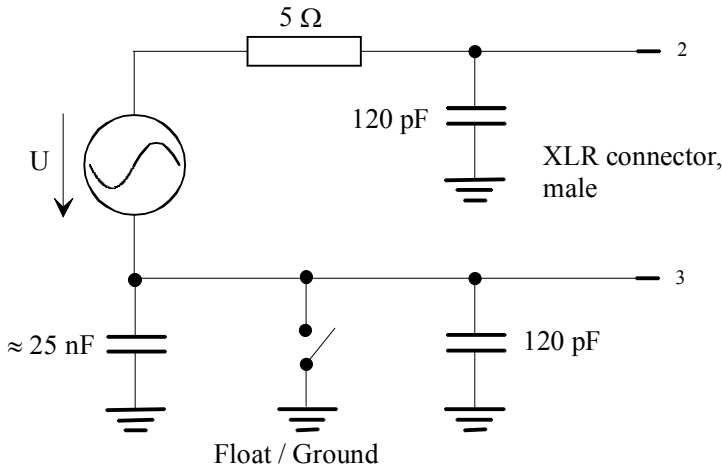


Figure 4-2 Unbalanced Output

The following output circuit configurations are available depending on the selected channel setting (capacitors are not shown; the ground symbol denotes the floating generator ground connection):

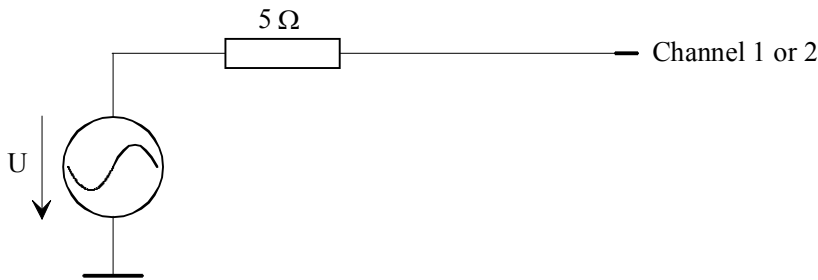


Figure 4-3 Channel = 1 or 2

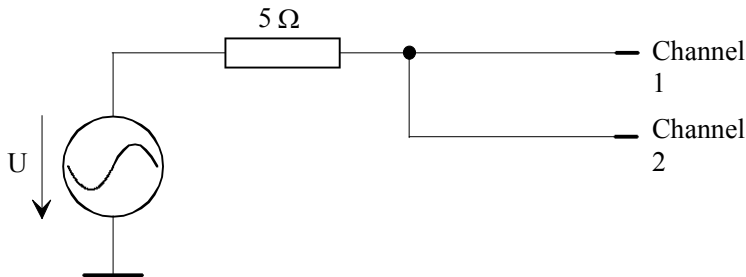


Figure 4-4 Channel = 2 ≡ 1

The selected output impedance is retained even if the output is deactivated; XLR Pin 3 is connected to the generator ground.

**Balanced Output (Output Type "Bal")**

The balanced output signal is applied between Pin 2 and Pin 3 of the XLR plug. Pin 1 is not connected. The source impedance consists of two identical resistors in both signal lines. In the diagrams, the ground symbol with the single line represents the floating generator ground connection and the earth symbol represents the R&S UPV housing ground connection.

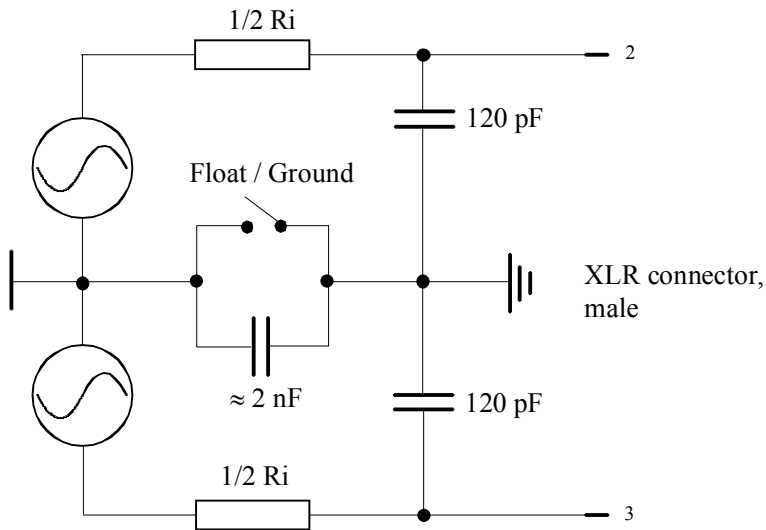


Figure 4-5 Balanced Output

The following output circuit configurations are available depending on the channel and impedance (capacitors are not shown):

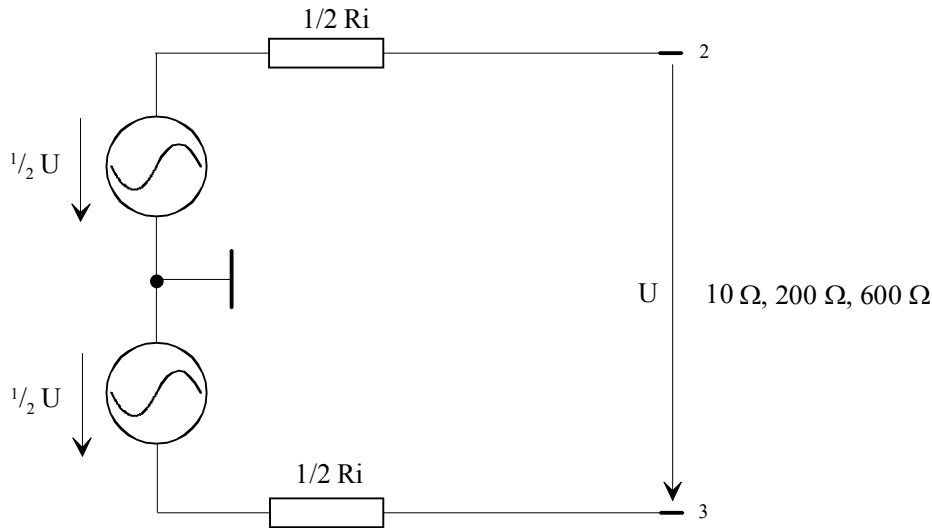


Figure 4-6 Channel = 1 or 2

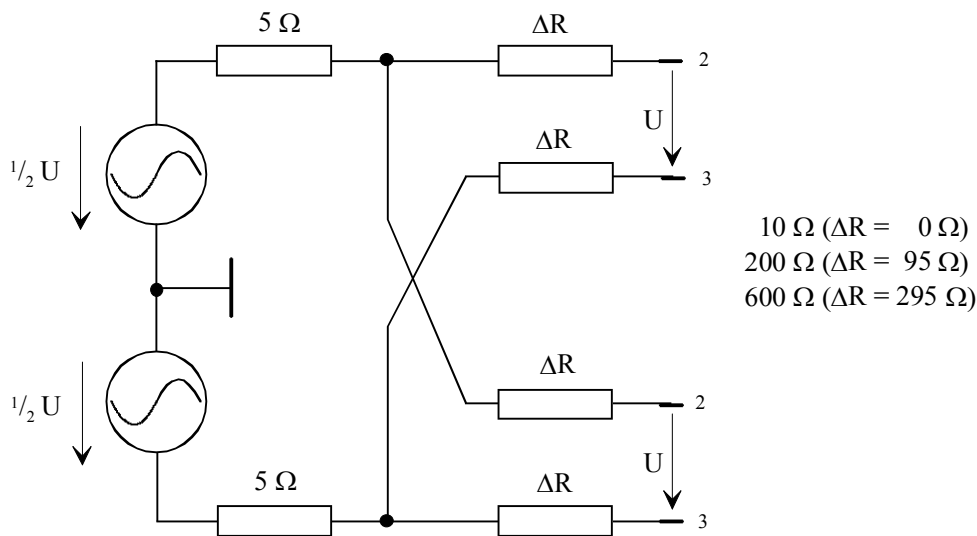


Figure 4-7 Channel = 2 = 1

The selected output impedance is retained even if the output is deactivated. The deactivated generator output is not connected to generator ground.

The diagrams above apply to all generator functions, except "Stereo Sine" and "DIM". The R&S UPV-B3 option (Second Generator) is required if a stereo or DIM signal is to be generated. In this case, the XLR plugs Ch1 and Ch2 are supplied slightly differently.



If the R&S UPV-B3 option (Second Generator) is installed and the generator function "Stereo Sine" is set, the XLR plugs of the outputs are connected as shown below:

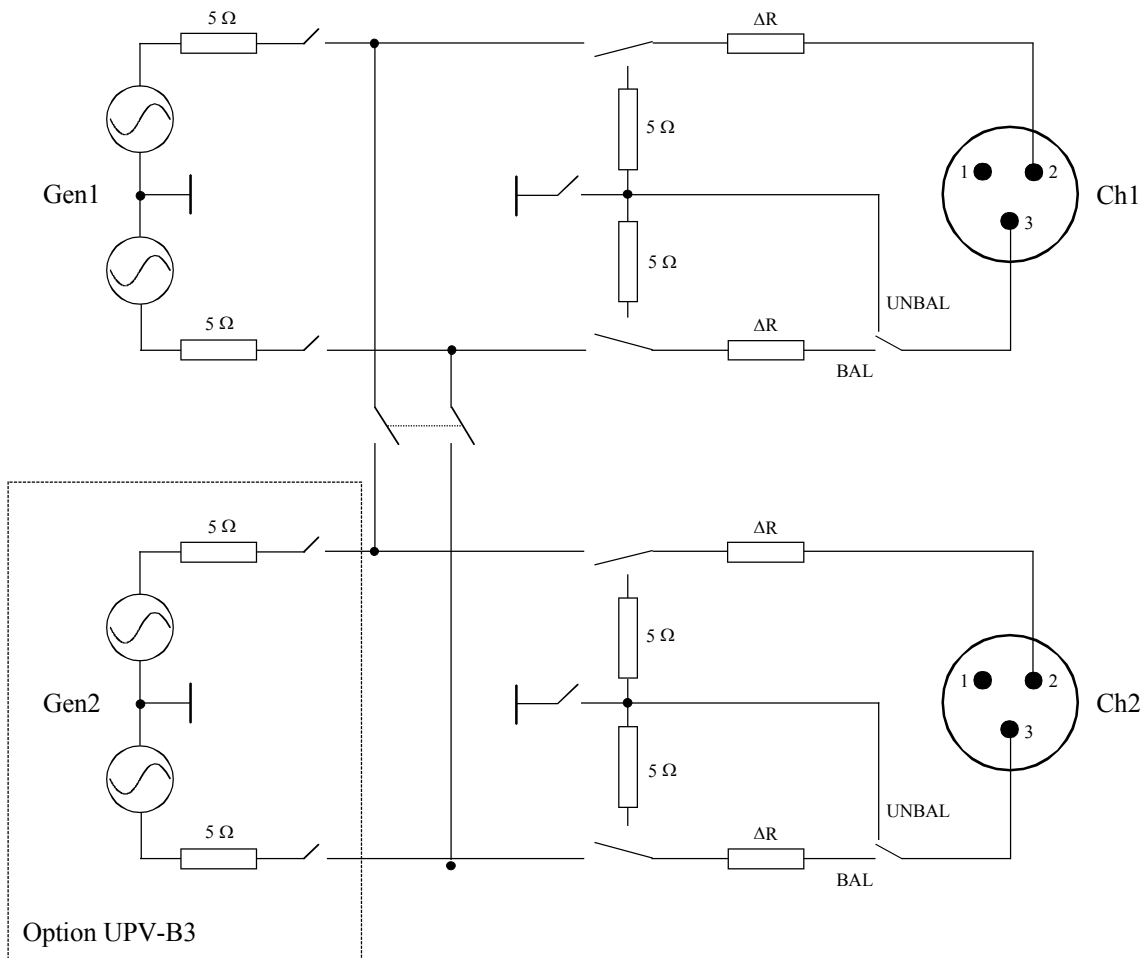


Figure 4-8 Connection of outputs with "Stereo Sine"

As can be seen in the circuit diagram, the two generator outputs are supplied by two independent sources.

If the R&S UPV-B3 option (Second Generator) is installed and the generator function "DIM" is set, the XLR plugs of the outputs are connected as shown below:

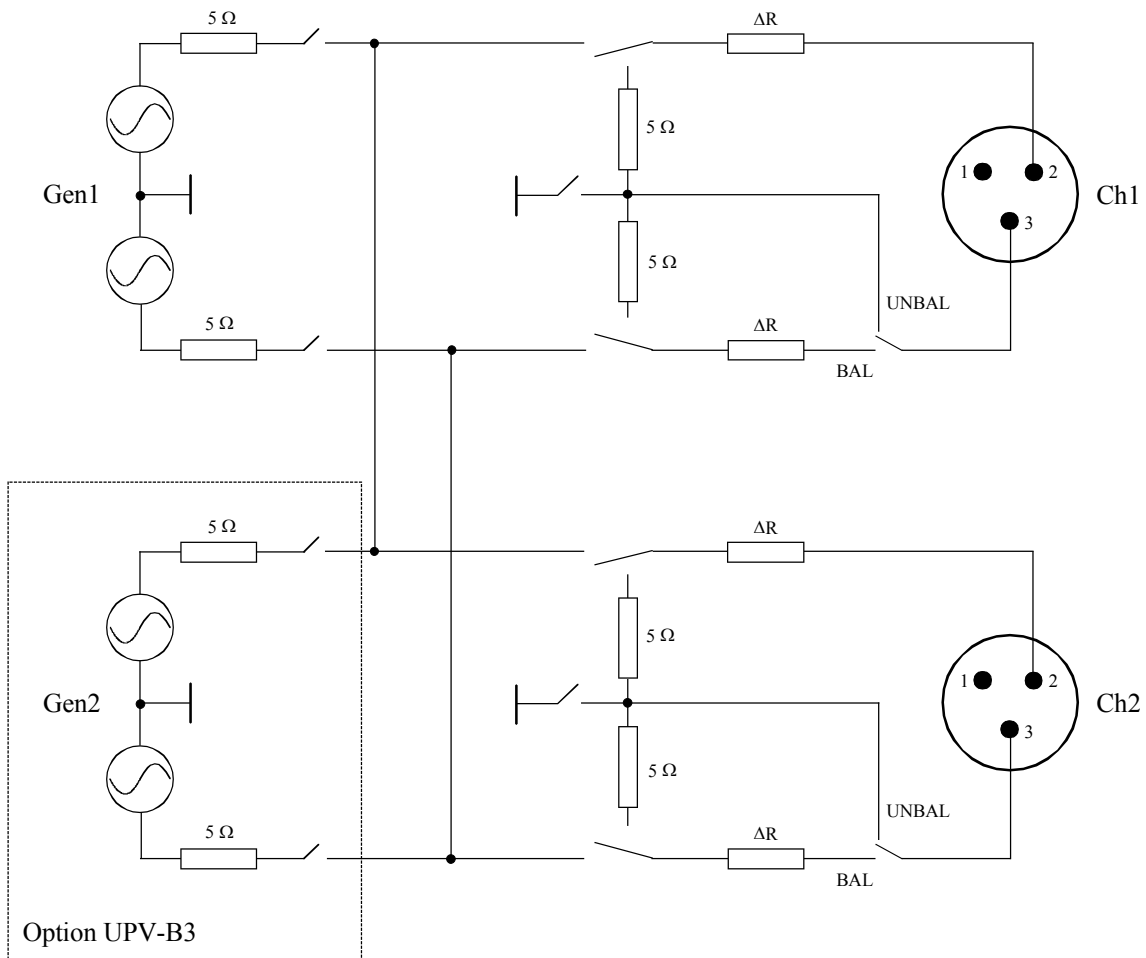


Figure 4-9 Connection of outputs with "DIM"

The two generator outputs are supplied by the R&S UPV-B3 option (Second Generator).

## Output Power

The output amplifier, attenuator and all internal resistors are short-circuit-proof. The peak current value is limited to approx. 200 mA. With a maximum RMS of 20 V (balanced) / 10 V (unbalanced), the maximum power loss in the load resistor (in the case of a short-circuit in the internal resistor) is 2.8 W / 1.4 W.

# Configuring the Digital Generator

## Digital Generator Configuration Panel

The configuration panel is used to set up the analog and digital generator.

The configuration options for the digital generator are described below.

### Source Mode

Used to determine whether audio data or impairments are generated. Jitter and Common are available as impairment signals. The digital audio signal is available to all digital interfaces at the same time.

In Source Mode "Jitter Only", jitter is applied to the digital audio signal. In Source Mode "Common Only", an analog common-mode signal is superimposed on the digital audio signal at the BAL output.



With digital audio interfaces, there are basically two signal types which occur: the analog interface signal and the encoded audio signal itself. The digital interface signal has analog parameters on which, for example, noise or other interference signals can be superimposed – this interference is also noticeable as shifting of the signal edges. When this effect (known as "jitter") exceeds a certain magnitude, it becomes impossible to decode or regenerate the audio signal correctly.

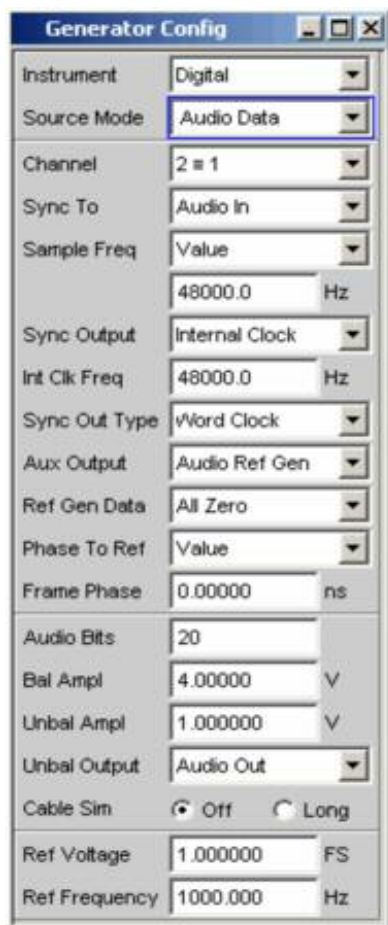
The R&S UPV can generate the various digital signal impairments: Shifting of the signal edges (jitter) and superimposition of a common-mode voltage on the digital lines (common mode). The internal analog generator is used for generating such interference signals.

Remote-control command:  
SOURCE:DIGital:SRCMode?

**Audio Data**

Audio data which is encoded as frames in the digital audio signal is generated.

The Generator Config panel contains the selection fields relevant for this Source Mode.



Remote-control command:

SOURCE:DIGital:SRCMode ADATA

Jitter only

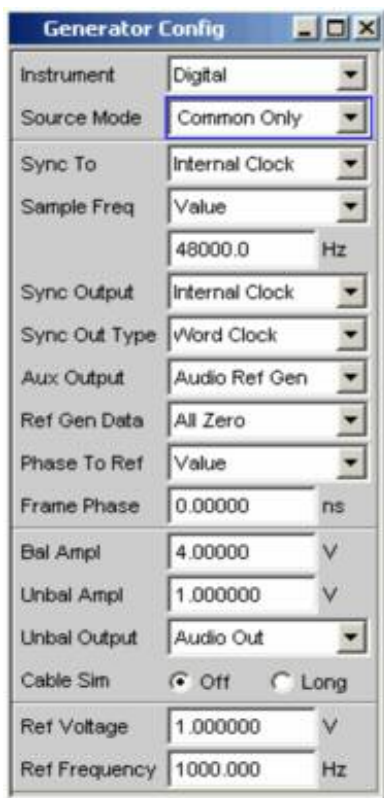


A digital audio signal with jitter is generated for tests on digital audio receivers. All data bits are set to zero (empty frame).

The value of the jitter and delay fault is normally given in UI (Unit Interval). One UI is defined as the smallest pulse width of the digital audio signal (eye width) and does not depend on the selected sampling rate. One UI corresponds to the clock period with which the digital signal is clocked ("biphase clock"). With digital audio signals, one UI corresponds to 128<sup>th</sup> of the sampling period; at 48 kHz, one UI is 163 ns.

Remote-control command:  
 SOURce:DIGital:SRCMode JITTER

Common only



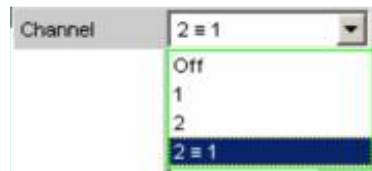
A digital audio signal with common-mode superimposition is generated at the BAL output. All data bits of the digital audio signal are set to zero (empty frame).

Balanced cables are also used for the digital audio signal links. Here, interference (e.g. from ground loops) occurs as common-mode voltage at the interfaces.

Remote-control command:  
`SOURce:DIGital:SRCMode COMMON`

**Channel**

Used to select the left and right-hand digital audio channels if Audio Data is selected as the Source Mode.



**OFF** Both channels are deactivated.  
The frequency and level setting of the channels have no effect.  
An "empty frame" which does not contain any audio data is generated.

```
Remote-control command:
OUTput:CHANnel OFF
```

**1** Only the left-hand channel supplies the generator signal; the right-hand channel is deactivated.

```
Remote-control command:
OUTput:CHANnel CH1
```

**2** Only the right-hand channel supplies the generator signal; the left-hand channel is deactivated.

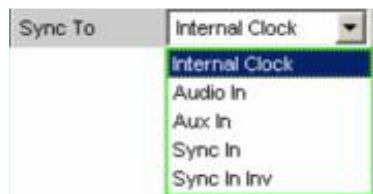
```
Remote-control command:
OUTput:CHANnel CH2
```

**2 = 1** Both the left and right-hand channel supply the same output signal.  
If the generator function "Stereo Sine" is selected, both channels may differ with regard to frequency, phase and amplitude.

```
Remote-control command:
OUTput:CHANnel CH2Is1
```

**Sync To**

Used to select the source to which the digital audio generator is synchronized.



**Internal CLK** The generator is synchronized to the internal clock generator.  
The clock frequency is determined by the sample frequency setting.

```
Remote-control command:
SOURCE:DIGital:SYNC:TO INTClock
```

**Audio In** Synchronization to the digital audio input signal.

```
Remote-control command:
SOURCE:DIGital:SYNC:TO AINPut
```

**Aux In** Synchronization to the digital audio signal at the AUX input XLR socket at the rear of the instrument.

```
Remote-control command:
SOURCE:DIGital:SYNC:TO AUXinput
```

**Sync In** Synchronization to the word-clock signal at the SYNC input BNC socket at the rear of the instrument. The generator sync PLL is used.

```
Remote-control command:
SOURCE:DIGital:SYNC:TO SINPut
```

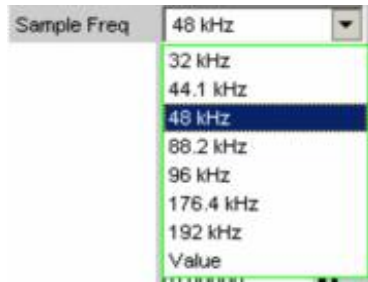
**Sync In inv** Synchronization to the inverted word-clock signal at the SYNC input BNC socket at the rear of the instrument.

```
Remote-control command:
SOURCE:DIGital:SYNC:TO SINVinput
```



**Sample Frequency**

Used to set the clock rate of the digital audio signal for the generator. The sample frequency setting is used as a reference whenever audio data signals are generated. With "Common Only" and "Jitter Only" generation, this setting therefore determines the clock rate of the generated empty frame.



If the entered sample frequency is not the same as the actual clock rate (e.g. with external synchronization), the frequency of all audio data signals is shifted accordingly.

This setting is also used to select the correct range for the generator sync PLL.

Value range for numeric entries:

30 kHz to 200 kHz

Standard sampling frequencies can be set directly in the selection field.

Synchronization ranges for the generator sync PLL:

30 kHz to 64 kHz (base rate range)

65 kHz to 128 kHz (high rate range)

129 kHz to 200 kHz (extended rate range)



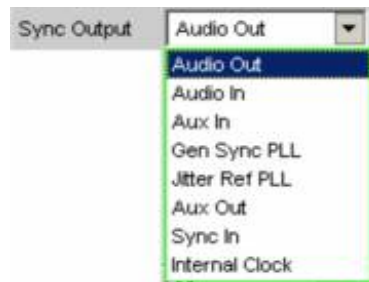
If "Sync To Audio In" is set, the generator can be set to the digital analyzer sampling frequency by selecting SYNC TO ANL.

<b>32 kHz</b>	Standard sampling rate 32 kHz  Remote-control command: OUTPut:SAMPlE:MODE F32
<b>44.1 kHz</b>	Standard sampling rate 44.1 kHz  Remote-control command: OUTPut:SAMPlE:MODE F44
<b>48 kHz</b>	Standard sampling rate 48 kHz  Remote-control command: OUTPut:SAMPlE:MODE F48
<b>88.2 kHz</b>	Standard sampling rate 88.2 kHz  Remote-control command: OUTPut:SAMPlE:MODE F88
<b>96 kHz</b>	Standard sampling rate 96 kHz  Remote-control command: OUTPut:SAMPlE:MODE F96
<b>176.4 kHz</b>	Standard sampling rate 176.4 kHz  Remote-control command: OUTPut:SAMPlE:MODE F176
<b>192 kHz</b>	Standard sampling rate 192 kHz  Remote-control command: OUTPut:SAMPlE:MODE F192
<b>Value:</b>	Variable sampling rate entry  Remote-control command: OUTPut:SAMPlE:MODE VALue OUTPut:SAMPlE:FREQuency <nu>
<b>Sync To Anlr</b>	The sampling rate of the digital audio analyzer is used for synchronization.  Remote-control command: OUTPut:SAMPlE:MODE SYNChron

**Sync Output**

Used to select the source for the digital audio sync output at the rear of the instrument.

"Sync Out Type" can be set to either Word Clock or Biphase Clock (the frequency of the biphase clock is 128 times that of the word clock).



**Audio Out** Clock signal of the digital audio generator. Always the same as the clock rate of the digital audio output on the front panel.  
If "Jitter" is set, jitter is applied to this output.

Remote-control command:  
OUTPut:DIGital:SYNC:OUTPut ADOutput

**Audio In** Clock signal of the selected digital audio input on the front panel.

Remote-control command:  
OUTPut:DIGital:SYNC:OUTPut ADINput

**Aux In** Clock signal of the digital audio auxiliary input at the rear of the instrument.

Remote-control command:  
OUTPut:DIGital:SYNC:OUTPut AXINput

**Gen Sync PLL** Clock signal at the output of the generator sync PLL. Allows the frequency of a word clock applied at the sync input to be increased by a factor of 128. If "Jitter" is set, the set jitter is not applied to this output.  
See setting of the generator sampling rate.

Remote-control command:  
OUTPut:DIGital:SYNC:OUTPut GSYPl1

**Jitt Ref PLL** Clock signal at the output of the jitter reference PLL. Allows a low-jitter clock to be recovered from the digital audio input signal.  
See setting of the digital audio analyzer sampling rate.

Remote-control command:  
OUTPut:DIGital:SYNC:OUTPut JRFP11

**Aux Out**      Clock signal of the digital audio auxiliary generator. This generator is used e.g. for the frame phase setting and the relock function.

Remote-control command:  
OUTPut:DiGital:SYNC:OUTPut AXOutput

**Sync In**      Loop-through option of the digital audio sync input, e.g. for cascading several instruments which synchronize to the word clock.

Remote-control command:  
OUTPut:DiGital:SYNC:OUTPut SYINput

**Internal Clk**      Output signal of the internal clock source. If the digital audio generator is not synchronized to the internal clock, the internal clock is available as an independent clock source and is set using the selection parameter "Int Clk Freq".

Remote-control command:  
OUTPut:DiGital:SYNC:OUTPut INTClock

**Int Clk Freq**

Used to set the (word-clock) frequency of the internal clock generator if the internal clock generator is used as an independent clock source at the digital audio sync output.



Remote-control command:  
OUTPut:DIGital:INTClockfreq <nu>

**Sync Out Type**

"Sync Out Type" can be set to either Word Clock or Biphase Clock (the frequency of the biphase clock is 128 times that of the word clock).

**Word CLK**

The signal of the digital audio sync output corresponds to the sampling frequency of the selected source.

Remote-control command:  
OUTPut:DIGital:SYNC:TYPE WCLock

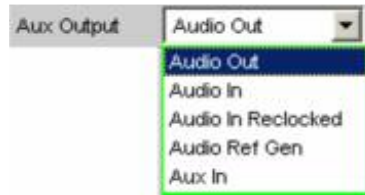
**Biphase CLK**

The signal of the digital audio sync output corresponds to the biphase clock, i.e. 128 times the sampling frequency of the selected source. The biphase clock is often used for direct clocking of the digital audio modules.

Remote-control command:  
OUTPut:DIGital:SYNC:TYPE BCLock

**Aux Output**

Used to select the source for the digital audio auxiliary output at the rear of the instrument.

**Audio Out**

The digital audio generator signal at the auxiliary output is identical to the signal at the front output. The signal output level is constant and does not depend on the selected BAL / UNBAL output level. The long cable simulator and common-mode superimposition have no effect on this output. If a jitter is set, it will also affect this output.

Remote-control command:  
 OUTPut:DIGital:AUXiliary AOUTput

**Audio In**

Loop-through option of the digital audio signal from the selected input to the digital audio auxiliary output. The signal output level is constant and does not depend on the selected input or the pulse amplitude at the digital input.

Remote-control command:  
 OUTPut:DIGital:AUXiliary AINPut

**Audio In Reclocked**

The jitter-reduced input signal is output. The audio data content is extracted from the input signal and output again via the digital audio auxiliary generator. This generator is controlled using the low-jitter clock from the jitter reference PLL.

Remote-control command:  
 OUTPut:DIGital:AUXiliary AINReclock

**Audio Ref Gen**



Here, the digital audio auxiliary generator is used as the reference generator for the frame phase setting of the digital audio generator.

If this setting is selected, it is then possible to set a frame phase and select the reference generator data.

This setting cannot be selected if the digital generator is synchronized to the sync input.

Remote-control command:  
 OUTPut:DiGital:AUXiliary RGENerator

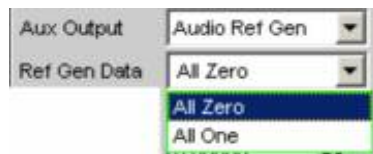
**Aux In**

Loop-through option of the digital audio auxiliary input, e.g. for cascading several instruments.

Remote-control command:  
 OUTPut:DiGital:AUXiliary AUXin

**Ref Gen Data**

If "Audio Ref Gen" is selected as the "Aux Output" source, it is then possible to configure the audio data for this reference generator.



**All Zero**

All audio data bits are set to zero. An "empty frame" is output (this is normally the case).

Remote-control command:  
 SOURce:DiGital:REFerence AZERo

**All One**

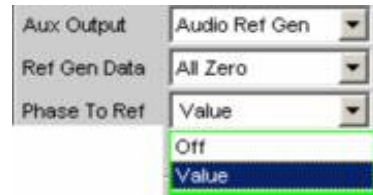
To allow digital audio receivers to be tested, the audio data bits can all be set to one.

Remote-control command:  
 SOURce:DiGital:REFerence AONE

**Phase To Ref**

If "Audio Ref Gen" is selected as the "Aux Output" source, it is then possible to vary the frame phase offset of the digital audio signal between the front output and the digital audio AUX output at the rear of the instrument.

The phase is shifted internally using the generator sync PLL.

**Off**

"Phase To Ref" variation is deactivated.

Here, the generator sync PLL is bypassed, which generally results in an improvement of the clock for the digital audio generator.

```
Remote-control command:
SOURCE:DIGital:PHASetorefvar OFF
```

**Value**

A frame phase shift is activated and an appropriate setting value can be entered.

```
Remote-control command:
SOURCE:DIGital:PHASetorefvar VALUE
```

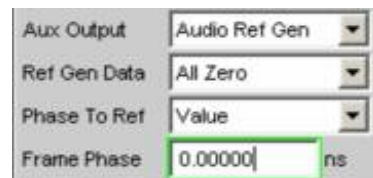
**Frame Phase**

Used to enter the value for the desired frame phase shift.

The value can be entered in various units.

The maximum variation range for the shift always corresponds to a phase shift of +/- 180° relative to the frame phase of the reference generator.

The generator sync PLL is used for generating the phase shift.



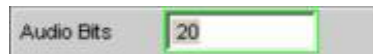
```
Remote-control command:
SOURCE:DIGital:FRAMEphase <nu>
```



**Audio Bits**

Wordwidth used by the digital audio generator for the Source Mode "Audio Data".  
If the wordwidth is reduced, the values of the audio samples are rounded off to the specified wordwidth. Unused data bits are encoded as zeroes in the digital audio signal.

Value range: 8 to 24



Remote-control command:  
OUTPut:AUDiobits <n>

**Bal Ampl**

Used to set the pulse amplitude of the digital audio signal at the BAL (XLR) output. The set voltage corresponds to the peak-to-peak value of the pulse amplitude when the output is terminated with the nominal impedance (110 Ohm)

The standard voltage is 4 V

Setting range: 0 V to 8.5 V

This voltage is linked to the setting for the UNBAL amplitude and is always 4 times higher than this amplitude.



Remote-control command:  
OUTPut:SIGNal:BAnced:LEVel <nu>

**Unbal Ampl**

Used to set the pulse amplitude of the digital audio signal at the UNBAL (BNC) output. The set voltage corresponds to the peak-to-peak value of the pulse amplitude when the output is terminated with the nominal impedance (75 Ohm)

The standard voltage is 1 V

Setting range: 0 V to 2.125 V

This voltage is linked to the setting for the BAL amplitude and is always a quarter of this amplitude.



Remote-control command:  
OUTPut:SIGNal:LEVel <nu>

**Unbal Output**

The unbalanced output can be switched so that the digital audio signal of the selected BAL or UNBAL input is output. If the BAL input is selected, the balanced signal is converted into an unbalanced signal. The signal at the BAL input can then be monitored conveniently e.g. on a connected oscilloscope.



**Audio Out** The digital audio generator signal is output.

Remote-control command:  
 OUTPut:DiGital:UNBalanced:OUTPut  
 AOUTput

**Audio In** The digital audio signal from the selected BAL or UNBAL input is output. It is not possible to output the signal of the optical input in this case. The pulse amplitude setting and the cable simulator do not have any effect on this output.

Remote-control command:  
 OUTPut:DiGital:UNBalanced:OUTPut  
 AINPut

**Cable Sim**

Cable simulation used to check the effect of attenuated input signals along long cables when tests are performed on digital audio receivers. A cable length of approx. 100 m is simulated.



**Off** Cable simulation is deactivated.

Remote-control command:  
 OUTPut:DiGital:CSIMulator OFF

**Long** Cable simulation for the BAL and UNBAL outputs is activated.

Remote-control command:  
 OUTPut:DiGital:CSIMulator SIMLong

**Ref Voltage**

Reference value for the relative amplitude units.

The unit for the reference value corresponds to the selected source mode (e.g. FS in the source mode "Audio Data").

If the reference value is changed, all amplitude settings linked to the reference value also change.



Remote-control command:  
SOURce:VOLTage:REFerence <nu>

**Ref Frequency**

Reference value for the relative frequency units.

If the reference frequency is changed, all frequency settings linked to the reference value also change.



Remote-control command:  
SOURce:FREQuency:REFerence <nu>

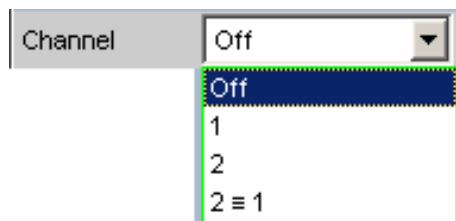
# Configuring the I<sup>2</sup>S Generator

## I<sup>2</sup>S Generator Configuration Panel

The Config panel is used to set the analog and digital generator. The configuration options for the I<sup>2</sup>S generator are described below.

### Channel

Used to select the digital audio channels left (Ch1) and right (Ch2).



#### OFF

Both channels are deactivated.  
The frequency and level setting of the channels have no effect.  
An "empty frame" that does not contain any audio data (all bits = zero) is generated.

```
Remote-control command:
OUTPut:CHANnel OFF
```

#### 1

Only the left channel supplies the generator signal; the right channel is deactivated (all bits = zero).

```
Remote-control command:
OUTPut:CHANnel CH1
```

#### 2

Only the right channel supplies the generator signal; the left channel is deactivated (all bits = zero).

```
Remote-control command:
OUTPut:CHANnel CH2
```

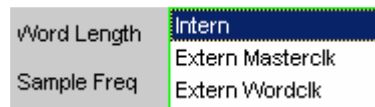
#### 2 ≡ 1

Both the left and right channels supply the same output signal.  
If the generator function "Stereo Sine" is selected, the two may differ with regard to frequency, phase and amplitude.

```
Remote-control command:
OUTPut:CHANnel CH2Is1
```

**Sync To**

Used to select the source to which the I<sup>2</sup>S generator is synchronized.



**Intern**                    The generator uses the internal clock.

Remote-control command:  
 SOURce:DIGital:SYNC:TO INT

**Extern Masterclk**        Synchronization to the applied master clock signal at the rear TX CLK IN connector.

Remote-control command:  
 SOURce:DIGital:SYNC:TO EXTM

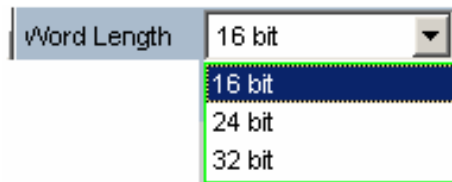
**Extern Wordclk**           Synchronization to the applied word clock signal at the rear TX CLK IN connector.

Remote-control command:  
 SOURce:DIGital:SYNC:TO EXTW

**Word Length**

Word length of a data frame for each channel.

Value range: 16, 24, 32.



**16 bit**                    Word length 16 bits

Remote-control command:  
 OUTPut:WORDlength W16

**24 bit**                    Word length 24 bits

Remote-control command:  
 OUTPut:WORDlength W24

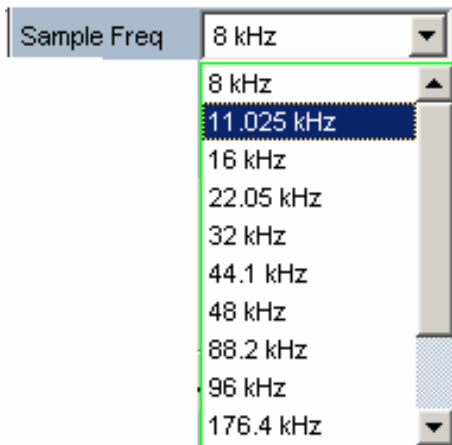
**32 bit**                    Word length 32 bits

Remote-control command:  
 OUTPut:WORDlength W32

**Sample Frequency**

Used to set the sampling frequency.

The sampling frequency corresponds to the frequency of the FSYNC signal. All frequency information of generated audio data are with reference to this setting. If the I<sup>2</sup>S generator is operated with external wordclock synchronization and the frequency of the external clock signal does not correspond to the set sampling frequency, the I<sup>2</sup>S generator generates audio data with an incorrect frequency. Even with external masterclock synchronization, the external clock signal must correspond to the set sampling frequency multiplied by the selected MClk ratio. Otherwise, the I<sup>2</sup>S generator also generates audio data with an incorrect frequency.



Value range for numeric entry:  
6.75 kHz to 410 kHz

Standard sampling frequencies can be set directly in the selection field.

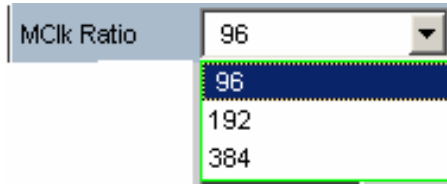
<b>8 kHz</b>	Standard sampling rate 8 kHz  Remote-control command: OUTPut:SAMPlE:MODE F08
<b>11.025 kHz</b>	Standard sampling rate 11.025 kHz  Remote-control command: OUTPut:SAMPlE:MODE F11
<b>16 kHz</b>	Standard sampling rate 16 kHz  Remote-control command: OUTPut:SAMPlE:MODE F16
<b>22.05 kHz</b>	Standard sampling rate 22.05 kHz  Remote-control command: OUTPut:SAMPlE:MODE F22

<b>32 kHz</b>	Standard sampling rate 32 kHz  Remote-control command: OUTPut:SAMPlE:MODE F32
<b>44.1 kHz</b>	Standard sampling rate 44.1 kHz  Remote-control command: OUTPut:SAMPlE:MODE F44
<b>48 kHz</b>	Standard sampling rate 48 kHz  Remote-control command: OUTPut:SAMPlE:MODE F48
<b>88.2 kHz</b>	Standard sampling rate 88.2 kHz  Remote-control command: OUTPut:SAMPlE:MODE F88
<b>96 kHz</b>	Standard sampling rate 96 kHz  Remote-control command: OUTPut:SAMPlE:MODE F96
<b>176.4 kHz</b>	Standard sampling rate 176.4 kHz  Remote-control command: OUTPut:SAMPlE:MODE F176
<b>192 kHz</b>	Standard sampling rate 192 kHz  Remote-control command: OUTPut:SAMPlE:MODE F192
<b>384 kHz</b>	Standard sampling rate 384 kHz  Remote-control command: OUTPut:SAMPlE:MODE F384
<b>Value:</b>	Variable sampling rate entry  Remote-control command: OUTPut:SAMPlE:MODE VALueOUTPut:SAMPlE:FREQuency <nu>

**MClk Ratio**

Ratio between MCLK and FSYNC.

Value range: 64, 96, 128, 192, 256, 512



The value range is limited by word length and sampling frequency.

**Word Length 16 bit, Sync To Intern:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	64, 128, 256, 512
>108 kHz to 216 kHz	64, 128, 256
>216 kHz to 410 kHz	64, 128

**Word Length 24 bit, Sync To Intern:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	96, 192, 384
>108 kHz to 216 kHz	96, 192

**Word Length 32 bit, Sync To Intern:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	128, 256, 512
>108 kHz to 216 kHz	128, 256
>216 kHz to 410 kHz	128

**Word Length 16 bit, Sync To Extern Masterclk:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	128, 256, 512
>108 kHz to 216 kHz	128, 256
>216 kHz to 410 kHz	128

**Word Length 24 bit, Sync To Extern Masterclk:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	192, 384
>108 kHz to 216 kHz	192



**Word Length 32 bit, Sync To Extern Masterclk:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	128, 256, 512
>108 kHz to 216 kHz	128, 256
>216 kHz to 410 kHz	128

**Word Length 16 bit, Sync To Extern Wordclk:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	64, 128, 256, 512
>108 kHz to 216 kHz	64, 128, 256
>216 kHz to 410 kHz	64, 128

**Word Length 24 bit, Sync To Extern Wordclk:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	96, 192, 384
>108 kHz to 216 kHz	96, 192

**Word Length 32 bit, Sync To Extern Wordclk:**

Sampling frequency	Selectable MClk ratio
6.75 kHz to 108 kHz	128, 256, 512
>108 kHz to 216 kHz	128, 256
>216 kHz to 410 kHz	128

<b>64</b>	64 times the sampling rate (with word length 16 bits)  Remote-control command: OUTPut:MCLKratio M64
<b>96</b>	96 times the sampling rate (with word length 24 bits)  Remote-control command: OUTPut:MCLKratio M96
<b>128</b>	128 times the sampling rate (with word length 16 and 32 bits)  Remote-control command: OUTPut:MCLKratio M128
<b>192</b>	192 times the sampling rate (with word length 24 bit)  Remote-control command: OUTPut:MCLKratio M192

- 256**                    256 times the sampling rate (with word length 16 and 32 bit)

Remote-control command:  
OUTPut:MCLKratio M256
- 384**                    384 times the sampling rate (with word length 24 bits)

Remote-control command:  
OUTPut:MCLKratio M384
- 512**                    512 times the sampling rate (with word length 16 and 32 bits)

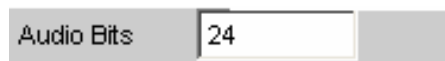
Remote-control command:  
OUTPut:MCLKratio M512

**Audio Bits**

Resolution of audio data within a frame.

If the resolution is reduced, the values of the audio samples are rounded off to the specified word length. Unused data bits are encoded as zeroes in the digital audio signal.

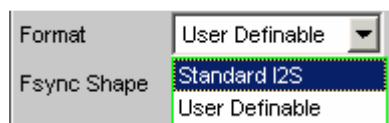
Value range: 8 ... "Word Length"



Remote-control command:  
OUTPut:AUDIobits <n>

**Format**

Selection of the I<sup>2</sup>S generator function.



**Standard I2S**    The I<sup>2</sup>S generator transmits in the standard I<sup>2</sup>S format. The following parameters are assigned a fixed default:

Fsync Shape	Square Pulse
Fsync Polarity	Left(1) = Low
Word Offset	-1

Remote-control command:  
OUTPut:FORMat SI2S

**User-definable**

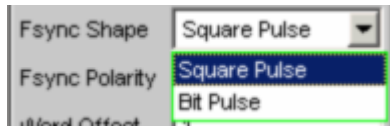
Der I<sup>2</sup>S generator transmits in I<sup>2</sup>S-like format. The following format-influencing parameters are additionally available:

Fsync Shape  
 Fsync Polarity  
 Word Offset

Remote-control command:  
 OUTPut:FORMat USER

**Fsync Shape**

Selection of the FSYNC signal form.



**Square Pulse**

The FSYNC signal is transmitted as a symmetrical rectangle. .

Remote-control command:  
 OUTPut: FSHape SQU

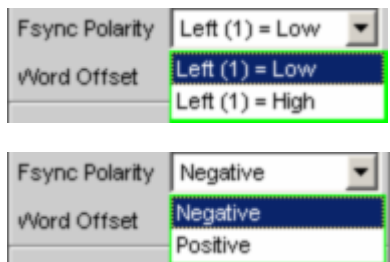
**Bit Pulse**

The FSYNC signal is transmitted as a bit pulse.

Remote-control command:  
 OUTPut: FSHape BITP

**Fsync Polarity**

FSYNC signal polarity.



If Fsync Shape is set to Square Pulse, the following selection is available:

**Left (1) = Low**

While the left channel (channel 1) is being sent, a low level is applied at the FSYNC signal at a word offset of 0.

Remote-control command:  
 OUTPut:FPulse LFTL

**Left (1) = High** While the left channel (channel 1) is being sent, a high level is applied at the FSYNC signal at a word offset of 0.

```
Remote-control command:
OUTPut:FPulse LFTH
```

If Fsync Shape is set to Bit Pulse, the following selection is available:

**Positive** At a Word Offset of 0, a positive pulse marks the beginning of the left data word.

```
Remote-control command:
OUTPut:FPulse POS
```

**Negative** At a Word Offset of 0, a negative pulse marks the beginning of the left data word.

```
Remote-control command:
OUTPut:FPulse NEG
```

### Word Offset

By using Word Offset, you can set the number of SCK clock cycles by which the Fsync signal transmission is delayed relative to the audio data.

Value range: -"Word Length"... 0 ... +"Word Length"-1

A screenshot of a control panel for 'Word Offset'. The label 'Word Offset' is on the left. To its right is a text input field containing the number '1'. The input field has a green border.

```
Remote-control command:
OUTPut:WRDOffset <n>
```

### Ref Voltage

Reference value for the relative amplitude units.

If this reference value is changed, all amplitude settings linked to the reference value also change.

A screenshot of a control panel for 'Ref Voltage'. The label 'Ref Voltage' is on the left. To its right is a text input field containing '1.000000'. Further right is a dropdown menu showing 'FS'.

```
Remote-control command:
SOURce:VOLTage:REFerence <nu>
```

### Ref Frequency

Reference value for the relative frequency units.

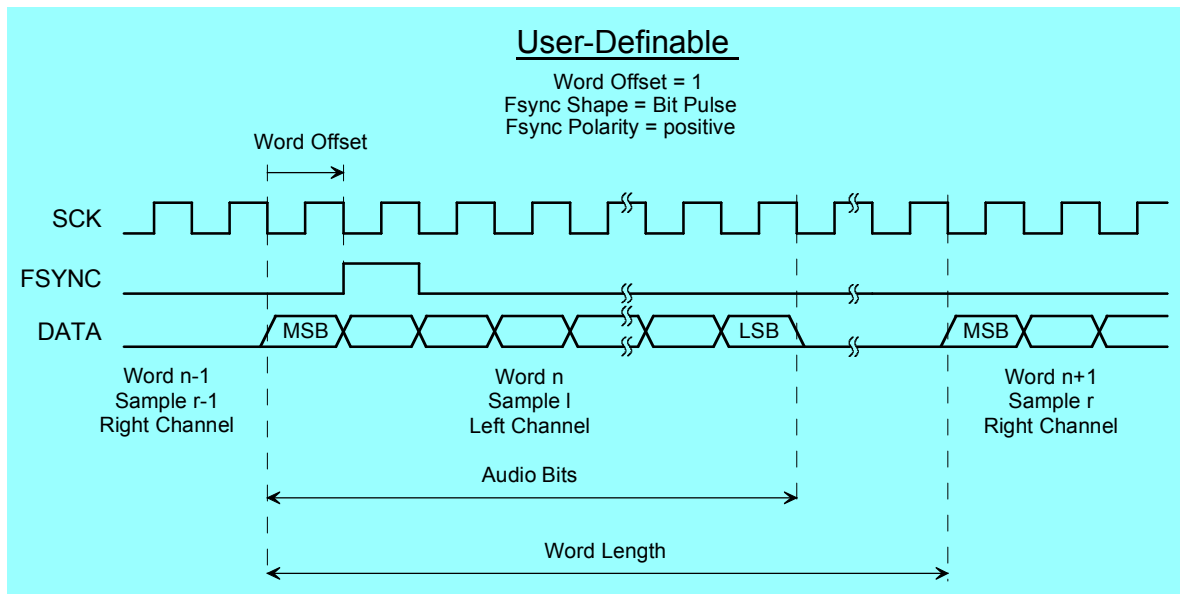
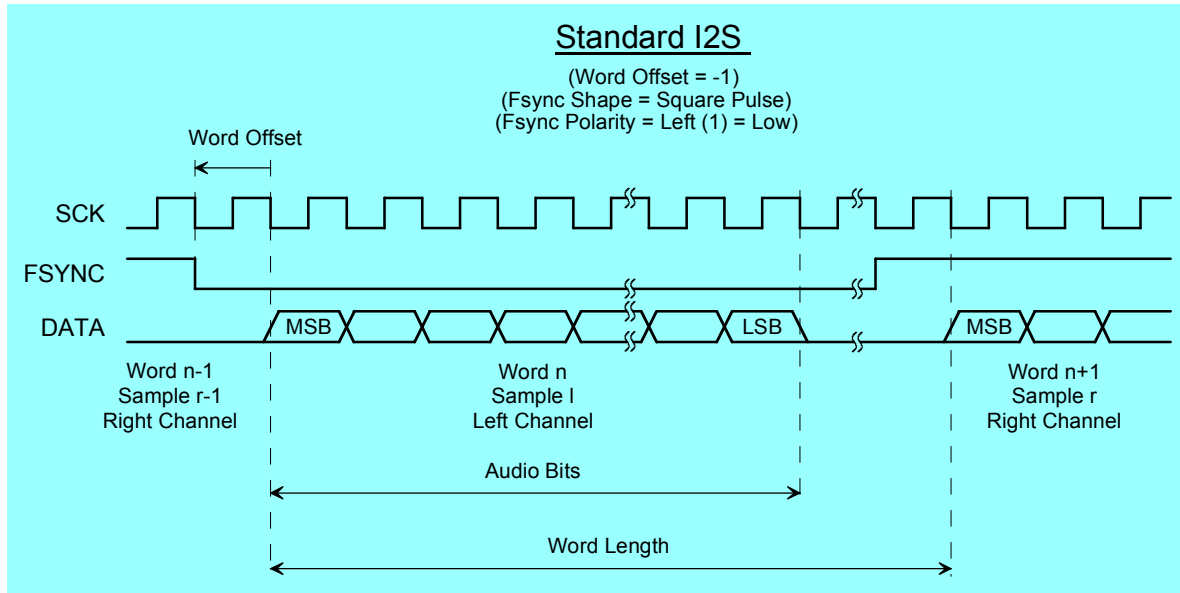
If this reference frequency is changed, all frequency settings linked to the reference value also change.

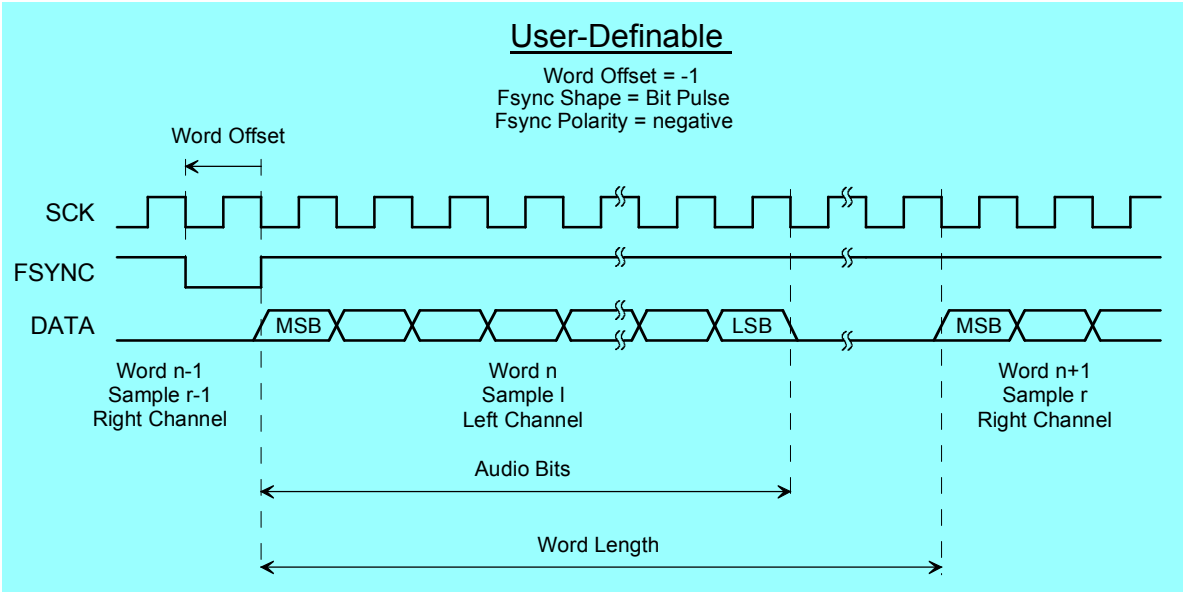
A screenshot of a control panel for 'Ref Frequency'. The label 'Ref Frequency' is on the left. To its right is a text input field containing '1000.000'. Further right is a dropdown menu showing 'Hz'.

```
Remote-control command:
SOURce:FREQuency:REFerence <nu>
```

## Timing Diagrams

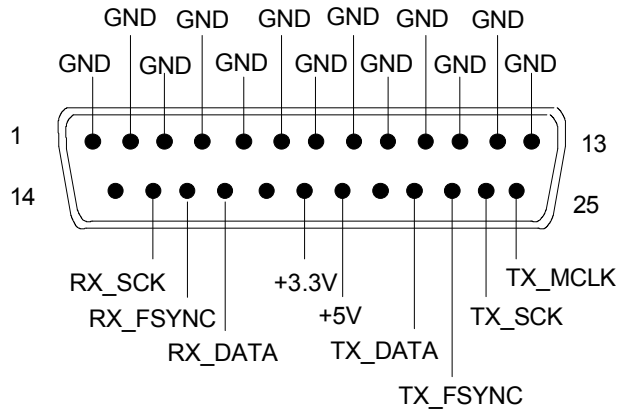
The timing diagrams below show a number of configuration examples that illustrate the effect of the parameters.





## Interface Assignment

I<sup>2</sup>S connector (25-contact D-Sub connector)



Pin	Signal	Input (I) Output (O)	Data direction
1	GND		Ground connection
2	GND		Ground connection
3	GND		Ground connection
4	GND		Ground connection
5	GND		Ground connection
6	GND		Ground connection
7	GND		Ground connection
8	GND		Ground connection
9	GND		Ground connection
10	GND		Ground connection
11	GND		Ground connection
12	GND		Ground connection
13	GND		Ground connection
14	not connected		
15	RX_SCK	I	Serial clock analyzer
16	RX_FSYNC	I	Frame sync analyzer
17	RX_DATA	I	Serial data analyzer
18	not connected		

Pin	Signal	Input (I) Output (O)	Data direction
19	+3.3 V (500 mA)	O	Power supply
20	+5 V (500 mA)	O	Power supply
21	not connected		
22	TX_DATA	O	Serial data generator
23	TX_FSYNC	O	Frame sync generator
24	TX_SCK	O	Serial clock generator
25	TX_MCLK	O	Master clock output generator

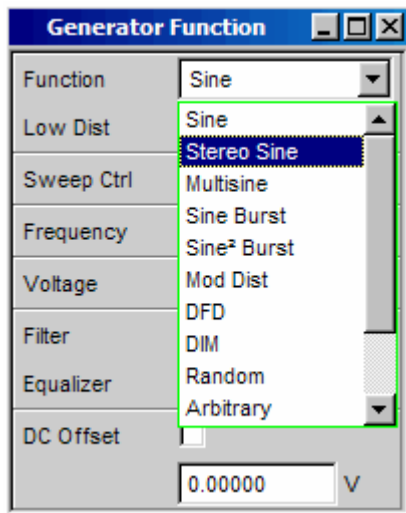
**TX CLK IN (BNC connector)**

Pin	Signal	Input (I) Output (O)	Data direction
1	GND		Ground connection
2	TX_CLK	I	Master clock input generator



## Generator Signals

The section "*Generator Signals*" on page 4.44 describes the setting parameters for all signals which can be generated at the analog or digital outputs. The signals are selected using the "Function" selection field in the "Generator Function" panel. The selected function determines which parameter fields are available in the panel.



The panels for the analog and digital generator are almost identical; the settings are therefore described together. Any differences are indicated.

## Sine

The generator generates a sinewave signal. Frequency and level are the same for both channels.

Remote-control command:  
 SOURce:FUNction[:SHAPE] SINusoid

### Low Dist

In the analog generator, the very low-noise and low-distortion generator (R&S UPV-B1 option) can be used to generate a sinewave signal instead of the universal generator. The maximum frequency is 185 kHz, irrespective of the bandwidth set in the "Generator Config" panel.

This parameter field does not appear in the digital generator.

#### ON

Low Dist

The low-distortion generator is activated.  
 A DC Offset is not possible; the parameter field is displayed in grey and cannot be accessed.

DC Offset

No filters can be used; the parameter field is hidden.

Remote-control command:  
 SOURce:LOWDistortion ON

#### OFF

Low Dist

The low-distortion generator is deactivated.

Remote-control command:  
 SOURce:LOWDistortion OFF

**Dither**

The screenshot shows a control panel for the Dither function. It includes a checked 'Dither' checkbox, a text field for amplitude set to '0.00010' with 'FS' units, a 'PDF' dropdown menu set to 'Triangle', and a 'Sweep Ctrl' dropdown menu with 'Gauss', 'Triangle', and 'Rectangle' options. The 'Triangle' option in the 'Sweep Ctrl' menu is highlighted with a blue background.

In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The tick box is used to activate/deactivate this function. The distribution function for amplitude can be selected in the "PDF" parameter field.

The parameter fields for Dither and PDF do not appear in the analog generator.

```
Remote-control command:
SOURCE:SINusoid:DITHer:STATe ON | OFF
SOURCE:SINusoid:DITHer <nu>
SOURCE:RANDom:PDF GAUSSsian | TRIangle | RECTangle
```

**Sweep Ctrl**

Used to activate the sweep system. The frequency or level of the signal can be varied within a selectable range from the start to the stop value. If frequency or level is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

**Frequency**

Used to set the frequency of the sinewave. The value range depends on the analog bandwidth set in the Generator Config panel or the digital clock rate.

```
Remote-control command:
SOURCE:FREQuency[1] <nu>
```

**Voltage**

Used to set the level of the sinewave. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for Output Type and Max Voltage in the Generator Config panel.

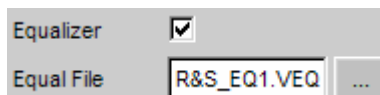
```
Remote-control command:
SOURCE:VOLTage[1] <nu>
```

**Filter**


The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected. It is not possible to use a filter if the low-distortion oscillator is activated.

See also the section "[Generator Filters](#)" on page 4.82.

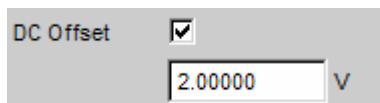
Remote-control command:  
SOURce:FILTer

**Equalizer**

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The tick box is used to activate/deactivate this function.

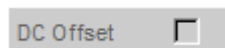
The  button opens a browser which can be used to select the precorrector file, see also the section "[Equalization](#)" on page 4.82.

Remote-control command:  
SOURce:VOLTage:EQUalize:STATe ON | OFF  
MMEMory:LOAD:LIST EQUalizer,'filename'

**DC Offset**

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

If the low-distortion generator is activated, no DC offset is possible; the parameter field is displayed in grey and cannot be accessed.



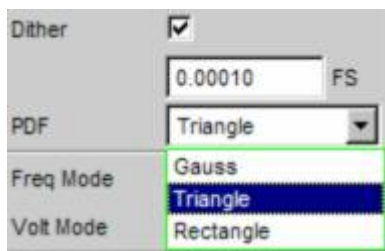
Remote-control command:  
SOURce:VOLTage:OFFSet:STATe ON | OFF  
SOURce:VOLTage:OFFSet <nu>

## Stereo Sine

The generator generates a sinewave signal on both channels. The frequency, level and phase can be set freely and separately for Channel 1 and 2. In the analog generator, the R&S UPV-B3 option is required for this function.

Remote-control command:  
`SOURce:FUNction[:SHAPE] STEReo`

### Dither



In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The tick box is used to activate/deactivate this function. The distribution function for amplitude can be selected in the "PDF" parameter field. The Dither setting is the same for both channels.

The parameter fields for Dither and PDF do not appear in the analog generator.

Remote-control command:  
`SOURce:SINusoid:DITHer:STATe ON | OFF`  
`SOURce:SINusoid:DITHer <nu>`  
`SOURce:RANDom:PDF GAUSSsian | TRIangle | RECTangle`

### Freq Mode

Determines the frequency and phase setting for Channel 1 and 2. The value range for frequency depends on the analog bandwidth set in the Generator Config panel or the digital clock rate.

**F&Ph** Channel 1 and 2 have the same frequency but the phase between the two channels can be selected. With the frequency sweep, the phase between the two channels remains constant.

Remote-control command:  
`SOURce:FREQuency:SElect FQPH`

**Ch1&2** The frequency can be entered separately for Channel 1 and 2. There is no fixed phase relationship between the channels. With the frequency sweep, the frequency of Channel 1 is swept but Channel 2 remains unchanged.

Remote-control command:  
`SOURce:FREQuency:SElect FQFQ`

**Volt Mode**

Determines the level setting for Channel 1 and 2. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for "Output Type" and "Max Voltage" in the Generator Config panel.

**Ch2/1**

The levels of Channel 1 and 2 have a fixed ratio relative to each other. With the level sweep, this ratio remains constant.

```
Remote-control command:
SOURCE:VOLTage:SElect VLRT
```

**Ch1&2**

The level can be set separately for Channel 1 and 2. With the level sweep, the level of Channel 1 is swept but Channel 2 remains unchanged.

```
Remote-control command:
SOURCE:VOLTage:SElect VLVL
```

**Sweep Ctrl**

Used to activate the sweep system. The frequency or level of the signal can be varied within a selectable range from the start to the stop value. The *Freq Mode* and *Volt Mode* settings determine how frequencies and levels are changed during the sweep. If frequency or level is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "Sweeps" on page 4.83.

**Frequency**

The frequency is identical for both channels (Freq Mode F&Ph).

```
Remote-control command:
SOURCE:FREQuency[1] <nu>
```

**Freq Ch1**

Frequency of Channel 1 (Freq Mode Ch1&2).

```
Remote-control command:
SOURCE:FREQuency[1] <nu>
```

**Volt Ch1**

Level of Channel 1.

```
Remote-control command:
SOURCE:VOLTage[1] <nu>
```

**Phase Ch2/1**

Phase of Channel 2 relative to Channel 1 (Freq Mode F&Ph).

```
Remote-control command:
SOURCE:PHASe <nu>
```

**Freq Ch2**

Frequency of Channel 2 (Freq Mode Ch1&2).

Remote-control command:  
 SOURce:FREQuency:CH2Stereo <nu>

**Volt Ch2**

Level of Channel 2 (Volt Mode Ch1&2).

Remote-control command:  
 SOURce:VOLTage:CH2Stereo <nu>

**Volt Ch2/1**

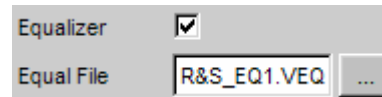
Ratio of the level of both channels relative to Channel 1 (Volt Mode Ch2/1).

Remote-control command:  
 SOURce:VOLTage:RATio <n>


**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "[Generator Filters](#)" on page 4.82.

Remote-control command:  
 SOURce:FILTer

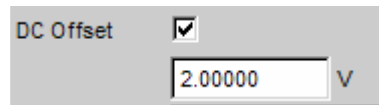
**Equalizer**

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The tick box is used to activate/deactivate this function. The precorrection is the same for both channels.

The  button opens a browser which can be used to select the precorrector file, see also the section "[Equalization](#)" on page 4.82.

Remote-control command:  
 SOURce:VOLTage:EQAlize:STATe ON | OFF  
 MMEMory:LOAD:LIST EQAlizer,'filename'

## DC Offset



DC Offset

2.00000 V

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed. The DC voltage is the same for both channels.

Remote-control command:  
SOURCE:VOLTage:OFFSet:STATe ON | OFF  
SOURCE:VOLTage:OFFSet <nu>

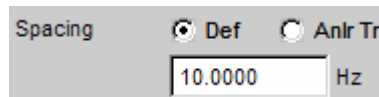


## Multisine

The generator generates a multi-tone signal with up to 17 sinewave tones. The frequency and level (and also the phase with the R&S UPV-B6 option) can be freely selected for each tone. Without the R&S UPV-B6 option, the phase is optimized in such a way that the ratio of peak value to RMS is as low as possible, which is often desired in the case of noise-like signals. Owing to the absence of associated windowing, linking the frequency spacing of the multi-sinewave to the resolution of the FFT allows extremely fast frequency response measurement.

Remote-control command:  
 SOURce:FUNction[:SHAPE] MULTisine

### Spacing



Used to set the frequency spacing. The frequency of each sinewave line is an integer multiple of this frequency spacing.

**Def** The frequency spacing can be freely defined.  
 Minimum value: Sampling rate/16384

Remote-control command:  
 SOURce:RANDom:SPACing:MODE USERdefined  
 SOURce:RANDom:SPACing:FREQuency <nu>

**Anlr Tr** The frequency spacing is adopted from the FFT set in the analyzer. This value depends on the sampling rate and the size of the FFT. This setting is only possible if an FFT or Post FFT is selected in the analyzer.  
 The parameter field for entering values is then hidden.

Remote-control command:  
 SOURce:RANDom:SPACing:MODE ATRack

### Voltage Mode

Used to select the entry mode for the voltages of the individual sinewave tones.

**Equal** All sinewave lines have the same amplitude. It is entered in the "Volt No1" parameter field.

Remote-control command:  
 SOURce:FUNction:MODE EQUAlvoltage

**Define** A separate amplitude can be defined for each sinewave line.

Remote-control command:  
 SOURce:FUNction:MODE DEFinedvoltage

**Crest Factor**

The ratio of peak value to RMS (crest factor) of the signal can be influenced using the phase of the individual sinewave lines. This setting is only possible if the R&S UPV-B6 option is installed. If this option is not installed, the crest factor is minimized.

**Optimized** The ratio of peak value to RMS of the signal is minimized.

```
Remote-control command:
SOURCE:VOLTage:CREStfactor:MODE
MINimized
```

**Value** The ratio of peak value to RMS of the signal is adjusted such that the ratio is as close to the preset value as possible. The user can enter this value in the next parameter field. The result depends on the number, frequency and level of the individual lines of the multi-sinewave.

```
Remote-control command:
SOURCE:VOLTage:CREStfactor:MODE VALue
SOURCE:VOLTage:CREStfactor <n>
```

**Define Phase** The start phase of each sinewave line can be defined.

```
Remote-control command:
SOURCE:VOLTage:CREStfactor:MODE DPHase
```

**No of Sine**

Used to set the number of sinewave tones of the multi-sinewave signal.

```
Remote-control command:
SOURCE:MULTIsine:COUNT <n>
```

**Freq No i**

Used to set the frequency of sinewave number *i* of the multi-sinewave signal.

```
Remote-control command:
SOURCE:FREQuency<i> <nu>
```

**Phase No i**

Used to set the start phase of sinewave number *i* of the multi-sinewave signal. This parameter field only appears if Define Phase is selected for Crest Factor.

```
Remote-control command:
SOURCE:PHASe<i> <nu>
```

**Volt No i**

Used to set the voltage of sinewave number *i* of the multi-sinewave signal. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for *Output Type* and *Max Voltage* in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage<i> <nu>

**Total Gain**

Used to set a gain factor which can be used to vary the total level of the multi-sinewave signal. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for *Output Type* and *Max Voltage* in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage:TOTal:GAIN <n> DB

**Total Peak**

Indicates the peak value of the multi-sinewave signal.

Remote-control command:  
SOURce:VOLTage:TOTal?

**Total RMS**

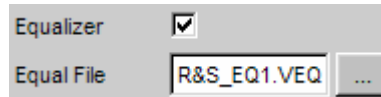
Indicates the RMS of the multi-sinewave signal (only in the analog generator).

Remote-control command:  
SOURce:VOLTage:RMS?


**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "*Generator Filters*" on page 4.82.

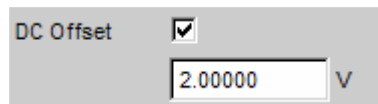
Remote-control command:  
SOURce:FILTer

**Equalizer**

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The tick box is used to activate/deactivate this function.

The  button opens a browser which can be used to select the precorrector file, see also the section ["Equalization"](#) on page 4.82.

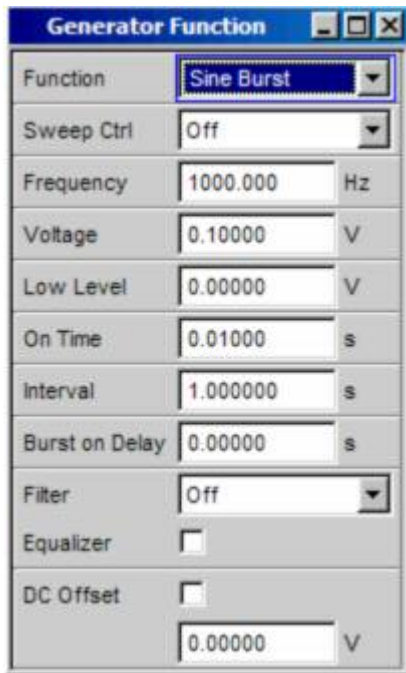
Remote-control command:  
SOURCE:VOLTage:EQUalize:STATE ON | OFF  
MMEMory:LOAD:LIST EQUalizer,'filename'

**DC Offset**

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:  
SOURCE:VOLTage:OFFSet:STATE ON | OFF  
SOURCE:VOLTage:OFFSet <nu>

## Sine Burst



The generator generates a sinewave signal, the amplitude of which changes periodically between high level (Voltage) during the burst duration (On Time) and low level (Low Level) during the burst pause. The "Interval" parameter field is used to set the repetition rate of the burst. The following always applies: Burst pause = Burst period (Interval) – Burst duration (On Time). Low Level can be set as a fixed value or as a ratio relative to the burst level.

When generator settings have been changed or a measurement has been started, the burst starts with the positive sinusoidal half-wave of the burst duration (On Time). The "Burst On Delay" parameter is used to set a defined delay time.

Remote-control command:  
 SOURce:FUNCTION[:SHAPE] BURSt

### Sweep Ctrl

Used to activate the sweep system. The frequency, level, ON-time and interval of the burst signal can be varied within a selectable range from the start to the stop value. If one of these parameters is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

### Frequency

Used to set the frequency of the sinewave. The value range depends on the analog bandwidth set in the Generator Config panel or the digital clock rate.

Remote-control command:  
 SOURce:FREQuency[1] <nu>

### Voltage

Used to set the level of the sinewave during the burst duration. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for "[Output Type](#)" and "[Max Voltage](#)" in the Generator Config panel.

Remote-control command:  
 SOURce:VOLTagE[1] <nu>

**Low Level**

Used to set the level of the sinewave during the burst pause. Low Level cannot be higher than the Voltage; if Voltage is reduced (also during a sweep), Low Level may also be reduced. Low Level can also be set as a fixed ratio relative to Voltage; the units %on, dBon and (in the analog generator only) V/on are available for this purpose.

Remote-control command:  
SOURce:VOLTage:LOWLevel <nu>

**On Time**

Used to set the burst duration. Entered as a fixed time or as a number of periods (cycles) of the sinewave frequency. On Time is always less than Interval; if increased, Interval may also be increased.

Minimum value: 1 sample  
Maximum value: 60 s – 1 sample

Remote-control command:  
SOURce:ONTime <nu>

**Interval**

Used to set the repetition rate of the burst signal. Entered as a fixed time or as a number of periods (cycles) of the sinewave frequency. Interval is always greater than or equal to On Time.

Minimum value: On Time  
Maximum value: 60 s

Remote-control command:  
SOURce:INTerval <nu>

**Burst on Delay**

Used to set the delay time which must expire (after generator settings have been changed or a measurement has been started) before the generator can start the burst with the high level (Voltage). During this time, the signal is output with the low level (Low Level).

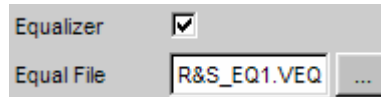
Value range: 0 to 60 s

Remote-control command:  
SOURce:ONTime:DELay <nu>


**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section ["Generator Filters"](#) on page 4.82.

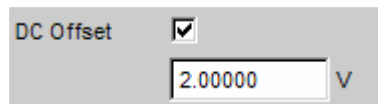
Remote-control command:  
SOURce:FILTer

**Equalizer**

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The tick box is used to activate/deactivate this function.

The  button opens a browser which can be used to select the precorrector file, see also the section "[Equalization](#)" on page 4.82.

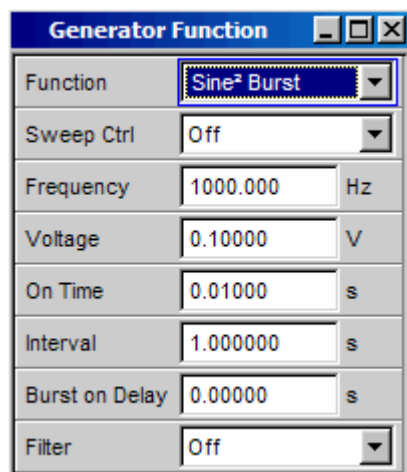
Remote-control command:  
SOURCE:VOLTage:EQUalize:STATE ON | OFF  
MMEMory:LOAD:LIST EQUalizer,'filename'

**DC Offset**

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:  
SOURCE:VOLTage:OFFSet:STATE ON | OFF  
SOURCE:VOLTage:OFFSet <nu>

## Sine<sup>2</sup> Burst



The generator generates a sine<sup>2</sup> signal, the amplitude of which is periodically activated (during the burst duration, i.e. On Time) and deactivated. The pulse can be inverted by entering a negative voltage.

The "Interval" parameter field is used to set the repetition rate of the burst. The following always applies: Burst pause = Burst period (Interval) – Burst duration (On Time).

The burst starts after generator settings have been changed or a measurement has been started. The "Burst On Delay" parameter is used to set a defined delay time.

Remote-control command:

```
SOURce:FUNCTION[:SHAPE] S2Pulse
```

### Sweep Ctrl

Used to activate the sweep system. The frequency, level, ON-time and interval of the burst signal can be varied within a selectable range from the start to the stop value. If one of these parameters is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

### Frequency

Used to set the frequency of the sinewave. The value range depends on the analog bandwidth set in the Generator Config panel or the digital clock rate.

Remote-control command:

```
SOURce:FREQUENCY[1] <nu>
```

### Voltage

Used to set the level of the sinewave during the burst duration. The pulse is inverted by entering a negative voltage; conversion into logarithmic units is then not possible. In the analog generator, the maximum total voltage depends on the settings for [Output Type](#) and [Max Voltage](#) in the Generator Config panel.

Remote-control command:

```
SOURce:VOLTage[1] <nu>
```



**On Time**

Used to set the burst duration. Entered as a fixed time or as a number of periods (cycles) of the sinewave frequency. On Time is always less than Interval; if increased, Interval may also be increased.

Minimum value: 1 sample

Maximum value: 60 s – 1 sample

Remote-control command:

```
SOURce:ONTime <nu>
```

**Interval**

Used to set the repetition rate of the burst signal. Entered as a fixed time or as a number of periods (cycles) of the sinewave frequency. Interval is always greater than or equal to On Time.

Minimum value: On Time

Maximum value: 60 s

Remote-control command:

```
SOURce:INTerval <nu>
```

**Burst on Delay**

Used to set the delay time which must expire (after generator settings have been changed or a measurement has been started) before the generator can start the burst. During this time, the signal voltage is 0 V (or 0 FS in the digital range).

Value range: 0 to 60 s

Remote-control command:

```
SOURce:ONTime:DELay <nu>
```

**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "[Generator Filters](#)" on page 4.82.

Remote-control command:

```
SOURce:FILTer
```

## Mod Dist

The generator generates a test signal for the intermodulation measurement in accordance with SMPTE and for the modulation factor analysis in accordance with IEC 268-3.

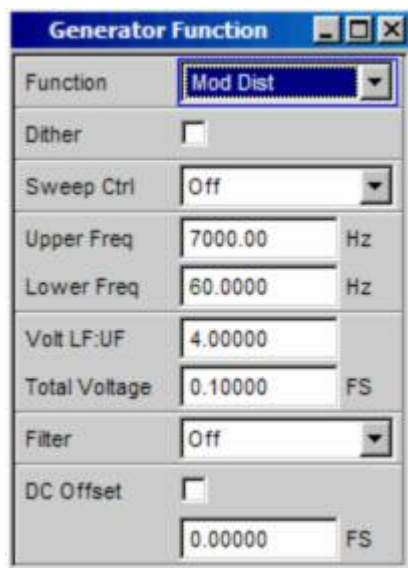
The signal consists of two sinewaves: a low-frequency noise signal and a high-frequency useful signal. The level of the noise signal is 1 to 10 times higher than that of the useful signal.

According to IEC 268-3, the frequency of the noise signal must be between 0.5 and 1.5 octaves above the lower limit frequency of the DUT (60 Hz according to SMPTE).

According to IEC 268-3, the frequency of the useful signal must be between 0.5 and 1.5 octaves below the upper limit frequency of the DUT (7 kHz according to SMPTE).

The frequency ratio of useful signal to noise signal should be greater than 8.

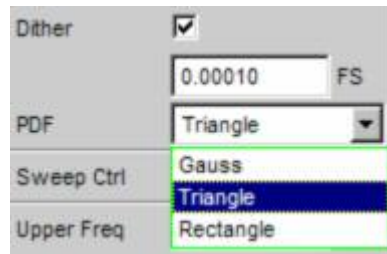
According to SMPTE, the level ratio of noise signal to useful signal must be 4:1; according to IEC 268-3, a ratio of 10:1 is also possible.



Panel of digital generator with Mod Dist function selected

Remote-control command:

```
SOURce:FUNCTION[:SHAPE] MDIST
```

**Dither**

In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The tick box is used to activate/deactivate this function. The distribution function for amplitude can be selected in the "PDF" parameter field.

The parameter fields for Dither and PDF do not appear in the analog generator.

```
Remote-control command:
SOURCE:SINusoid:DITHer:STATe ON | OFF
SOURCE:SINusoid:DITHer <nu>
SOURCE:RANDom:PDF GAUSSsian | TRIangle | RECTangle
```

**Sweep Ctrl**

Used to activate the sweep system. The frequency of the useful signal (Upper Freq) or the total level (Total Voltage) of the signal can be varied within a selectable range from the start to the stop value. If frequency or level is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window. Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

**Upper Freq**

Used to set the frequency of the high-frequency useful signal.

```
Remote-control command:
SOURCE:FREQuency[1] <nu>
```

**Lower Freq**

Used to set the frequency of the low-frequency noise signal.

```
Remote-control command:
SOURCE:FREQuency2 <nu>
```

**Volt LF:UF**

Used to set the level ratio of noise signal to useful signal as a dimension-less number.

```
Remote-control command:
SOURCE:VOLTage:RATio <n>
```

**Total Voltage**

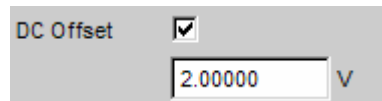
Used to set the level of the overall signal. The maximum RMS depends on the level ratio. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for *Output Type* and *Max Voltage* in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage:TOTal <nu>

**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "*Generator Filters*" on page 4.82.

Remote-control command:  
SOURce:FILTer

**DC Offset**

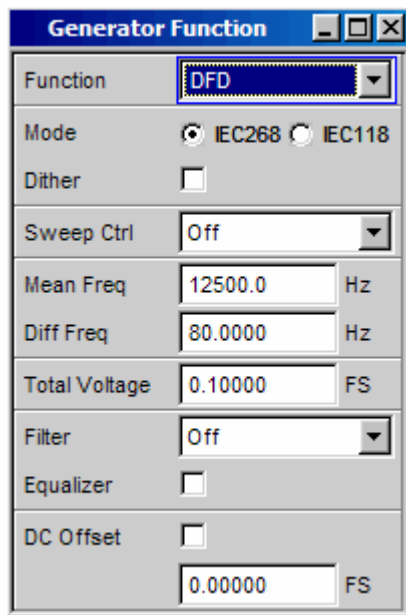
A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:  
SOURce:VOLTage:OFFSet:STATe ON | OFF  
SOURce:VOLTage:OFFSet <nu>

## DFD

The generator generates a test signal for the intermodulation measurement using the differential-tone method in accordance with IEC 118 or 268.

The signal consists of two very close sinewaves of the same amplitude.



Panel of digital generator with DFD function selected

Remote-control command:  
 SOURce:FUNction[:SHAPE] DFD

### Mode

Used to select the entry mode for the frequencies of both signals.

#### IEC 268

Entry of center frequency (Mean Freq) and difference frequency (Diff Freq). If a frequency sweep (for the X or Z-axis) is selected, the center frequency is swept.

Remote-control command:  
 SOURce:FUNction:MODE IEC268

#### IEC 118

Entry of upper frequency (Upper Freq) and difference frequency (Diff Freq). If a frequency sweep (for the X or Z-axis) is selected, the upper frequency is swept.

Remote-control command:  
 SOURce:FUNction:MODE IEC118

**Dither**

The screenshot shows a control panel for the Dither function. It includes a checked 'Dither' checkbox, a text field for amplitude set to '0.00010' with 'FS' to its right, a 'PDF' dropdown menu currently showing 'Triangle', and a list of PDF options: 'Gauss', 'Triangle' (which is highlighted in blue), and 'Rectangle'.

In the digital generator, a noise component with adjustable amplitude can be superimposed on the signal. The tick box is used to activate/deactivate this function. The distribution function for amplitude can be selected in the "PDF" parameter field.

The parameter fields for Dither and PDF do not appear in the analog generator.

```
Remote-control command:
SOURCE:SINusoid:DITHer:STATe ON | OFF
SOURCE:SINusoid:DITHer <nu>
SOURCE:RANDom:PDF GAUSSsian | TRIangle | RECTangle
```

**Sweep Ctrl**

Used to activate the sweep system. The center frequency (in the IEC 118 mode) and the upper frequency (in the IEC 268 mode) or the total level (Total Voltage) of the signal can be varied within a selectable range from the start to the stop value. If frequency or level is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

**Mean Freq**

Used to set the center frequency (in the IEC 268 mode).

```
Remote-control command:
SOURCE:FREQuency:MEAN <nu>
```

**Upper Freq**

Used to set the upper frequency (in the IEC 118 mode).

```
Remote-control command:
SOURCE:FREQuency[1] <nu>
```

**Diff Freq**

Used to set the frequency difference of the two sinewaves.

```
Remote-control command:
SOURCE:FREQuency:DIFFerence <nu>
```

**Total Voltage**

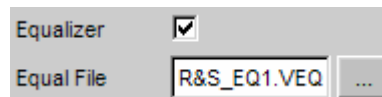
Used to set the level of the overall signal. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for *Output Type* and *Max Voltage* in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage:TOTal <nu>


**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "*Generator Filters*" on page 4.82.

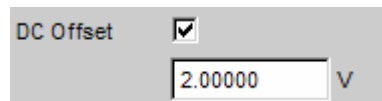
Remote-control command:  
SOURce:FILTer

**Equalizer**

The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The tick box is used to activate/deactivate this function.

The  button opens a browser which can be used to select the precorrector file, see also the section "*Equalization*" on page 4.82.

Remote-control command:  
SOURce:VOLTage:EQUalize:STATe ON | OFF  
MMEMory:LOAD:LIST EQUalizer,'filename'

**DC Offset**

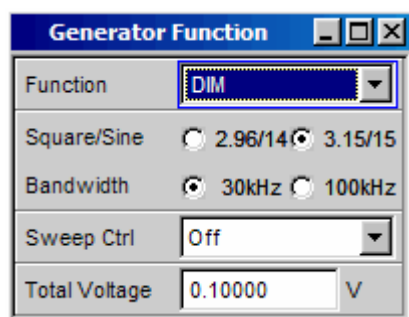
A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:  
SOURce:VOLTage:OFFSet:STATe ON | OFF  
SOURce:VOLTage:OFFSet <nu>

## DIM

The generator generates a test signal for measuring the Dynamic InterModulation distortions in accordance with IEC 268-3. The R&S UPV-B3 option is required to generate this signal.

A high-frequency sinewave is superimposed on a low-frequency squarewave signal. The squarewave signal is limited with respect to bandwidth using a first-order filter. The amplitude of the squarewave signal is 4 times higher than that of the sinewave signal.



Panel of generator with DIM function selected

Remote-control command:  
 SOURce:FUNctIon[:SHAPE] DIM

### Square/Sine

Used to select the ratio between the frequencies of the squarewave signal and sinewave signal.

**2.96/14** Squarewave signal: 2.96 kHz; sinewave signal: 14.0 kHz

Remote-control command:  
 SOURce:DIM DIMA

**3.15/15** Squarewave signal: 3.15 kHz; sinewave signal: 15.0 kHz

Remote-control command:  
 SOURce:DIM DIMB

### Bandwidth

Used to select the bandwidth (3 dB) of the first-order filter in order to limit the bandwidth of the squarewave signal.

**30kHz** Bandwidth limited to 30 kHz.

Remote-control command:  
 SOURce:BANDwidth F30

**100kHz** Bandwidth limited to 100 kHz.

Remote-control command:  
 SOURce:BANDwidth F100



**Sweep Ctrl**

Used to activate the sweep system. The total level (Total Voltage) of the signal can be varied within a selectable range from the start to the stop value. If the level is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

**Total Voltage**

Used to set the level of the overall signal. The maximum value depends on the settings for [Output Type](#) and [Max Voltage](#) in the Generator Config panel.

Remote-control command:

```
SOURce:VOLTage:TOTal <nu>
```

## Random

The generator generates a noise signal, the characteristics of which can be defined in either the time or frequency domain:

### Time domain

Selectable distribution function for amplitude

### Frequency domain

Several thousand equidistant sinewave lines in a selectable frequency domain

### Special application:

If the frequency spacing of the sinewave lines generated here is identical to the analysis grid of the FFT, analysis can be performed without leakage in the FFT. It is therefore possible to obtain a selectivity of one line with the squarewave window. This type of generator/analyzer configuration allows frequency responses of DUTs to be determined in one go with high precision and selectivity.

Remote-control command:

```
SOURce:FUNCTion[:SHAPE] RANDom
```

### Domain



Used to select whether the characteristics of the noise signal are defined in the frequency or time domain.

### Freq

To generate the output signal, sinewave lines with adjustable amplitude are generated and superimposed on each other with a defined frequency spacing. Depending on the selectivity of the analyzer, the output signal is displayed not as a sequence of individual lines but as a noise signal with a continuous level versus frequency. The frequency-defined noise can be used to generate several thousand single tones of any given amplitude (multi-tone).

Remote-control command:

```
SOURce:RANDom:DOMain FREquency
```

### Time

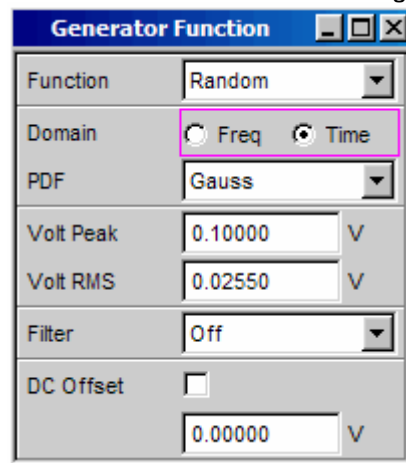
In this mode, noise signals are generated with interleaved random functions which have been optimized for uniformly distributed noise. Periodicity only occurs after at least 1 day.

Remote-control command:

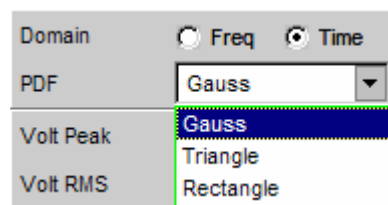
```
SOURce:RANDom:DOMain TIME
```

## Time domain

Panel used to define the noise signal in the time domain.



## PDF



The distribution function for amplitude can be selected in the "PDF" parameter field.

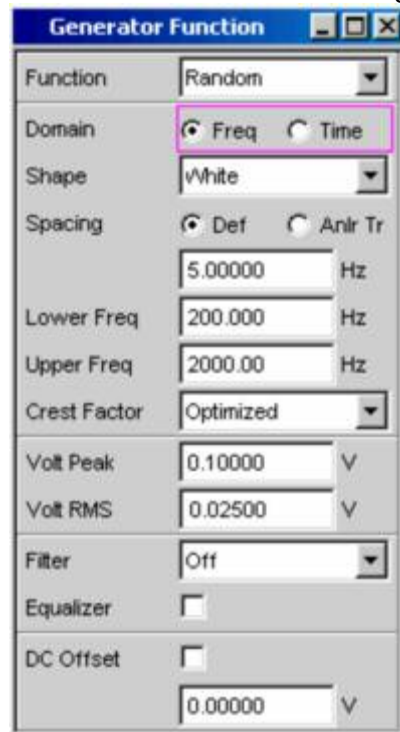
Remote-control command:

SOURCE:RANDOM:PDF GAUSSian | TRIangle | RECTangle

The other settings for time-domain noise (level, filter and DC offset) are described following the settings for frequency-domain noise at the end of this chapter, starting with [Volt Peak](#).

## Frequency domain

Panel used to define the noise signal in the frequency domain.



## Shape

Used to define the amplitude distribution of the signal spectrum within a selectable frequency domain.

**White** All sinewave lines between the lower and upper frequency limit have the same amplitude.

Remote-control command:  
SOURce:RANDom:SHApe WHITE

**Pink** Pink noise. The amplitude of the sinewave lines between the lower and upper frequency limit is proportional to the function  $\sqrt{1/f}$ , i.e. it decreases by 3 dB per octave. Measurements performed using a third-octave analyzer return a uniform frequency spectrum.

Remote-control command:  
SOURce:RANDom:SHApe PINK

**Third Octave** Pink noise with a bandwidth of one third octave. The center frequency is adjustable.


Remote-control command:  
SOURce:RANDom:SHApe TOCTave

**File** The amplitude distribution is read from the file which is displayed in the next parameter field "Shape File".

Remote-control command:  
SOURce:RANDom:SHApe ARBitary

**Shape File**

File containing the amplitude distribution.

The  button opens a browser which can be used to select the file.

Remote-control command:  
 MMEMoRY:LOAD:LIST ARBiTrary, 'filename'

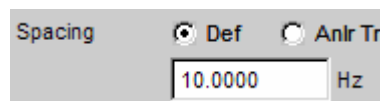
**File format:**

ASCII file containing max. 16384 amplitude values which have to be entered as a sequence of numbers (value range FLOAT). The file must contain one line with the keyword "FREQUENCY\_FILE" before the number sequence. Comment lines must begin with '#' and can be used anywhere in the file. No distinction is made between upper-case and lower-case characters. The recommended and preset file extension is '.FTF'. However, due to the keyword "FREQUENCY\_FILE" which must always be entered, it is also possible to use any other file extension.

The amplitudes of the individual frequency lines must be entered as dimension-less numeric values starting with 0 Hz. The numbers only indicate the amplitude ratio of the lines with respect to each other and not the output amplitude. The output amplitude is set following phase optimization according to the value defined in the "Volt Peak" parameter field. Since the ratio of peak value to RMS is calculated internally, it is also possible to enter the RMS.

The frequency spacing is taken from the "Spacing" setting defined in the panel.

Example: rs\_exam.ftf in the directory D:\UPVUser

**Spacing**

Used to set the frequency spacing. The frequency of each sinewave line is an integer multiple of this frequency spacing.

**Def** The frequency spacing can be freely defined.  
 Minimum value: Sampling rate/16384

Remote-control command:  
 SOURce:RANDom:SPACing:MODE USERdefined  
 SOURce:RANDom:SPACing:FREQuency <nu>

**Anlr Tr** The frequency spacing is adopted from the FFT set in the analyzer. This value depends on the sampling rate and the size of the FFT. This setting is only possible if an FFT or Post FFT is selected in the analyzer.  
 The parameter field for entering values is then hidden.

Remote-control command:  
 SOURce:RANDom:SPACing:MODE ATRack

**Lower Freq**

Used to define the lower frequency limit of the noise signal if Shape is set to White or Pink.

Remote-control command:  
 SOURce:RANDOM:FREQuency:LOWer <nu>

**Upper Freq**

Used to define the upper frequency limit of the noise signal if Shape is set to White or Pink.

Remote-control command:  
 SOURce:RANDOM:FREQuency:UPPer <nu>

**Mean Freq**

Used to set the center frequency in the case of third-octave noise.

Remote-control command:  
 SOURce:FREQuency:MEAN <nu>

**Crest Factor**

The ratio of peak value to RMS (crest factor) of the signal can be influenced using the phase of the individual sinewave lines. This setting is only possible if the R&S UPV-B6 option is installed. If this option is not installed, the crest factor is minimized. If the noise is defined in the time domain, the selected distribution function for amplitude determines the crest factor. This parameter field is hidden in this case.

**Optimized**

The ratio of peak value to RMS of the signal is minimized.

Remote-control command:  
 SOURce:VOLTage:CREStfactor:MODE  
 MINimized

**Value**

The ratio of peak value to RMS of the signal is adjusted such that the ratio is as close to the preset value as possible. The user can enter this value in the next parameter field. The result depends on the number, frequency and level of the individual lines of the noise signal.

Remote-control command:  
 SOURce:VOLTage:CREStfactor:MODE VALue  
 SOURce:VOLTage:CREStfactor <n>

**Volt Peak**

Used to enter the peak value of the noise signal. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for *Output Type* and *Max Voltage* in the Generator Config panel.

The peak value and RMS are interlinked by means of the crest factor. If the noise is defined in the time domain, the selected distribution function for amplitude determines the crest factor.

Remote-control command:  
SOURce:VOLTage:TOTal <nu>

**Volt RMS**

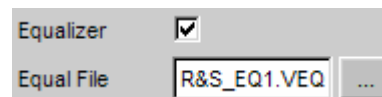
Used to enter the RMS of the multi-sinewave signal (only in the analog generator). The peak value and RMS are interlinked by means of the crest factor. If the noise is defined in the time domain, the selected distribution function for amplitude determines the crest factor.

Remote-control command:  
SOURce:VOLTage:RMS <nu>

**Filter**


The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section *"Generator Filters"* on page 4.82.

Remote-control command:  
SOURce:FILTer

**Equalizer**

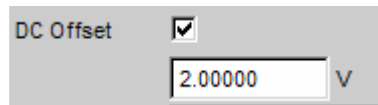
The generator signal is precorrected in the frequency domain using the file selected in the "Equal File" parameter field. The tick box is used to activate/deactivate this function.

These parameter fields are hidden if time-domain noise (Domain Time) is selected.

The  button opens a browser which can be used to select the precorrector file, see also the section *"Equalization"* on page 4.82.

Remote-control command:  
SOURce:VOLTage:EQAlize:STATe ON | OFF  
MMEMory:LOAD:LIST EQAlizer,'filename'

## DC Offset



DC Offset   
2.00000 V

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:

SOURce:VOLTage:OFFSet:STATe ON | OFF

SOURce:VOLTage:OFFSet <nu>




## Arbitrary

The generator generates a freely definable curve shape which is read out from a file as a sequence of samples. The maximum length is 16384 samples. When output, the curve is repeated continuously in an unbroken sequence. The individual samples are output at the sampling rate selected in the generator.

Remote-control command:  
 SOURce:FUNCTion[:SHAPE] ARBitrary

**Shape File** File from which the curve shape is read.

The  button opens a browser which can be used to select the file.

Remote-control command:  
 MMEMory:LOAD:LIST ARBitrary, 'filename'

### File format:

ASCII file with max. 16384 samples. The individual samples are entered as a sequence of numbers (value range FLOAT). The file must contain one line with the keyword "TIMETAB\_FILE" before the number sequence. Comment lines must begin with '#' and can be used anywhere in the file. No distinction is made between upper-case and lower-case characters. The recommended and preset file extension is '.ARB'. However, due to the keyword "TIMETAB\_FILE" which must always be entered, it is also possible to use any other file extension.

The numerically highest value (Maximum) is output with the peak voltage set in the "Volt Peak" entry field; the other samples are level-controlled according to their ratio to the maximum. Since the ratio of peak value to RMS is calculated internally from the samples, it is also possible to enter the RMS.

Example: rs\_exam.arb in the directory D:\UPV\User

**Volt Peak** Used to enter the peak value of the arbitrary signal. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for [Output Type](#) and [Max Voltage](#) in the Generator Config panel. The peak value and RMS are interlinked by means of the crest factor.

Remote-control command:  
 SOURce:VOLTage:TOTal <nu>

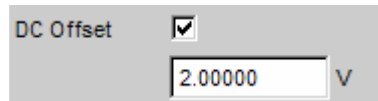
**Volt RMS** Used to enter the RMS of the arbitrary signal (only in the analog generator). The peak value and RMS are interlinked by means of the crest factor.

Remote-control command:  
 SOURce:VOLTage:RMS <nu>

**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "[Generator Filters](#)" on page 4.82.

Remote-control command:  
SOURCE:FILTER

**DC Offset**

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:  
SOURCE:VOLTage:OFFSet:STATe ON | OFF  
SOURCE:VOLTage:OFFSet <nu>

## Polarity

The generator generates a test signal for the polarity measurement. This measurement is used to check the polarity of the input signal transmitted by the DUT.

Remote-control command:  
SOURce:FUNCTION[:SHAPE] POLarity

The test signal is a special sine<sup>2</sup> burst with the following fixed parameters:

<b>Frequency</b>	1.2 kHz in the analog generator Sampling rate/80 in the digital generator
<b>On Time</b>	1 cycle
<b>Interval</b>	2 cycles

Only the voltage of the signal can be adjusted:

**Voltage** Used to set the level of the sinewave during the burst duration. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for [Output Type](#) and [Max Voltage](#) in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage[1] <nu>

## Modulation

The generator generates a sinewave signal which can be modulated with respect to frequency or amplitude according to a sinusoidal function.

Remote-control command:  
 SOURce:FUNction[:SHAPE] MODulation

**Mode** Used to select the modulation type: amplitude or frequency modulation.

**FM** Frequency modulation

Remote-control command:  
 SOURce:FUNction:MODE FM

**AM** Amplitude modulation

Remote-control command:  
 SOURce:FUNction:MODE AM

**Mod Freq** Used to set the modulation frequency.

Remote-control command:  
 SOURce:FREQuency[1] <nu>

**Carrier Freq** Used to set the carrier frequency.

Remote-control command:  
 SOURce:FREQuency2 <nu>

**Deviation** With FM, this parameter field is used to set the modulation deviation in % relative to the carrier frequency.

Remote-control command:  
 SOURce:VOLTage[1] <n> [PCT]

**Mod Depth** With AM, this parameter field is used to set the modulation depth in % relative to the carrier amplitude.

Remote-control command:  
 SOURce:VOLTage[1] <n> [PCT]

**Carrier Volt**

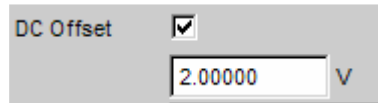
Used to set the level of the unmodulated sinewave signal. With AM, only up to half of the maximum value; this ensures that 100 % AM can always be set. The maximum value depends on the set DC offset. In the analog generator, the maximum total voltage also depends on the settings for *Output Type* and *Max Voltage* in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage2 <nu>

**Filter**

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected, see also the section "*Generator Filters*" on page 4.82.

Remote-control command:  
SOURce:FILTer

**DC Offset**

A DC offset is superimposed on the generator signal. This offset reduces the maximum possible AC voltage. The tick box is used to activate/deactivate this function. The value set for the offset voltage is always displayed.

Remote-control command:  
SOURce:VOLTage:OFFSet:STATe ON | OFF  
SOURce:VOLTage:OFFSet <nu>

## DC (Direct-Current Voltage)

The generator generates a DC voltage signal. Unlike the DC offset, it is possible to sweep this DC voltage.

Remote-control command:  
SOURce:FUNCTION[:SHAPE] DC

### Sweep Ctrl

Used to activate the sweep system. The DC voltage can be varied within a selectable range from the start to the stop value. If the level is selected as the X-axis, the measurement values can be displayed as a curve in the Sweep Graph graphical window.

Sweep points: Linear or logarithmic between start and stop or read from a file.

Stepping: Automatic in a defined time grid or synchronized to the measurement time of the analyzer. Manual using the rotary knob. All the setting parameters of the sweep system are described in the section "[Sweeps](#)" on page 4.83.

### Voltage

DC voltage level. In the analog generator, the maximum value depends on the settings for [Output Type](#) and [Max Voltage](#) in the Generator Config panel.

Remote-control command:  
SOURce:VOLTage:TOTal <nu>

## Equalization

The generator can be given a predefined frequency response using a table containing frequency points and the associated gain factors. The set amplitude of the generator is changed automatically according to frequency on the basis of this table.

The table must be saved in a particular format in a file which can be loaded in the "Equalization" parameter field in the Generator Function panel.

## Generator Filters

The generator signal is filtered in the time domain. One of the user-definable filters in the filter panel or a weighting filter can be selected. All level settings apply to the unfiltered signal (see section ["Filters"](#) on page 4.240).

## Sweeps

With many generator functions, it is advisable to output the signal parameters (level, frequency and, with burst signals, ON-time and interval length) not only statically but also to vary them over time. Varying one or more of the signal parameters is referred to as a (generator) sweep. The measurement values obtained can be, but do not have to be, recorded as series of measurement values.

For this purpose, the R&S UPV has a very flexible sweep system where up to two generator parameters or one analyzer parameter can be varied in many different ways. When the generator sweep is activated, any analyzer sweep that may be active (variation of the center frequency for the RMS Selective filter) is deactivated.

The sweep results (series of measurement values) can be displayed graphically (2-D graph in a sweep window) or numerically (sweep list, see section "[List Sweep](#)" on page 4.101). With the graphical display, the 1<sup>st</sup> sweep parameter is usually plotted on the X-axis, the recorded measurement value on the Y-axis and the optional 2<sup>nd</sup> sweep parameter on the Z-axis (not visible in the 2-D graph). Therefore, "sweep axis" generally refers to the characteristic of the 1st sweep parameter; "Z-sweep" is a synonym for a sweep with 2 parameters (2-dimensional sweep).

Up to 8 measurement values can be recorded for each sweep point (in 4 sweep windows each with 2 traces). To record a certain measurement value, a trace must be set to this measurement value in one of the 4 sweep display panels. It is also possible to set more than one trace to one measurement value.

The generator sweeps can be configured in many different ways and can be distinguished according to the following characteristics:

- *number of varied signal parameters* in **1 or 2-dimensional sweeps** ("Z-sweeps")
- *type of stepping* in **manual and automatic sweeps**
- *stepping condition* in **synchronous and time-triggered sweeps**
- *sweep-axis spacing* in **linear, logarithmic and list-controlled sweeps**
- *sweep direction* in **upward and downward sweeps**
- *physical basic unit* of the sweep parameter in **frequency, level, time and phase sweeps**
- *behavior when the stop value is reached* in **single and continuous sweeps**

Which sweep parameters are available for the individual generator functions depends on the characteristics of the respective signal. The following generally applies:

- A frequency sweep is not possible for multi-tone signals or noise signals.
- A phase sweep, i.e. the variation in phase shift between Channel 1 and 2, is only possible for stereo-sinewaves and should only be performed if both frequencies are the same.
- Time sweeps, i.e. the variation in ON-time and interval length, are only possible with burst signals.
- Z-sweeps are only possible if at least 2 signal parameters of the set generator function have sweep capability.



Table 4-1 List of sweep-capable function parameters depending on selected function

Function	VOLTAGE	FREQUENCY	Phase	ON-TIME	INTERVAL
Sine	yes	yes	---	---	---
Stereo Sine	yes	yes	yes	---	---
Multisine	no	no	---	---	---
Sine Burst	yes	yes	---	yes	yes
Sine <sup>2</sup> burst	yes	yes	---	yes	yes
Mod Dist	yes (total voltage)	yes (user frequency)	---	---	---
DFD	yes (total voltage)	IEC268 mode: center frequency IEC118 mode: upper frequency	---	---	---
DIM	yes (total voltage)	---	---	---	---
Random	no	---	---	---	---
Arbitrary	no	---	---	---	---
Polarity	no	---	---	---	---
Modulation	no	no	---	---	---
DC	yes	---	---	---	---

## Activating / Deactivating the Sweep System

The sweep system is activated and deactivated using "Sweep Ctrl". How the sweep is to be stepped and how the sweep axis is to be defined are also determined at the same time. For generator sweeps, this parameter field is available in the generator functions; the analyzer sweep is only available for the measurement function "RMS Selective" and is described in greater detail in the associated section "[RMS Measurement, Selective](#)" on page 4.160.

The sweep system can be activated and configured separately in each generator function. If the function (or instrument) is changed, the sweep system is reconfigured, activated or deactivated implicitly.

The *generator* sweep is also deactivated when the *analyzer* sweep is activated.

A sweep cycle is started by pressing the START key (for continuous sweeps) or SINGLE key (for single sweeps).

Each new sweep point that the sweep system sets automatically triggers a new measurement. If the measurement values generated during measurement are to be recorded and displayed (graphically or numerically), the desired measurement values (e.g. "Funct Ch1") must be selected as "Traces" in the sweep display panels. Furthermore, it must also be ensured that during measurement value recording the X-axis is set to "Auto" in the used sweep display panels.

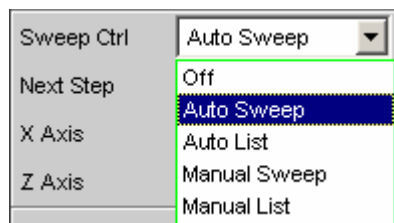
On completion of the sweep measurements, the used traces and the associated X-axes should be switched to "Hold" to prevent the sweep results from being deleted if instrument settings are changed inadvertently.

When the sweep system is active, the START, SINGLE and STOP/CONT keys have the following effect:

- START starts a continuous sweep.
- SINGLE starts a single sweep or causes an already started continuous sweep to be continued as a single sweep.
- STOP/CONT stops an active sweep or restarts a stopped sweep.

**Sweep Ctrl**

Used to activate and configure or deactivate the generator sweep system.



**Off**

The generator sweep system is *deactivated*; no additional parameter fields are displayed. If the analyzer sweep system is also deactivated, the START, SINGLE and STOP/CONT keys affect the measurement system:

- START starts a continuous measurement
- SINGLE starts a single measurement or causes an already started continuous measurement to be continued as a single measurement
- STOP/CONT stops an active measurement or starts a stopped or completed measurement as a continuous measurement

Remote-control command:  
 SOURce:SWEEp:CONTrol OFF

**Auto Sweep**

The generator sweep system is *activated*; the sweep stepping is performed automatically; the sweep axis is calculated from the start value, stop value and step size or point number. The stepping condition (fixed time grid or synchronized to the analyzer) is determined in the "Next Step" parameter field.

Remote-control command:  
 SOURce:SWEEp:CONTrol ASweep

**Auto List** The generator sweep system is *activated*; the sweep stepping is performed automatically; the sweep axis is determined from the predefined list of sweep points (usually loaded as a file). The stepping condition (fixed time grid or synchronized to the analyzer) is determined in the "Next Step" parameter field.

```
Remote-control command:  
SOURce:SWEep:CONTRol ALIST
```

**Manual Sweep** The generator sweep system is activated; the sweep stepping is performed manually; the sweep axis is calculated from the start value, stop value and step size or point number.

```
Remote-control command:  
SOURce:SWEep:CONTRol MSWEEP
```

**Manual List** The generator sweep system is *activated*; the sweep stepping is performed manually; the sweep axis is determined from the predefined list of sweep points (usually loaded as a file).

```
Remote-control command:  
SOURce:SWEep:CONTRol MLIST
```

## One-Dimensional Sweep

With one-dimensional sweeps, only 1 parameter is varied; the Z-axis is deactivated.



Each sweep cycle can consist of max. 1024 individual points, which means that the X-axis is divided into max. 1023 steps.

As soon as all of the points on the X-axis have been processed, the analyzer returns to the 1<sup>st</sup> X-value and performs the next sweep cycle using the same settings.

---

### Note:

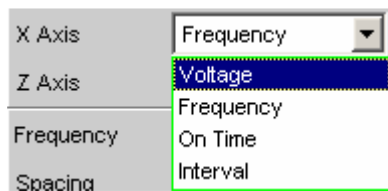
*The last 20 sweep cycles (scans) are available as the data set. If more than 20 scans have been performed, only the last 20 can be saved as the trace data set. Similarly, only the last 20 scans are retained if the graph is rescaled.*

---

A one-dimensional continuous sweep which was started by pressing the START key is repeated infinitely often.

### X Axis

Used to select the sweep parameter (with *one*-dimensional sweeps) or the *first* sweep parameter (with *two*-dimensional sweeps). Only visible for activated generator sweep system.



The reason why the sweep axis is referred to as the X-axis is because this sweep parameter is usually plotted on the X-axis in the 2-D graph.

---

### Note:

*It is also possible to plot a measurement value on the X-axis (e.g. the measured RMS in the case of external measurement value triggering). In such cases, the sweep axis (sweep X-axis) and the graphical X-axis are not necessarily identical.*

---

### Voltage

Used to activate a level sweep. Which signal parameter is actually swept (e.g. the level of a single sinewave line or the total level of a multi-tone signal) depends on the respective generator function.

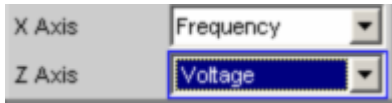
Remote-control command:  
 SOURce:SWEep:XAXis VOLTage

---

<b>Frequency</b>	<p>Used to activate a frequency sweep. Not possible for noise signals and multi-tone signals. Which signal parameter is actually swept (e.g. the frequency of a single sinewave line or the center frequency of a two-tone signal) depends on the respective generator function.</p> <p>Remote-control command: SOURce:SWEEp:XAXis FREQuency</p>
<b>Phase</b>	<p>Used to activate a phase sweep. Only possible for stereo signal.</p> <p>Remote-control command: SOURce:SWEEp:XAXis PHASe</p>
<b>On Time</b>	<p>Used to activate a burst-duration sweep. Only with burst signals. The ON-time of the burst signal is swept, i.e. the time during which the high level of the burst is output.</p> <p>Remote-control command: SOURce:SWEEp:XAXis ONTime</p>
<b>Interval</b>	<p>Used to activate a burst-interval sweep. Only with burst signals. The interval length of the burst signal is swept.</p> <p>Remote-control command: SOURce:SWEEp:XAXis INTervall</p>

## Two-Dimensional Sweep

With two-dimensional sweeps, 2 (different) parameters are varied; the 1st parameter is selected as the X-axis and the 2nd parameter as the Z-axis.



Both axes (sweep dimensions) can each consist of max. 1024 individual points, which means that each axis is divided into max. 1023 steps.

As soon as all of the points on the X-axis have been processed, the analyzer returns to the 1<sup>st</sup> X-value and simultaneously sets the next Z-value. When the sweep cycle for the last Z-point has been completed, the X and Z-values are reset to their original start values.

---

### Note:

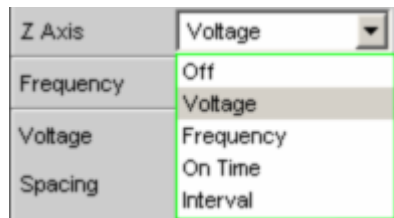
*The last 20 sweep cycles (scans) are available as the data set. If the Z-axis contains more than 20 points, only the last 20 scans can be saved as the trace data set. Similarly, only the last 20 scans are retained if the graph is rescaled.*

---

A two-dimensional continuous sweep which was started by pressing the START key is stopped after the sweep cycle for the last Z-point.

### Z Axis

Used to select the second sweep parameter for the *two-dimensional* sweep. Used both to activate and to deactivate the two-dimensional sweep. Only visible for activated generator sweep system.




---

### Note:

*With some generator functions (e.g. DC, DIM), it is possible to sweep one parameter only. The "Z Axis" parameter field (and therefore a two-dimensional sweep) is not available in this case.*

---

### Off

Used to deactivate the two-dimensional sweep (switch-over to a one-dimensional sweep).

Remote-control command:  
SOURCE:SWEep:ZAXis OFF

<b>Voltage</b>	<p>Used to activate the two-dimensional sweep and select the level variation as the second sweep parameter. Which signal parameter is actually swept (the level of a single sinewave line or the total level of a multi-tone signal) depends on the respective generator function.</p> <p>Remote-control command: SOURce:SWEEp:ZAXis VOLTage</p>
<b>Frequency</b>	<p>Used to activate the two-dimensional sweep and select the frequency variation as the second sweep parameter. Not possible for noise signals and multi-tone signals. Which signal parameter is actually swept (the frequency of a single sinewave line or the center frequency of a two-tone signal) depends on the respective generator function.</p> <p>Remote-control command: SOURce:SWEEp:ZAXis FREQuency</p>
<b>Phase</b>	<p>Used to activate a two-dimensional sweep and select phase variation as the second sweep parameter. Only possible for stereo signal.</p> <p>Remote-control command: SOURce:SWEEp:ZAXis PHASe</p>
<b>On Time</b>	<p>Used to activate the two-dimensional sweep and select the burst-duration variation as the second sweep parameter. Only with burst signals. The ON-time of the burst signal is swept, i.e. the time during which the high level of the burst is output.</p> <p>Remote-control command: SOURce:SWEEp:ZAXis ONTime</p>
<b>Interval</b>	<p>Used to activate the two-dimensional sweep and select the burst-interval variation as the second sweep parameter. Only with burst signals. The interval length of the burst signal is swept.</p> <p>Remote-control command: SOURce:SWEEp:ZAXis INTervall</p>

**Note:**

*The smallest "Interval" value must be greater than the largest occurring "On Time" value. With logarithmic and linear sweeps, this is ensured by limiting and, where necessary, correcting the start and stop values. With the list sweep, the user should make sure that this condition is observed in the used lists since automatic correction (if required) only begins with the currently active sweep, which can lead to unexpected results.*

**Note:**

*Theoretically, it is possible (and not forbidden on the user interface) to specify the same parameter (e.g. voltage) for both axes. In this case, the Z-parameter has no effect but nevertheless still determines the number of sweep cycles.*

---



## Automatic Sweep

With automatic sweeps, the sweep stepping is performed automatically when a measurement has been completed (synchronous sweep) or when a definable dwell time has expired (time-triggered sweep). Once started, the sweep continues to run indefinitely if no further user entries are made (in the case of one-dimensional continuous sweeps) or until the last sweep point has been reached.

An automatic sweep is selected in the "Sweep Ctrl" parameter field, whereby the sweep axis

- is calculated from user entries ("Auto Sweep") or
- is loaded with a predefined list (e.g. from a file) ("Auto List")

### Next Step

Used to select the sweep stepping. Only visible for automatic sweeps.



### Anlr Sync

The sweep stepping is synchronized to the analyzer, i.e. a new sweep point is set automatically when all measurements activated in the analyzer have been completed. This setting should be selected whenever the internal analyzer is used for sweeping. It ensures that a measurement value is determined for every sweep point with minimum sweep time.

---

#### Note:

*If one or more measurement values cannot be determined for a particular sweep point (e.g. the selected level range of the analyzer is too low or the signal supplies a level which is too high), the measurement values concerned are marked as invalid ("NAN") and the next sweep point is set.*

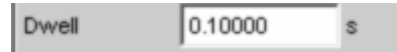
---

Remote-control command:  
 SOURCE:SWEep:NEXTstep ASYNc

**Dwell Value**

The sweep stepping is time-controlled in *constant* intervals, i.e. a new sweep point is set automatically if the preset time has expired, irrespective of whether the measurements activated in the analyzer have been completed. A new measurement is started at the same time.

The user can enter the dwell time in the next parameter field.



This setting should only be selected if the internal analyzer is not used or the measurement values are not required. It ensures that the sweep stepping is performed in a fixed time grid.

**Note:**

*If the selected dwell time is too short thus preventing one or more measurement values from being determined, the measurement values concerned are marked as invalid ("NAN").*

Remote-control command:  
 SOURce:SWEEp:NEXtstep DWELL  
 SOURce:SWEEp:DWELL <nu>

**Dwell File**

The sweep stepping is time-controlled in *individually set* intervals, i.e. a new sweep point is set automatically if the associated time has expired, irrespective of whether the measurements activated in the analyzer have been completed. A new measurement is started at the same time.

The file containing the list of dwell times can be specified by the user in the parameter field below.



This setting should only be selected if the internal analyzer is not used or the measurement values are not required. It allows a different dwell time to be specified for each sweep point.

**Note:**

*If the dwell-time list is shorter than the sweep list or the length of the sweep axis, the last dwell time in the list is applicable for all remaining sweep points.*

Remote-control command:  
 SOURce:SWEEp:NEXtstep LIST

## Manual Sweep

With manual sweeps, the sweep stepping is performed by the user. When the manual sweep is started, only the first sweep point is set (and measured); all subsequent points must be set explicitly by the user (e.g. using the rotary knob). It is also possible to skip sweep points by, for example, turning the rotary knob by several notches. The selected sweep point is activated immediately, i.e. currently active measurements do not have to be completed first. The user is therefore responsible for waiting until the required measurements are completed before advancing to the next sweep step.

With the manual sweep, generator parameters can be changed using a freely definable increment. The increment is defined by a fixed "Step" (with "Manual Sweep") or by a variable step size which can be defined using a file (with "Manual List"). With remote control, stepping is performed using the command "INIT:NEXT<n>".

A manual sweep should be used instead of the automatic sweep if the required dwell time or the settling characteristics of the DUT is not known beforehand. It has the following advantages:

- With manual stepping, the *dwell time* can be determined separately for each sweep point *during the sweep cycle*.
- When a new sweep point has been set, measurements are performed continuously at this point. All measurement values determined in this way can be assessed in the measurement display. If the sweep is advanced to the next sweep point, the value measured *last* is saved.

A manual sweep is selected in the "Sweep Ctrl" parameter field, whereby the sweep axis

- is calculated from user entries ("Manual Sweep") or
- is loaded with a predefined list (e.g. from a file) ("Manual List")

---

**Note:**

*When a manual sweep has been started, the rotary knob no longer has its usual functions (e.g. navigation in the panels, movement of the graph cursor) but instead is only used to vary the sweep parameter. When the sweep is completed or interrupted, the original functions of the rotary knob are restored.*

---

## Linear and Logarithmic Sweep

Both linear and logarithmic sweeps are calculated automatically from user entries. For this purpose, the user must specify:

- the spacing type (logarithmic or linear)
- either the number of points ("Points") or the step size ("Step")

Spacing	Log Points	
Start	20000.0	Hz
Stop	20.0000	Hz
Points	30	

Spacing	Lin Steps	
Start	100.000	Hz
Stop	20000.0	Hz
Step	50.0000	Hz

- the start and stop value ("Start" and "Stop"), which implies the sweep direction

A maximum of 1024 points are available for each sweep axis which means that each axis can be divided into max. 1023 (linear or logarithmic) equidistant steps.

### Spacing

Used to select the sweep range spacing, i.e. the way in which the sweep points are distributed on the sweep axes. Only visible for activated generator sweep system. It is set separately for each sweep parameter.

Spacing	Log Points
Start	Lin Points
Stop	Lin Steps
Points	Log Points
	Log Steps

It can be selected separately for each sweep parameter (i.e. X and Z-axis).

**Lin Points**

The sweep range is divided linearly by specifying a number of points (linear sweep). This number is entered in the "Points" parameter field.

Should be selected if equidistant, linear spacing of *all* points is required.

Remote-control command (must be entered separately for each sweep parameter used):

```
SOURce:SWEEp:FREQuency:SPACing  
LINPoints  
SOURce:SWEEp:PHASe:SPACing LINPoints  
SOURce:SWEEp:VOLTage:SPACing LINPoints  
SOURce:SWEEp:ONTime:SPACing LINPoints  
SOURce:SWEEp:INTerval:SPACing  
LINPoints
```

**Lin Steps**

The sweep range is divided into intervals of a specified linear step size starting at "Start" (linear sweep). This step size is entered in the "Step" parameter field.

Remote-control command (must be entered separately for each sweep parameter used):

```
SOURce:SWEEp:FREQuency:SPACing  
LINSteps  
SOURce:SWEEp:PHASe:SPACing LINSteps  
SOURce:SWEEp:VOLTage:SPACing LINSteps  
SOURce:SWEEp:ONTime:SPACing LINSteps  
SOURce:SWEEp:INTerval:SPACing LINSteps
```

**Log Points**

The sweep range is divided logarithmically by specifying a number of points (logarithmic sweep). This number is entered in the "Points" parameter field. Not possible for phase sweep.

Should be selected if equidistant, logarithmic spacing of *all* points is required.

Remote-control command (must be entered separately for each sweep parameter used):

```
SOURce:SWEep:FREQuency:SPACing
LOGPoints
SOURce:SWEep:VOLTage:SPACing LOGPoints
SOURce:SWEep:ONTime:SPACing LOGPoints
SOURce:SWEep:INTerval:SPACing
LOGPoints
```

**Log Steps**

The sweep range is divided into intervals of a specified logarithmic step size starting at "Start" (logarithmic sweep). Each sweep point is calculated by multiplying the previous point by a constant factor. This factor is entered in the "Step" parameter field. Not possible for phase sweep.

Remote-control command (must be entered separately for each sweep parameter used):

```
SOURce:SWEep:FREQuency:SPACing
LOGSteps
SOURce:SWEep:VOLTage:SPACing LOGSteps
SOURce:SWEep:ONTime:SPACing LOGSteps
SOURce:SWEep:INTerval:SPACing LOGSteps
```

**Start**

Used to enter the start value for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system. It is set separately for each sweep parameter.

Start	<input type="text" value="20000.0"/>	Hz
-------	--------------------------------------	----

The start and stop value implicitly determine the sweep direction: If the start value is less than the stop value, an upward sweep is performed, otherwise a downward sweep will be performed. If a start value identical to the stop value is entered, the stop value is automatically loaded with the old start value. In this way, it is possible to change the sweep direction by entering just one value.

Remote-control command:  
SOURce:SWEEp:FREQuency:STARt <nu>  
SOURce:SWEEp:PHASe:STARt <nu>  
SOURce:SWEEp:VOLTage:STARt <nu>  
SOURce:SWEEp:ONTime:STARt <nu>  
SOURce:SWEEp:INTerval:STARt <nu>

**Stop**

Used to enter the stop value for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system. It is set separately for each sweep parameter.

Stop	<input type="text" value="20.0000"/>	Hz
------	--------------------------------------	----

The start and stop value implicitly determine the sweep direction: If a stop value identical to the start value is entered, the start value is automatically loaded with the old stop value.

Remote-control command:  
SOURce:SWEEp:FREQuency:STOP <nu>  
SOURce:SWEEp:PHASe:STOP <nu>  
SOURce:SWEEp:VOLTage:STOP <nu>  
SOURce:SWEEp:ONTime:STOP <nu>  
SOURce:SWEEp:INTerval:STOP <nu>

**Points**

Used to enter the number of sweep points for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system if "Lin Points" or "Log Points" is set for "Spacing". It is set separately for each sweep parameter.

Points	<input type="text" value="30"/>
--------	---------------------------------

The sweep range is divided into "Points – 1" (linear or logarithmic) equidistant steps. At least 2 points (start and stop value) are required.

A maximum of 1024 points can be selected for each sweep parameter.

---

**Note:**

*If the Z-axis contains more than 20 points, only the last 20 scans are available as the data set (for saving and rescaling the graph). If a two-dimensional sweep is to be saved as a complete trace data set, the number of points on the Z-axis must not exceed 20.*

---

Remote-control command:

```
SOURce:SWEEp:FREQuency:POINts <nu>  
SOURce:SWEEp:PHASe:POINts <nu>  
SOURce:SWEEp:VOLTage:POINts <nu>  
SOURce:SWEEp:ONTime:POINts <nu>  
SOURce:SWEEp:INTerval:POINts <nu>
```



**Step**

Used to enter the (linear or logarithmic) step size for the sweep parameter set in the parameter field above. Only visible for activated generator sweep system if "Lin Steps" or "Log Steps" is set for "Spacing". It is set separately for each sweep parameter.

The entry range is limited automatically so that at least one and at most 1023 steps exist (corresponding to 1024 sweep points).

With *linear* step, the size of the step must always be entered, i.e. the numeric value is positive even if the start value is greater than the stop value. The physical unit is the same as that used when specifying "Start" and "Stop".

 (Example for lin. frequency sweep)

With *logarithmic* step, the factor must be entered by which each sweep point is to be multiplied in order to move to the next sweep point. The logarithmic step size of level sweeps can also be specified in dB. Swapping the start and stop value (reversal of the sweep direction), therefore produces the reciprocal value and changes the sign of the dB value. The closer the numeric value is to 1.0 or 0 dB, the more sweep steps will be performed.

 (Example for log. downward sweep)

**Note:**

*Since the **last** step of the sweep is automatically adapted such that it corresponds exactly to the stop value, it may deviate by max. 50 % from the selected step size. If this is to be avoided, either the start / stop value must be corrected accordingly or the sweep spacing must be set using the "Points" parameter.*

Remote-control command:  
 SOURce:SWEep:FREQuency:STEP <nu>  
 SOURce:SWEep:PHASe:STEP <nu>  
 SOURce:SWEep:VOLTage:STEP <nu>  
 SOURce:SWEep:ONTime:STEP <nu>  
 SOURce:SWEep:INTerval:STEP <nu>

## List Sweep

With list-controlled sweeps, any sweep axis can be defined. The sweep points do not have to be in ascending or descending order but instead can have any values ("Random sweep") provided that they are within the physical limits of the sweep parameter. The sweep points are processed by the sweep system in the order in which they exist in the list. To define the list sweep as an upward or downward sweep, the sweep points must be entered in the appropriate order.

The list is usually loaded as a file. It must contain at least two (different) points.

A maximum of 1024 points are available for each sweep axis; if the list contains more than 1024 values, only the first 1024 points are loaded.

---

### Note:

*If the Z-axis of the two-dimensional sweep is defined as a list containing more than 20 points, only the last 20 scans are available as the data set (for saving and rescaling the graph). If a two-dimensional sweep is to be saved as a complete trace data set, the number of points on the Z-axis must not exceed 20.*

---

### Tot Volt File

Used to enter the file name for the list of the level sweep parameter (level sweep list). Only visible for activated generator list sweep.



Which signal parameter is actually swept (the level of a single sinewave line or the total level of a multi-tone signal) depends on the selected generator function.

Remote-control command:  
 MMEMemory:LOAD:VOLTage 'filename'

### Freq File

Used to enter the file name for the list of the frequency sweep parameter (frequency sweep list). Only visible for activated generator list sweep.



Which signal parameter is actually swept (the frequency of a single sinewave line or the center frequency of a two-tone signal) depends on the selected generator function.

Remote-control command:  
 MMEMemory:LOAD:FREQuency 'filename'

**Phase File**

Entry of file name for the phase sweep list. Only visible with generator list sweep activated.



Remote-control command :  
MMEemory:LOAD:PHASe 'filename'

**On Time File**

Used to enter the file name for the list of the burst-duration sweep (burst-duration sweep list). Only visible for activated generator list sweep in the generator functions "Burst" and "Sine<sup>2</sup> Burst".



Remote-control command:  
MMEemory:LOAD:ONTime 'filename'

**Interval File**

Used to enter the file name for the list of the burst-interval sweep (burst-interval sweep list). Only visible for activated generator list sweep in the generator functions "Burst" and "Sine<sup>2</sup> Burst".



Remote-control command:  
MMEemory:LOAD:INTerval 'filename'

## Sweep Speed

The time required for a sweep cycle is only relevant for automatic sweeps and is determined by the following factors:

- Setting time of the generator
- Required dwell time; depends on the characteristics of the DUT (e.g. settling time)
- Only with synchronous sweeps (i.e. when using the internal analyzer): measurement speed

The setting times of the generator and, if necessary, the measurement time should be minimized in order to ensure the shortest possible cycle time and thus a high sweep speed. A series of optimization options are provided for this purpose:

### Minimizing the generator setting time

The setting time of the digital generator part is just a few microseconds and can therefore be disregarded. However, configuration of the analog software in the analog generator (which involves settling procedures) requires a number of milliseconds and should therefore be avoided for sweeps wherever possible.

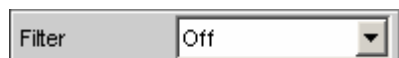
- Using the **universal generator** instead of the low-distortion generator for *frequency* sweeps. With low frequencies in particular, the low-distortion generator requires long settling times for frequency changes. The universal generator is superior to the low-distortion generator with respect to frequency setting time and accuracy and is therefore preferable as a sweep generator. The low-distortion generator should only be used if the DUT and the measurement function require its extremely good distortion properties or large frequency range.



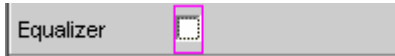
- Using a **fixed level range** for *level* sweep and with active precorrection; the level should be set to the highest value occurring in the sweep. The automatic operating mode controls the level of the analog hardware to maximize the signal-to-noise value of the generator at every level. This mode should only be used if sweeping is to be performed over several decades and both the DUT and the measurement function require a high S/N value.



- **Deactivating filtering.** An activated filter needs a short settling time for every frequency or level change.



- **Deactivating frequency response pre-correction** for *frequency* sweeps. If the equalizer is activated, a new level must be set for each new frequency. An alternative method of frequency response correction is to use suitable reference curves when recording the measurement values.



- **Reducing the dwell time** when using an *external* analyzer. The dwell time required by the DUT and the external analyzer must be determined by trial and error and can be specified as a fixed value or separately for each sweep point as a list.



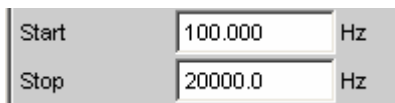
- **Synchronizing** the generator to the analyzer when using an *internal* analyzer. If the generator and analyzer of the R&S UPV are operated together, a generator sweep should always be synchronized to the analyzer. This ensures that the generator is advanced precisely at the point when all measurement results are available and have settled (where applicable also frequency, level monitor and input measurements on the active channels).



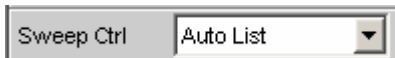
- Reducing the measurement points for **low frequencies**. Low frequencies require longer measurement times than higher frequencies. The sweep axis should therefore be divided in such a way that only a few low tones are used. This can be achieved in the following ways:



Linear instead of logarithmic spacing

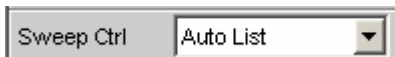


Increasing the lower sweep limit

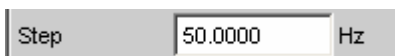


List sweep

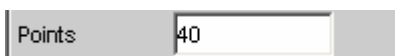
- Reducing the measurement points. The duration of the sweep cycle increases more or less linearly with the number of sweep points. The list sweep allows the intervals between the individual sweep points to be freely selected. This means that it is possible to group sweep points together at points of interest without needing to drastically increase their number.



List sweep



Avoiding an unnecessarily small step size

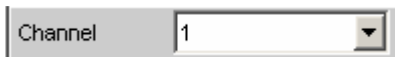


Avoiding an unnecessarily large number of sweep points

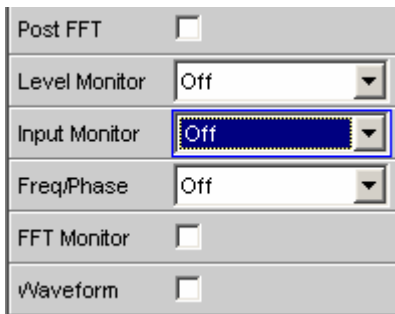
**Minimizing the measurement time**

When using the internal analyzer, the required measurement time depends on the selected measurement functions. Generally speaking, every measurement function used should wherever possible be configured for high measurement speed; this, of course, depends on the specific measurement function. For this reason, only a few generally applicable rules are given below:

- Only activate those measurement channels which are to be measured. An unconnected measurement input can increase the measurement time considerably because measurement is only completed when a measurement value exists for this channel. A number of measurement functions require considerably more time to measure a signal with a low level (noise). Even if there is a signal on the second channel, the measurement time will still be at least slightly longer than for single-channel mode since the second channel must be fully evaluated and displayed.



- Only activate those measurement functions which are required for the specific measurement task.



- Deactivate any traces that are not required. In 4 sweep windows, 2 traces can be activated in each window. Only those traces that are required for measurement value recording should be active.



- If the internal generator is used, many measurement functions allow reference to its settings ("Gen Track"). These functions should be used since they not only shorten the measurement time (because, for example, the frequency does not have to be measured) but can also increase the measurement accuracy (e.g. sample-precise setup and measurement over entire periods without errors due to measurement termination in the case of RMS).



(With RMS and RMS Selective)



(With THD+N and THD)

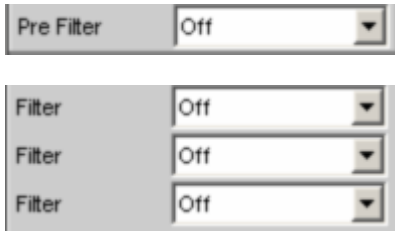


(With RMS Selective)

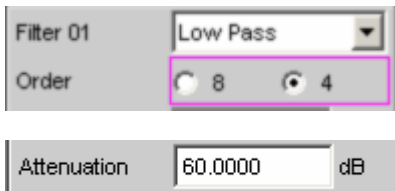


(With activated notch filter)

- Deactivating unnecessary filters. The filters must resettle whenever generator settings are changed. Measurement is not possible during this time. The start of measurement is delayed by the sum of settling times for all activated filters.



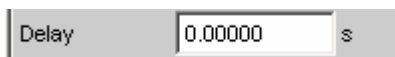
- Reducing the order and/or attenuation with user-defined high-pass and low-pass filters. This reduces the settling time.



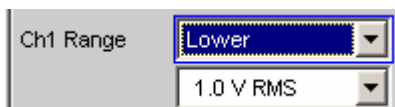
- Deactivating the settling functions. The settling function does not need to be activated for the majority of measurement signals. If the DUT supplies a stable signal, the R&S UPV will return settled measurement values making the settling function unnecessarily. Using the settling (or averaging) function *multiplies* the measurement time by at least the number of set "samples".



- Deactivating the measurement start delay. The measurement start delay is intended to compensate delays of the DUT. Whenever generator or analyzer settings are changed, the start of the 1<sup>st</sup> measurement (and consequently every single sweep point) is delayed by the specified time. This time should be set to 0.0 if no start delay is required.



- Manual selection of the analyzer level range (only with analog measurement signals). If the level of the measurement signal is known and a limitation of the dynamic response is acceptable, the analyzer level range should be selected manually. It should be set to the highest anticipated level; an "UNDERRANGE" must be expected and tolerated in this case; a new measurement with corrected range setting is not performed. "Range LOWER" can be selected to make sure that a higher level which would invalidate the measurement does not occur. This mode allows the measurement to correct the measuring range in the case of "OVERRANGE".



## Selecting the Analyzer

### Analyzer Configuration Panel

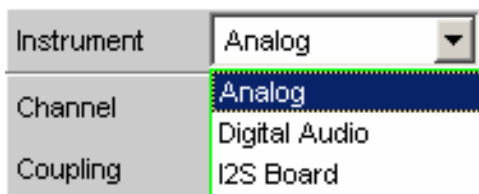
The Analyzer Config panel enables you to enter settings for the analog or digital analyzer.

To adapt the R&S UPV analyzer to the measurement task at hand, first define the settings in the Analyzer Config panel. These settings will influence which capabilities are available in the Analyzer Function panel.

The first step is to select one of the two analyzers (analog or digital).

#### Instrument

Used to selection the analyzer.



#### Analog

The user can choose between analyzers of various bandwidths.

Remote-control command:  
INSTRUMENT2[:SElect] ANLG

#### Digital Audio

Either audio data, amplitude, jitter and phase or a common signal can be measured, see section ["Configuring the Digital Analyzer"](#) on page 4.119.

Remote-control command:  
INSTRUMENT2[:SElect] DIG

#### I<sup>2</sup>S Board

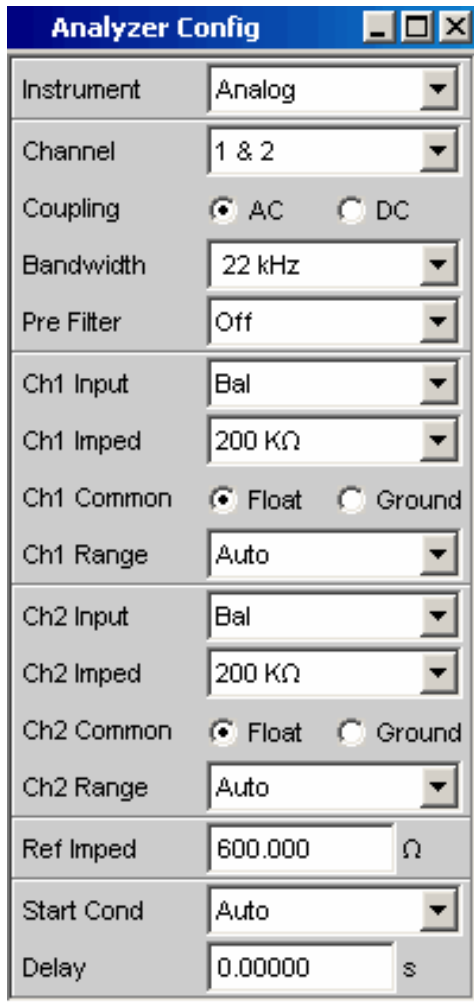
The I<sup>2</sup>S audio analyzer can measure audio data (8 bit to 32 bit) in I<sup>2</sup>S format.

Remote-control command:  
INSTRUMENT I2SB



## Configuring the Analog Analyzer

### Analog Analyzer Configuration Panel



The image shows a software window titled "Analyzer Config" with a standard Windows-style title bar (minimize, maximize, close buttons). The window contains a list of configuration parameters for an analog analyzer, organized into sections. Each parameter is either a dropdown menu, a radio button selection, or a text input field with a unit indicator.

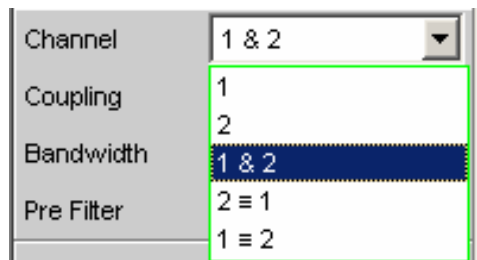
Parameter	Value
Instrument	Analog
Channel	1 & 2
Coupling	<input checked="" type="radio"/> AC <input type="radio"/> DC
Bandwidth	22 kHz
Pre Filter	Off
Ch1 Input	Bal
Ch1 Imped	200 K $\Omega$
Ch1 Common	<input checked="" type="radio"/> Float <input type="radio"/> Ground
Ch1 Range	Auto
Ch2 Input	Bal
Ch2 Imped	200 K $\Omega$
Ch2 Common	<input checked="" type="radio"/> Float <input type="radio"/> Ground
Ch2 Range	Auto
Ref Imped	600.000 $\Omega$
Start Cond	Auto
Delay	0.00000 s

Figure 4-10 Analyzer Config panel

The Config panel is used to set up the analog and digital analyzer. The configuration options for the analog analyzer are described below.

**Channel**

Used to select the active XLR sockets in the bottom right-hand part of the R&S UPV front panel.



If a single-channel measurement is selected (1 or 2), the channel not being measured is disabled. Disabled inputs are floating; they are terminated with the set input impedances (300 Ω, 600 Ω or 200 kΩ).

- |                  |   |
|------------------|---|
| <b>1</b>         | <p>Only the signal applied at XLR socket 1 is measured.</p> <p>Remote-control command:<br/>INPut:CHANnel CH1</p>  |
| <b>2</b>         | <p>Only the signal applied at XLR socket 2 is measured.</p> <p>Remote-control command:<br/>INPut:CHANnel CH2</p>  |
| <b>1 &amp; 2</b> | <p>Both XLR sockets are available for analysis of the applied signals.<br/>Channel 1 and Channel 2 can have different settings.</p> <p>Remote-control command:<br/>INPut:CHANnel CH1And2</p>                |
| <b>2 ≡ 1</b>     | <p>Both XLR sockets are available for analysis of the applied signals.<br/>Here, however, the setting for Channel 1 is also used for Channel 2.</p> <p>Remote-control command:<br/>INPut:CHANnel CH2Is1</p> |
| <b>1 ≡ 2</b>     | <p>Both XLR sockets are available for analysis of the applied signals.<br/>Here, however, the setting for Channel 1 is also used for Channel 2.</p> <p>Remote-control command:<br/>INPut:CHANnel CH1Is2</p> |

**Coupling**

Used to select the input coupling.

AC or DC coupling can be selected. The coupling can be selected separately for both channels if "Channel 1&2" is set.

If AC coupling is selected, the R&S UPV has a limit frequency (-3 dB) of approx. 2 Hz. DC coupling should be selected if input voltages with very low-frequency signal components are to be measured.

**AC**

The DC component of the measurement signal is removed at the input using a high-pass filter and therefore cannot affect the measurement result. If the "DC" measurement function is selected, measurements are always performed with DC coupling, even if AC coupling is selected.

Remote-control command:  
INPut:COUPling AC

**DC**

Measurement signals up to 0 Hz are recorded and taken into consideration in the measurement results of RMS, RMS Selective, Peak, Quasi Peak, DC, FFT and Waveform.

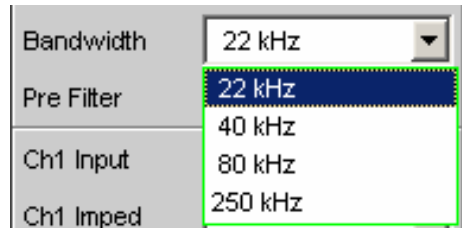
**Caution:**

If the input signal contains a large DC component, this results in a reduced dynamic response for the AC component since the measuring range of the input amplifier is based on the overall signal.

Remote-control command:  
INPut:COUPling DC

**Bandwidth**

4 different analyzer bandwidths are available; the selected bandwidth determines the upper frequency limit for the measurement signal.



- 22 kHz**      The maximum signal frequency is 22 kHz. The signal is sampled at 48 kHz.
- Remote-control command:  
INPut:BA<sup>N</sup>Dwidth:MODE B22
- 40 kHz**      The maximum signal frequency is 40 kHz. The signal is sampled at 96 kHz.
- Remote-control command:  
INPut:BA<sup>N</sup>Dwidth:MODE B40
- 80 kHz**      The maximum signal frequency is 80 kHz. The signal is sampled at 192 kHz.
- Remote-control command:  
INPut:BA<sup>N</sup>Dwidth:MODE B80
- 250 kHz**     The maximum signal frequency is 250 kHz. The signal is sampled at 768 kHz.
- Remote-control command:  
INPut:BA<sup>N</sup>Dwidth:MODE B250

**Pre Filter**

The selected prefilter affects all measurement functions. This means that prefiltering is possible without having to select the required filter for every single measurement function.

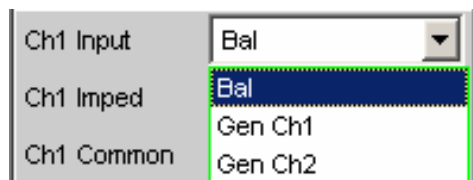


The description or characteristic of the various filters is found in section *"Filters"* on page 4.240.

Remote-control comand:  
INPut:FILTer

**Ch1 Input**  
(Ch2 Input)

Used to select the signal source for Channel 1.  
If both channels have the same settings (2 = 1 or 1 = 2), only the text "Input" appears to the left of the selection field.  
If Channel 1 & 2 is selected, the fields "Ch2 Input" to "Ch2 Range" also appear in which settings different to those for Channel 1 can be made for Channel 2.



**Bal**                    **Balanced** = Balanced-to-ground measurement inputs.

Unbalanced DUTs can be connected using XLR/BNC adapters (UPL-Z1 option).

Remote-control command:  
INPut [1] | 2:TYPE BALanced

**Gen Ch1**              Internal connection of analyzer channel 1 to generator output 1. The analyzer input impedance is 200 kΩ.

Remote-control command:  
INPut [1] | 2:TYPE GEN1

**Gen Ch2**              Internal connection of analyzer channel 1 to generator output 2. The analyzer input impedance is 200 kΩ.

Remote-control command:  
INPut [1] | 2:TYPE GEN2

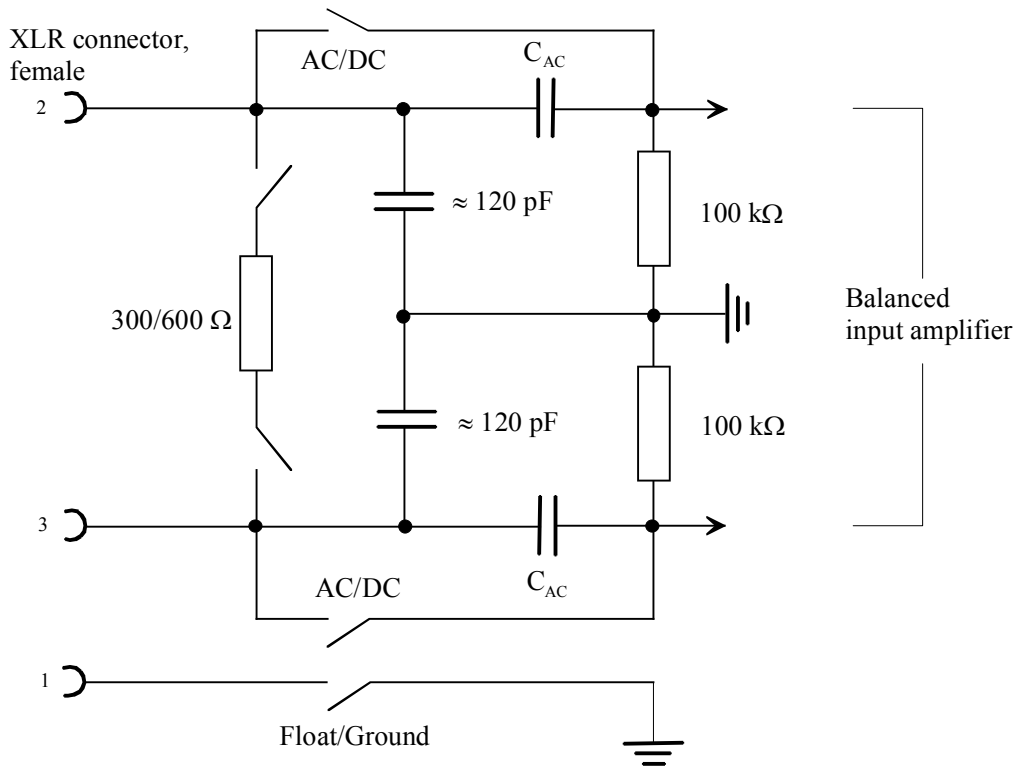


Figure 4-11 Balanced analyzer input

The two analyzer inputs can be connected to the XLR sockets to allow external signals to be measured. They can, however, also be freely connected to the outputs of the internal R&S UPV generator, as shown in the diagram below (the ground symbol represents the floating generator ground, and the earth symbol represents the analyzer and housing ground):

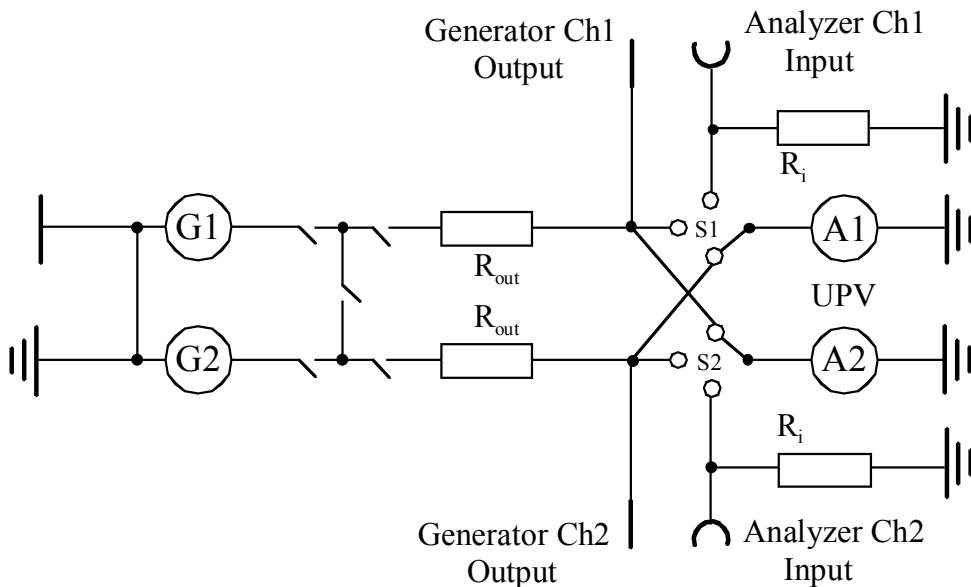


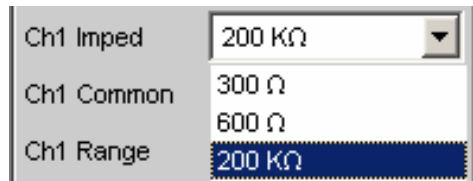
Figure 4-12 Possible connections for analyzer inputs

The sources labelled G1 and G2 represent generators 1 and 2 if the R&S UPV-B3 option (Second Generator) is installed. S1 and S2 represent the input selectors of the two analyzer inputs. They are used to switch the analyzer to an external signal or to set up an internal connection to the R&S UPV generator.  $R_{out}$  represents the generator output resistors and  $R_i$  represents the analyzer input resistors. The circles labelled A1 and A2 symbolize the R&S UPV analyzers.

### Ch1 Imped (Ch2 Imped)

Used to select the input impedance; can only be selected if Input is set to "Bal".

If both channels have the same settings (2 = 1 or 1 = 2), only the text "Impedance" appears to the left of the selection field.



With impedances of 300  $\Omega$  and 600  $\Omega$ , only voltages up to 25 V can be applied (this applies to both DC and AC coupling because the low input impedances are located upstream of the coupling capacitors). In the case of voltages > 25 V, the input is protected against overloading: The input impedance is switched to 200 k $\Omega$  and the generator output is disabled (see [Chapter 3 Manual Operation, Rapid Deactivation of the Outputs](#)). The "OVLd" LEDs on the front panel of the R&S UPV (immediately next to the generator outputs and analyzer inputs) indicate the status.

**300  $\Omega$**             The input impedance is 300  $\Omega$ .

Remote-control command:  
INPut[1]|2:IMPedance R300

**600  $\Omega$**             The input impedance is 600  $\Omega$ .

Remote-control command:  
INPut[1]|2:IMPedance R600

**200 k $\Omega$**             The input impedance is 200 k $\Omega$ .

Remote-control command:  
INPut[1]|2:IMPedance R200K

### Ch1 Common (Ch2 Common)

Potential reference of Pin 1 of the XLR inputs; can only be selected if Input is set to "Bal".

"Float" must always be set if the analyzer inputs are disabled or connected to the internal generator.

If both channels have the same settings (2 = 1 or 1 = 2), only the text "Common" appears to the left of the selection field.



#### Float

The connection between XLR Pin 1 and instrument ground is interrupted by means of a tripped contact. The permissible voltage to EN 61010-1 is 30 V AC or 70 V DC with respect to the instrument housing.

Remote-control command:  
INPut[1]|2:COMMON FLOat

#### Ground

XLR Pin 1 is connected to the instrument ground (PE conductor). The ground reference is cancelled if the analyzer is later switched to the internal generator or the set balanced channel is disabled.



#### Important:

Measurement potential reference only; not a safety connection to VDE 0411!

#### Note:

*If an XLR/BNC adapter (UPL-Z1) is used, XLR Pins 1 and 3 are connected by means of the adapter. Float/Ground switching therefore allows the potential reference of the BNC outer conductor to be selected (see also Figure 4-13).*

#### Warning:

*If dangerous contact voltages  $U_{rms} > 30$  V are to be measured, the user must ensure that the outer conductor of the used BNC/XLR adapter is safely connected to protective earth.*

Remote-control command:  
INPut[1]|2:COMMON GROund



If the signal is to be supplied via unbalanced analyzer inputs, it is advisable to use the XLR/BNC adapter R&S UPL-Z1. The internal connection of this adapter is shown in the illustration below.

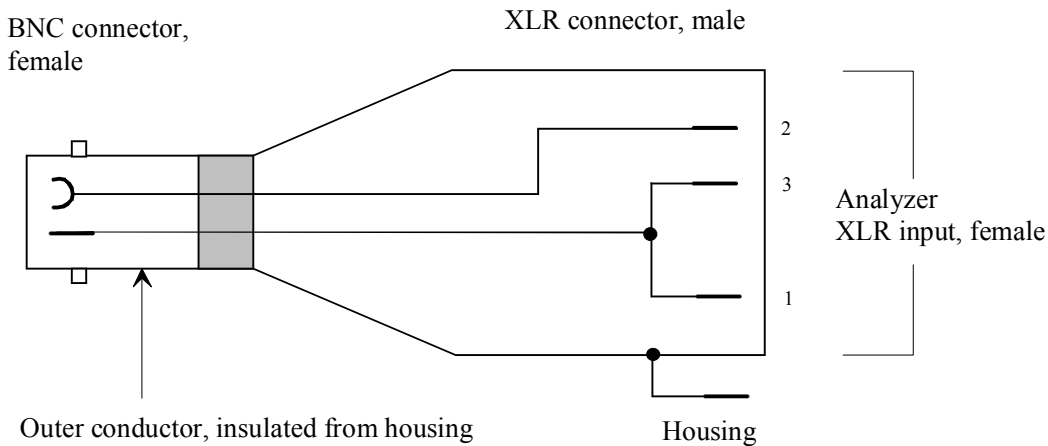
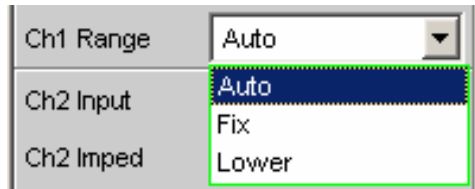


Figure 4-13 XLR/BNC adapter UPL-Z1

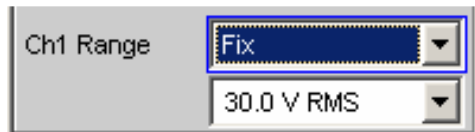
**Ch1 Range**  
(Ch2 Range)

The possibility of selecting the measuring range allows optimum adaptation to a voltage range required for a specific measurement task. When the selection window is opened, the user can toggle between 3 modes.

If both channels have the same settings (2 = 1 or 1 = 2), only the text "Range" appears to the left of the selection field.



If the Fix or Lower mode is selected, the set nominal range value appears in the next field where a new range can be set by opening the selection window.



Remote-control command:  
SENSe[1]:VOLTage:RANGe[1]|2:VALue <n> [V]

**Auto** Automatic measuring range selection. The optimum range is set separately for each channel; this also applies to the channel settings "2 = 1" or "1 = 2".

Remote-control command:  
SENSe[1]:VOLTage:RANGe[1]|2:MODE AUTO

**Fix** The set measuring range is fixed.

---

**Note:**

*Switching from Auto to Fix causes the range currently valid for the channel to be adopted. If Channel is set to "2 = 1" or "1 = 2", the less sensitive range is adopted by Channel 1 and 2.*

---

Remote-control command:

```
SENSE[1]:VOLTage:RANGe[1]|2:MODE FIX
```

**Lower** The set measuring range is fixed as the lowest range; in the case of overranging, this range is automatically substituted by higher ranges.

Remote-control command:

```
SENSE[1]:VOLTage:RANGe[1]|2:MODE LOWER
```

If Channel 1 & 2 is selected, the fields "Ch2 Input" to "Ch2 Range" appear after this parameter block. In these fields, settings different to those for Channel 1 can be made for Channel 2.

The ranges are graduated in steps of 5 dB from 18 mV to 100 V and allow optimum dynamic response when measuring non-linear distortion. If "Auto" (automatic range selection) is set, overranging or underranging of the limits in a current measuring range causes the instrument to switch to the next step. This is also the case for the "Lower" range setting; here, however, the instrument only goes down to the selected range limit.

The range values are RMS values for sinewaves or other signal shapes up to a crest factor of  $\sqrt{2}$ .

With the DC measurement function, the ranges are graduated in 10 dB steps from 100 mV to 100 V. Selecting a different range causes internal setting of the next least sensitive, valid range.

**Ref Imped**

Reference value for impedance.

The screenshot shows a control panel for 'Ref Imped'. It consists of a text box containing the value '600.0000', a vertical scroll bar to its right, and a unit symbol 'Ω' to the right of the scroll bar.

Reference impedance for the indicated power in the units dBm, W, Δ%W, ΔW, P/Pr and %P/Pr.

The power is calculated using the following formula:

$$P = \frac{U^2}{R}$$

where U is the measured voltage and R is the set reference impedance. The indicated power is only correct if the reference impedance is identical to the resistance of the DUT.

Remote-control command:

```
SENSe[1]:POWer:REFerence:RESistance <nu>
```

**Start Cond**

Indicates the event which triggers a measurement.

The screenshot shows a control panel for 'Start Cond'. It features a dropdown menu with 'Auto' selected, and a small downward-pointing arrow to the right of the menu.

Depending on the selected "Start Cond", measurement begins either immediately (Auto) or only if the desired trigger condition has been satisfied. Details see section ["Start Conditions"](#) on page 4.141.

**Delay**

Delay for Start Cond.

The screenshot shows a control panel for 'Delay'. It consists of a text box containing the value '0.000000', a vertical scroll bar to its right, and a unit symbol 's' to the right of the scroll bar.

A delay can be entered if "Auto" is selected as the Start Cond. Details see section ["Start Conditions"](#) on page 4.141.

# Configuring the Digital Analyzer

## Digital Analyzer Configuration Panel

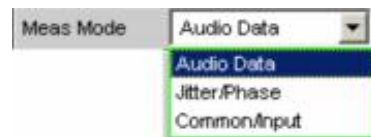
The configuration panel is used to set up the analog and digital analyzer.

The configuration options for the digital analyzer are described below.

### Meas Mode

Meas Mode specifies what is to be measured at the digital interfaces. With digital audio interfaces, there are basically two signal types which have to be measured, i.e. the interface signal and the encoded audio signal itself.

Apart from the encoded audio signal (Audio Data), the R&S UPV can also measure various noise signals (impairments) at the interface: Shifting of the signal edges (jitter) or superimposition of a common-mode voltage on the balanced digital lines (common mode). The internal analog analyzer is used for measuring such signals.



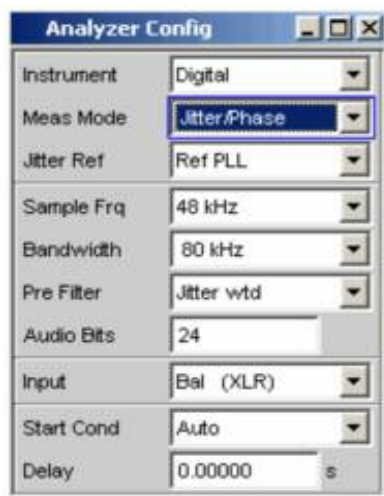
### Audio Data



The data content of the selected digital audio input is extracted from the digital audio signal and analyzed.

The Analyzer Config panel contains the selection fields relevant for this Meas Mode.

Remote-control command:  
SENSE:DIGital:MMODE ADATA

**Jitter/Phase**

Measurement of jitter signals at the digital audio inputs.

Measurement of a frame phase offset of the digital audio signal between the front input and AUX input.

The digital interface signal has analog parameters on which, for example, noise or other interference signals can be superimposed – this interference is also noticeable as shifting of the signal edges. When this effect (known as "jitter") exceeds a certain magnitude, it becomes impossible to decode or regenerate the audio signal correctly. Here, the decoders used in practice often behave differently which means that it may be advisable to perform measurements across the entire range of jitter compatibility, for example.

The value of the jitter and delay fault is normally given in UI (Unit Interval). One UI is defined as the smallest pulse width of the digital audio signal (eye width) and does not depend on the selected sampling rate. One UI corresponds to the clock period with which the digital signal is clocked ("biphase clock"). With digital audio signals, one UI corresponds to 128<sup>th</sup> of the sampling period; at 48 kHz, one UI is 163 ns.

If several digitally encoded signals are merged (common practice in, for example, studio engineering), the phase position of the frames in the digital audio signals (i.e. the components which contain the sample value of the left and right-hand channel) plays a significant role. Using the R&S UPV, this shift can be measured as the phase between the digital input (on the front panel) and the reference channel (AUX input on the rear panel).

Remote-control command:  
SENSE:DIGital:MMODE JPhase

**Common/Input**



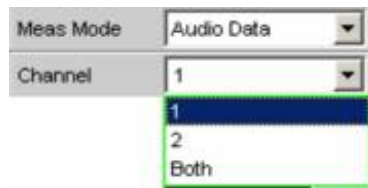
Measurement of the common signal at the digital BAL input.  
The DIGITAL INPUT amplitude can be measured at the BAL or UNBAL input.

As is customary in analog technology, balanced cables are also used for digital audio signal links. Here, interference (e.g. from ground loops) occurs as common-mode voltage at the interfaces.

Remote-control command:  
SENSe:DiGital:MMODE CINPut

**Channel**

Used to set the active measurement channel in the Meas Mode "Audio Data".  
Used to select the audio data for the left-hand channel (Ch1), right-hand channel (Ch2) or both channels.



If a single-channel measurement is selected (Ch1 or Ch2), the data content of the other channel is not taken into consideration.

**1** Only the signal on the left-hand channel is measured.

Remote-control command:  
INPut:CHANnel CH1

**2** Only the signal on the right-hand channel is measured.

Remote-control command:  
INPut:CHANnel CH2

**Both** Both channels are measured (stereo).

Remote-control command:  
INPut:CHANnel BOTH

**Jitter Ref**

Used to select the jitter reference clock (only available for jitter measurement).

If jitter is to be measured, a reference clock must be available. The internal oscillator (generator clock) can be used for this purpose. Alternatively, a reference PLL (Phase Locked Loop) can also be used if the DUT is not synchronized to the generator of the R&S UPV. The PLL has a lower limit frequency for the obtained jitter signal; if the frequency drops below this limit, the PLL changes with the jitter signal. The clock rate of the jitter reference must be the same as the clock rate of the digital audio signal at the input. The clock of the digital audio generator or the clock obtained from the jitter reference PLL of the analyzer is provided for this purpose.

**Internal CLK**

The internal clock generator is used for the jitter reference. It is always best to use this setting if the digital audio signal to be measured is supplied by the digital audio generator of the R&S UPV and this generator is running at the internal clock rate. In this case, no lower limit frequency has to be taken into consideration for the jitter measurement.

Remote-control command:  
 SENSE:DIGital:JITTer:REFerence  
 INTClock

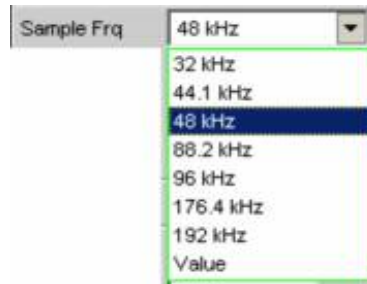
**Ref PLL**

The reference signal is the clock signal obtained from the digital audio input signal using the jitter reference PLL. The lower limit frequency of this PLL must be taken into consideration for the jitter measurement; if the frequency drops below this limit, the reference signal changes with the jitter signal and a low jitter value is measured. The limit frequency of the jitter reference PLL is approx. 500 Hz.

Remote-control command:  
 SENSE:DIGital:JITTer:REFerence REFPl1

**Sample Frequency**

Used to set the clock rate of the digital audio signal for the analyzer. The sample frequency setting is used as a reference for all audio data frequency measurements.



If the entered frequency does not correspond to the applied frequency, all filters and frequency measurements are shifted accordingly with respect to frequency.

When jitter measurements are performed and the jitter-reduced digital audio signal is output at the AUX output (reclock function), this parameter is used to select the correct range for the reference PLL.

Value range for numeric entries:

30 kHz to 200 kHz

Standard sampling frequencies can be set directly in the selection field.

Synchronization ranges for the jitter reference PLL:

30 kHz to 64 kHz (base rate range)

65 kHz to 128 kHz (high rate range)

129 kHz to 200 kHz (extended rate range)

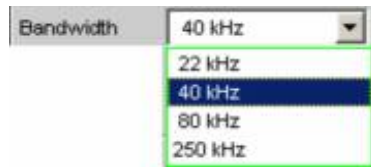
<b>32 kHz</b>	Standard sampling rate 32 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F32
<b>44.1 kHz</b>	Standard sampling rate 44.1 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F44
<b>48 kHz</b>	Standard sampling rate 48 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F48
<b>88.2 kHz</b>	Standard sampling rate 88.2 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F88
<b>96 kHz</b>	Standard sampling rate 96 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F96



- 176.4 kHz**      Standard sampling rate 176.4 kHz  
 Remote-control command:  
 INPut:SAMPlE:FREQuency:MODE F176
- 192 kHz**      Standard sampling rate 192 kHz  
 Remote-control command:  
 INPut:SAMPlE:FREQuency:MODE F192
- Value:**      Variable entry for sampling rate  
 Remote-control command:  
 INPut:SAMPlE:FREQuency:MODE VALue

**Bandwidth**

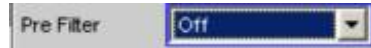
With impairment analysis, jitter and common signals are measured up to this bandwidth setting.



- 22 kHz**      Analog analyzer bandwidth 22 kHz  
 Remote-control command:  
 INPut:BANDwidth:MODE B22
- 40 kHz**      Analog analyzer bandwidth 40 kHz  
 Remote-control command:  
 INPut:BANDwidth:MODE B40
- 80 kHz**      Analog analyzer bandwidth 80 kHz  
 Remote-control command:  
 INPut:BANDwidth:MODE B80
- 250 kHz**      Analog analyzer bandwidth 250 kHz  
 Remote-control command:  
 INPut:BANDwidth:MODE B250

**Pre Filter**

The selected prefilter affects all measurement functions. This means that prefiltering is possible without having to select the required filter for every single measurement function.



The description or characteristic of the various filters is found in section *"Filters"* on page 4.240.

Remote-control command:  
INPut:FILTer

**Audio Bits**

Wordwidth used by the digital audio analyzer in the Meas Mode "Audio Data".

Value range: 8 to 24

If the wordwidth is reduced, the values of the audio samples are trimmed down to the specified wordwidth. Reduced wordwidth results in a corresponding reduction in dynamic response.



Remote-control command:  
INPut:AUDIobits <n>

**Input**

Used to select the input interface for the digital audio analyzer:

In the Meas Mode "Common/Input" (R&S UPV-B22 option), the common-mode signal is always measured at the XLR socket (BAL) regardless of which digital input is selected. The "DIG INP AMP" measurement is performed at the selected input (BAL or UNBAL). The Common/Input measurement is not possible for the optical input or if "Intern" is selected.



**Bal (XLR)**      Balanced digital audio input (XLR).

Remote-control command:  
INPut:TYPE BALanced

**Unbal (BNC)**      Unbalanced digital audio input (BNC).

Remote-control command:  
INPut:TYPE UNBalanced

<b>Optical</b>	Optical digital audio input (TOSLINK).  Remote-control command: INPut:TYPE OPTical
<b>Intern</b>	Internal at digital audio generator output. Loop measurement possible without connected cable.  Remote-control command: INPut:TYPE INTern

**Start Cond**

Indicates the event which triggers a measurement.

A screenshot of a software interface showing two settings. The first is 'Start Cond' with a dropdown menu currently displaying 'Auto'. The second is 'Delay' with a text input field containing '0.00000' and a unit selector 's'.

Depending on the "Start Cond" selected, the measurement starts either immediately (Auto) or only once the required trigger condition is met. For details, see section ["Start Conditions"](#) on page 4.141.

**Delay**

Delay for Start Cond.

A screenshot of a software interface showing a single setting. It is 'Delay' with a text input field containing '0.00000' and a unit selector 's'.

The "Delay" setting determines the time which must elapse between the above-mentioned events and restarting of the measurement so that, for example, a DUT has sufficient time to settle.

You can enter a delay for menu item Start Cond "Auto". For details, see section ["Start Conditions"](#) on page 4.141.

# Configuring the I<sup>2</sup>S Analyzer

## I<sup>2</sup>S Analyzer Configuration Panel

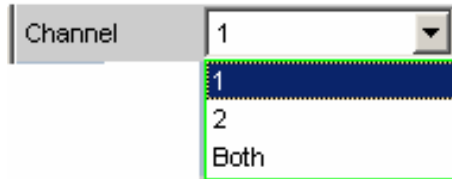
The Analyzer Config panel enables you to enter settings for the analog or digital analyzer.

The configuration options for the I<sup>2</sup>S analyzer are described below.

### Channel

Used to set the currently active measurement channel.

Used to select the audio data for the left channel (Ch1), right channel (Ch2) or both channels.



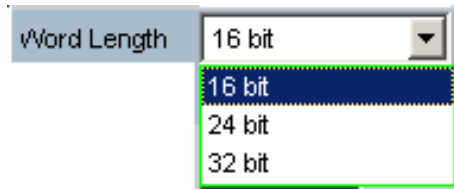
If a single-channel measurement is selected (Ch1 or Ch2), the data content of the other channel is not taken into consideration.

- |             |   |
|-------------|---|
| <b>1</b>    | Only the signal on the left channel is measured.<br><br>Remote-control command:<br>INPut:CHANnel CH1  |
| <b>2</b>    | Only the signal on the right channel is measured.<br><br>Remote-control command:<br>INPut:CHANnel CH2 |
| <b>Both</b> | Both channels are measured (stereo).<br><br>Remote-control command:<br>INPut:CHANnel BOTH             |

**Word Length**

Word length of a data frame for each channel.

Value range: 16, 24, 32



**16 bit**

Word length 16 bits

Remote-control command:  
INPut:AUDiobits W16

**24 bit**

Word length 24 bits

Remote-control command:  
INPut:AUDiobits W24

**32 bit**

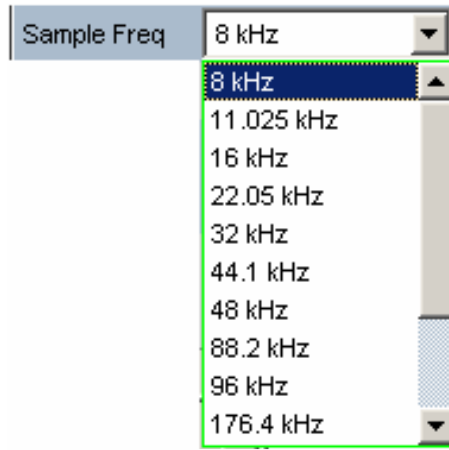
Word length 32 bits

Remote-control command:  
INPut:AUDiobits W32

**Sample Frequency**

Used to set the sampling frequency.

The sampling frequency corresponds to the frequency of the FSYNC signal. All frequency information of generated audio data is with reference to this setting.



If the selected frequency does not correspond to the applied frequency, all filters and frequency measurements are shifted accordingly with respect to frequency.

Value range for numeric entry:  
6.75 kHz to 410 kHz

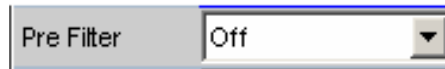
Standard sampling frequencies can be set directly in the selection field.

<b>8 kHz</b>	Standard sampling rate 8 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F08
<b>11.025 kHz</b>	Standard sampling rate 11.025 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F11
<b>16 kHz</b>	Standard sampling rate 16 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F16
<b>22.05 kHz</b>	Standard sampling rate 22.05 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F22
<b>32 kHz</b>	Standard sampling rate 32 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F32

<b>44.1 kHz</b>	Standard sampling rate 44.1 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F44
<b>48 kHz</b>	Standard sampling rate 48 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F48
<b>88.2 kHz</b>	Standard sampling rate 88.2 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F88
<b>96 kHz</b>	Standard sampling rate 96 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F96
<b>176.4 kHz</b>	Standard sampling rate 176.4 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F176
<b>192 kHz</b>	Standard sampling rate 192 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F192
<b>384 kHz</b>	Standard sampling rate 384 kHz  Remote-control command: INPut:SAMPlE:FREQuency:MODE F384
<b>Value:</b>	Variable sampling rate entry  Remote-control command: INPut:SAMPlE:FREQuency:MODE VALINPut:SAMPlE:FREQuency <nu>

**Pre Filter**

The selected prefilter affects all measurement functions. This means that prefiltering is possible without having to select the required filter for every single measurement function.



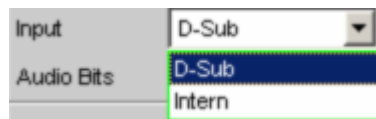
**Off** Used to deactivate the prefilter.

Remote-control command:  
INPut:FILTer OFF

... A description and the characteristics of the various filters are given in the filter description in the Analyzer Function panel.

**Input**

Used to select the data source for the I<sup>2</sup>S audio analyzer:



**D-Sub** The D-Sub connector at the rear of the instrument is selected as the input.

Remote-control command:  
INPut:INPut DSUB

**Intern** The internal generator is selected as the input. A loop measurement can be performed without a connected cable being required (loopback test).

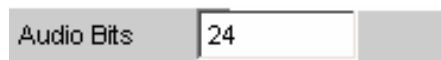
Remote-control command:  
INPut:INPut INT

**Audio Bits**

Word width of audio data that is analyzed.

If the word width is reduced, the values of the audio samples are rounded off to the specified word length. A reduced word length leads to a reduction in the dynamic range.

Value range: 8 ... "Word Length"



Remote-control command:  
INPut:AUDIobits <n>



**Format**

Selection of the I<sup>2</sup>S analyzer format.



**Standard I2S** The I<sup>2</sup>S analyzer receives in the standard I<sup>2</sup>S format. The following format-influencing parameters are assigned a fixed default:

Fsync Slope Left(1) = Falling  
 Word Offset -1

Remote-control command:  
 INPut:FORMat SI2S

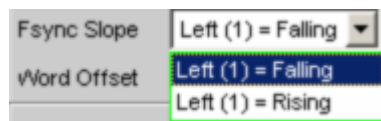
**User-definable** The I<sup>2</sup>S analyzer receives in I<sup>2</sup>S-like format. The following format-influencing parameters are additionally available:

Fsync Slope  
 Word Offset

Remote-control command:  
 INPut:FORMat USER

**Fsync Slope**

Polarity of the Fsync signal.



**Left (1) = Falling** At a Word Offset of 0, a falling edge of the signal marks the beginning of the left data word (channel 1).

Remote-control command:  
 INPut:FSlope LFTF

**Left (1) = Rising** At a Word Offset of 0, a rising edge of the signal marks the beginning of the left data word (channel 1).

Remote-control command:  
 INPut:FSlope LFTR

**Word Offset**

By using Word Offset, you can set the number of the SCK cycles by which the Fsync signal is analyzed with delay with respect to the audio data.

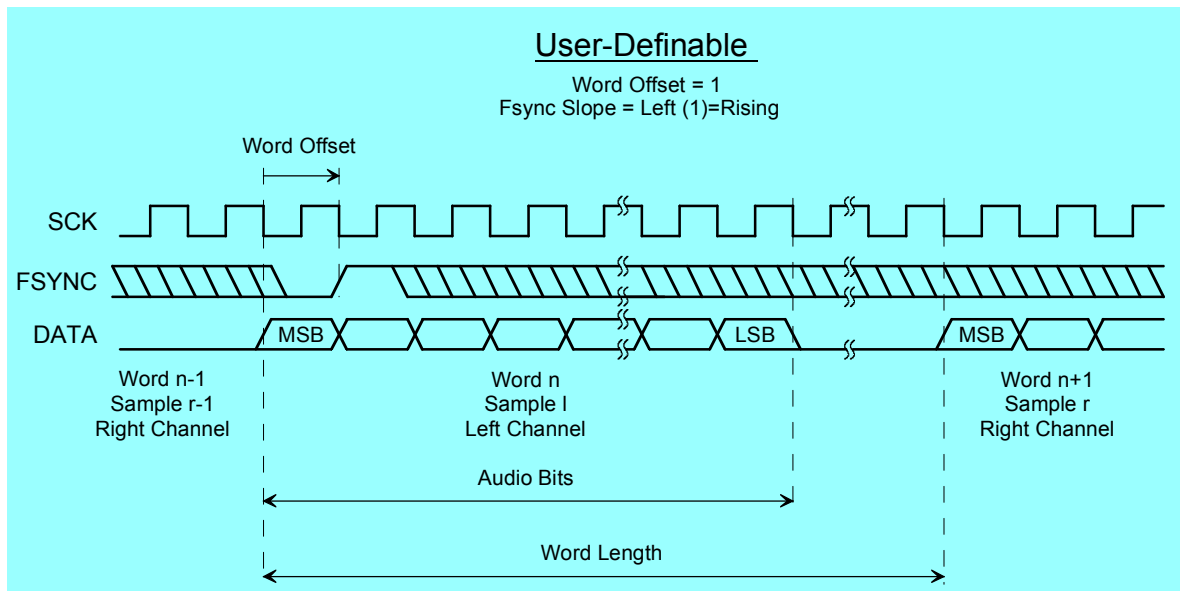
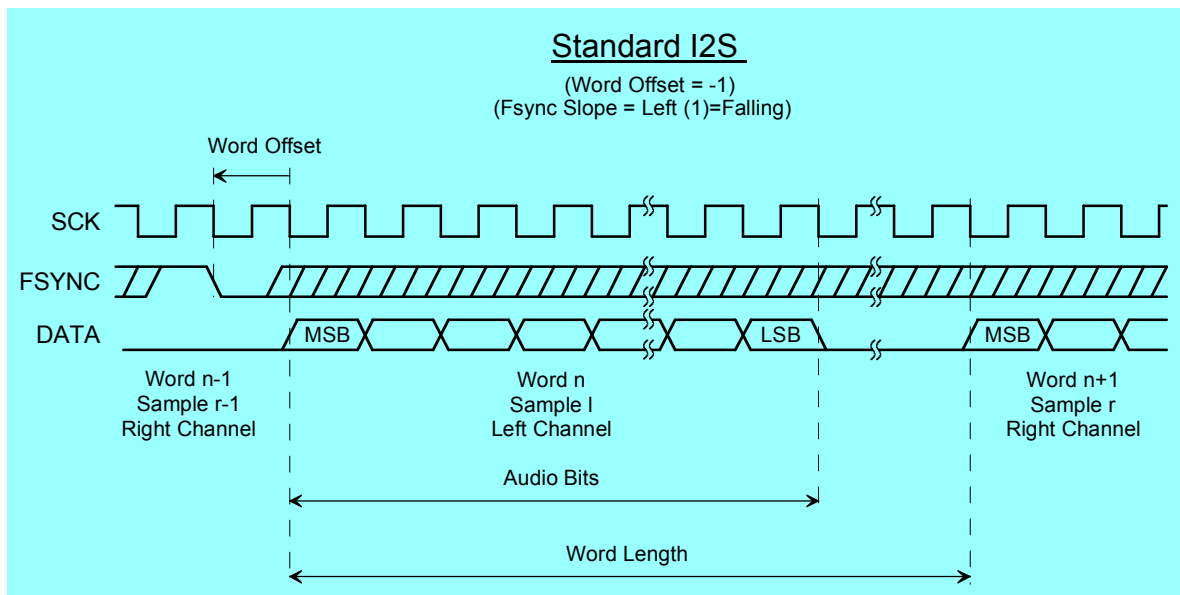
Value range: -"Word Length"... 0 ... +"Word Length"-1



Remote-control command:  
INPut:WRDOffset <n>

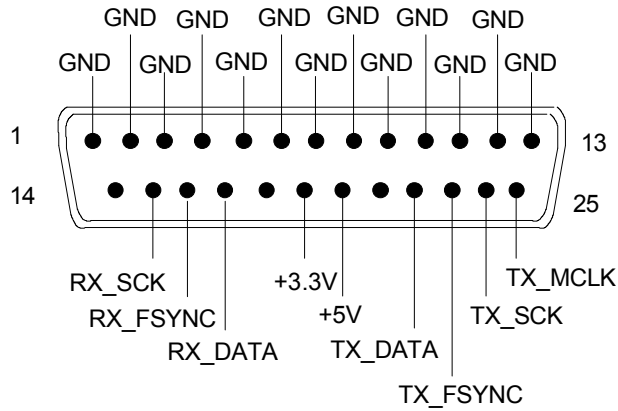
**Timing Diagrams**

A number of configuration examples are shown in the timing diagrams below which illustrate the effect of some parameters.



## Interface Assignment

I<sup>2</sup>S connector (25-contact D-Sub connector)



Pin	Signal	Input (I) Output (O)	Data direction
1	GND		Ground connection
2	GND		Ground connection
3	GND		Ground connection
4	GND		Ground connection
5	GND		Ground connection
6	GND		Ground connection
7	GND		Ground connection
8	GND		Ground connection
9	GND		Ground connection
10	GND		Ground connection
11	GND		Ground connection
12	GND		Ground connection
13	GND		Ground connection
14	not connected		
15	RX_SCK	I	Serial Clock Analyzer
16	RX_FSYNC	I	Frame Sync Analyzer
17	RX_DATA	I	Serial Data Analyzer
18	not connected		

Pin	Signal	Input (I) Output (O)	Data direction
19	+3.3 V (500 mA)	O	Power Supply
20	+5 V (500 mA)	O	Power Supply
21	not connected		
22	TX_DATA	O	Serial Data Generator
23	TX_FSYNC	O	Frame Sync Generator
24	TX_SCK	O	Serial Clock Generator
25	TX_MCLK	O	Master Clock Output Generator

**TX CLK IN (BNC connector)**

Pin	Signal	Input (I) Output (O)	Data direction
1	GND		Ground connection
2	TX_CLK	I	Master Clock Input Generator

## Starting Measurements

In manual operating mode, measurements are started (and also stopped) using the keys "START", "SINGLE" and "STOP/CONT" in the "CONTROL" panel. The effect of these keys depends on whether or not the sweep system is active:

- The measurement system can only be directly controlled using the keys if the sweep system is *inactive*.
- If, however, the sweep system is *active*, the measurement system is controlled by the sweep system and the keys are used to control the sweep system.

## Overview of the Measurement System

The following information refers to a **deactivated sweep system**, i.e. a sweep is not activated in either the generator or the analyzer.

A measurement, in a narrower sense, is the one-off or continuous **recording of measurement values** for all activated measurement types. It can take the form of a *single* measurement value or a *data set* (sample in the time domain, spectral lines in the frequency domain).

The one-off recording of measurement values is referred to as a **single measurement** (see section "[Single measurement](#)" on page 4.139 and continuous recording as a **continuous measurement** (see section "[Continuous measurement](#)" on page 4.138).

The measurement system is controlled

- explicitly using the **control keys** START (Ctrl F5), SINGLE (Ctrl F6) and STOP/CONT (Ctrl F7).
- implicitly by means of "**termination events**". These are events (user entries) which invalidate the measurement currently being performed, i.e. changes in the generator, analyzer or filter bank. Following a termination event, the current measurement is restarted automatically. This ensures that the displayed measurement data is not corrupted by internal switching operations.

## Activating and Deactivating Measurement Types

With the R&S UPV it is possible to record up to 8 different **measurement values** simultaneously and display them numerically and/or graphically. These measurement values are

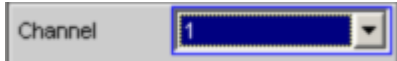
- selected measurement function for channel 1 and 2
- level monitor (RMS or DC downstream of the prefilter) for channel 1 and 2
- input monitor (peak measurement upstream of the prefilter) for channel 1 and 2
- frequency on channel 1; frequency, phase or group delay on channel 2

It is also possible to record a large number of **data sets** which can also be displayed numerically and/or graphically:

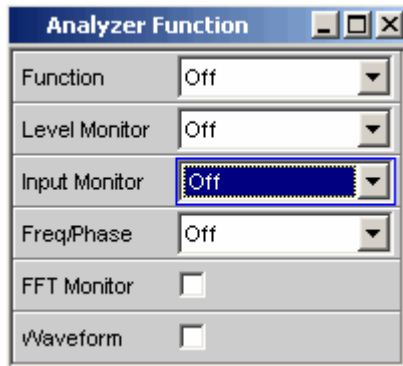
- Post FFT and/or bargraph for channel 1 and 2 with distortion measurements; FFT as measurement function
- FFT Monitor (4 k FFT) for channel 1 and 2
- Waveform (display of the measurement signal in the time domain) for channel 1 and 2

Although the measurement types mentioned above are performed simultaneously and therefore affect each other only slightly with respect to time, it is only possible to display the results of these measurements in sequence. It is therefore recommended to deactivate any measurement types that are not required in order to reduce the total measurement time:

- Switching over to single-channel measurement (in the "Analyzer Config" panel) stops the other measurement channel from being measured and displayed.



- Deactivating individual measurement types (in the "Analyzer Function" panel) stops measurement results which are not required from being recorded and displayed.



All activated measurement types are measured in each (single) measurement. The measurement is not regarded as having been completed until all of the desired results (possibly also with settling) are available. Only then can the sweep be stepped or a triggered measurement result be retrieved by the remote control station. Consequently, the slowest measurement type determines the measurement speed of the entire instrument.

## States of the Measurement System

The states of the measurement system are displayed above the softkeys (channel 1 above the 5<sup>th</sup> softkey and channel 2 above the 6<sup>th</sup> softkey). The current state is also indicated by the two LEDs above the START and SINGLE key.

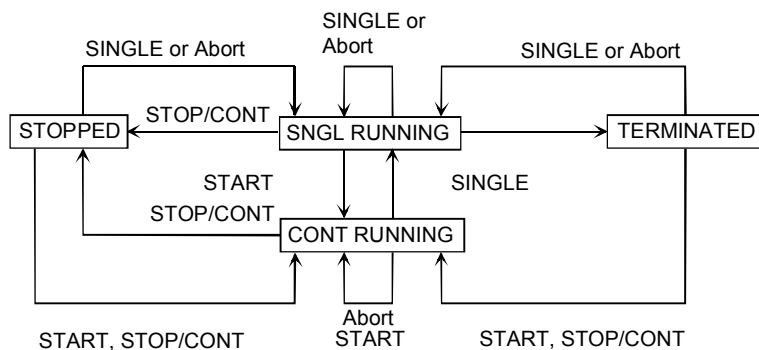


The following states are possible:

Off	Channel is deactivated; measurement values are not recorded on this channel.
Single	Single measurement is being performed.
Cont	Continuous measurement is being performed.
Terminated	(Single) measurement has been terminated.
Stopped	Measurement has been terminated; continuous measurement has been stopped.

The state of a current measurement (e.g. "Rang") or of the terminated measurement (e.g. "Over" if no measurement result is available due to "OVERRANGE") is also indicated.

More detailed information on these status displays can be found in [chapter 3, "Overview of Status Messages"](#).



### Continuous measurement

This is the standard operating mode of the measurement system and is set each time the R&S UPV is switched on. With continuous measurement, only the **START LED** lights up. The R&S UPV measures all activated measurement types continuously until one of the following events occurs:



Pressing the **START** key stops the current measurement immediately, resets the MIN/MAX indicator, the MIN/MAX values and the limit violations of the measurement display, and causes the continuous measurement to be restarted.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key switches the instrument to single measurement mode. Each measurement type first completes the measurement that has already been started; when all measurement types have been completed, the measurement system is in the "Term" (terminated) state. Continuous measurement can be reactivated by pressing the START or STOP/CONT key.



Remote-control command:  
INIT:CONT OFF

Pressing the **STOP/CONT** key stops the current measurement immediately and causes the measurement system to enter the "Stop" state. Continuous measurement can be reactivated using the START key or by pressing the STOP/CONT key again.

Remote-control command: -

#### Termination event

... stops the current measurement immediately and causes the continuous measurement to be restarted (see section ["Overview of the Measurement System"](#) on page 4.136).

#### Single measurement

Each measurement type is performed once only; the measurement system then assumes the "Term" (terminated) state. The measurement does not necessarily have to produce a real result: if an error occurs during the measurement, the measurement result is classed as invalid. "----" appears in the associated measurement window instead of the measurement value; a NAN value ("not a number", 9.97e37) is read out by the remote-control station.

Each single measurement must be triggered again by pressing the SINGLE key or by means of a termination event. The **START LED** and **SINGLE LED** light up in the case of a single measurement. The control keys have the following function *while* a single measurement is being performed:



Pressing the **START** key stops the current single measurement immediately, resets the MIN/MAX indicator, the MIN/MAX values and the limit violations of the measurement display, and causes continuous measurement to be started.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key stops the current measurement immediately and causes the single measurement to be restarted.

Remote-control command:  
INIT:CONT OFF



Pressing the **STOP/CONT** key stops the current measurement immediately and causes the measurement system to enter the "Stop" state. The single measurement is reactivated by pressing the SINGLE key.

Remote-control command: -

#### Termination event

... stops the current measurement immediately and causes the single measurement to be restarted (see section ["Overview of the Measurement System"](#) on page 4.136).



### Terminated measurement

The measurement system only assumes this state when a single measurement is terminated. No further measurements are performed; the measurement values and data sets are frozen until the next measurement is started. Measurement values should only be read out via the remote-control station when the system is in this state. **None of the LEDs** light up when a measurement has been terminated. The control keys have the following function:



Pressing the **START** key resets the MIN/MAX indicator, the MIN/MAX values and the limit violations of the measurement display, and causes continuous measurement to be started.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key causes a single measurement to be started.

Remote-control command:  
INIT:CONT OFF



Pressing the **STOP/CONT** key causes continuous measurement to be started.

Remote-control command: -

### Termination event

... causes a single measurement to be started (see section "[Overview of the Measurement System](#)" on page 4.136).

### Stopped measurement

The measurement system only assumes this state when the STOP/CONT key is pressed while a measurement is being performed. No currently valid measurement values or data sets are available. Measurement values should *not* be read out via the remote-control station when the system is in this state. The control keys have the same function as for a terminated measurement (see "[Terminated measurement](#)").

## Start Conditions

The Analyzer Config panel is used to define which conditions trigger a measurement to be started.

### Start Cond

Indicates the event that triggers a measurement.



Depending on the "Start Cond" selected, the measurement starts either immediately (Auto) or only once the required trigger condition is met.

### Operating principle

"Start Cond" determines when, how often or the conditions under which measurement values are recorded.

If the conditions for recording measurement values are met, the measurement value is triggered, displayed in the measurement result window and stored in a buffer within the R&S UPV. The measurement value list can be displayed either numerically or graphically.

#### Auto

Continuous measuring mode without trigger condition.

Values are recorded in the measurement value buffer only if the frequency sweep for the selective RMS measurement or any type of generator sweep is active at the same time.

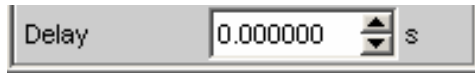
Pressing the "Single" or "Start" key toggles between single and continuous measurement if no sweep is active.

This mode must be switched on to allow the frequency of the selective RMS measurement or the generator to be swept. Performing multiple sweeps at once is not possible.

Remote-control command:  
TRIGger:SOURce AUTO

**Delay**

Delay for Start Cond.



You can enter a delay for menu item Start Cond "Auto". It applies under the following conditions:

- Signal change on the generator (value entry, value change via rotary knob)
- Performance of sweeps
- Pressing of Stop/Cont or Start key (continuous measurement)
- Pressing of Single key (single measurement)
- Change in the Analyzer panels
- Change in the Generator panels
- Change in the Filter panel

The "Delay" setting determines the time that must elapse between the above events and restarting of the measurement so that, for example, a DUT has sufficient time to settle.

---

**Note:**

*The delay is taken into account only with single measurements, i.e. when single measurements in the Start Cond "Auto" mode are triggered by the SINGLE key or continuation of sweep. In the case of continuous measurement, the delay is taken into account only for the first measurement after the start. The remaining measurements are carried out without any delay.*

---

Remote-control command:  
TRIGger:DElay <nu>

## Sweep Options

Apart from the measurement system, the R&S UPV also has a comprehensive sweep system. This sweep system is enabled as a generator sweep system by activating a generator sweep or as an analyzer sweep system by activating the RMS selection sweep, and then takes control of the measurement system.

When a sweep system is activated, sweeps are started and also stopped in manual operating mode using the keys "START", "SINGLE" and "STOP/CONT" in the "CONTROL" panel.

## Overview of the Sweep Options

The following information refers to an **activated sweep system**, i.e. a sweep is activated in either the generator or the analyzer.

Sweeps are measurement cycles in which the individual measurements are triggered by predefined generator and analyzer settings. The generator and analyzer sweeps can be defined either by entering the start value, stop value, spacing and points/step or by specifying a sweep list. Both methods ultimately define a **table of settings** (X axis) which is processed when the sweep is started.

A one-off sweep is referred to as a **single sweep** and a continuously repeated sweep as a **continuous sweep**.

The **active sweep system** is **controlled**

- explicitly using the **control keys** START (Ctrl F5), SINGLE (Ctrl F6) and STOP/CONT (Ctrl F7).
- implicitly by means of "**termination events**". These are events (user entries) which invalidate the current measurement and, therefore, the current sweep, i.e. changes in the generator, analyzer or filter bank. Following a termination event, the current sweep is restarted automatically. This ensures that the recorded data sets are based on the same settings.

It is *not* possible to **control** the **measurement system** if the sweep system is activated. Exception: If a sweep is terminated, "continuous *measurement*" is activated by pressing the **STOP/CONT** key or by means of a termination event (see section "[Terminated sweep](#)" on page 4.147).

The R&S UPV provides a large number of different sweep options. These options are summarized below:

- Generator sweep system: time-synchronous sweeps (DWELL sweeps), analyzer-synchronous sweeps (AUTO sweeps) and manual sweeps (MANU sweeps). They can also be 2-dimensional (provided that more than one sweepable parameter exists for the selected generator function), i.e. 2 generator parameters are varied. This is then referred to as a Z sweep because the Z axis is swept in addition to the X axis.
- Analyzer sweep system: analyzer-synchronous sweep of the RMS selection frequency.

All sweeps can be performed either as parameter sweeps with constant increment or as list sweeps.

## Activating and Deactivating Sweeps

In the R&S UPV, the desired sweep system is activated/deactivated directly in the associated function panel:



- generator sweep under "Sweep Ctrl" in the "Generator Function" panel.
- sweep of the tracking filter for the "RMS Selective" measurement function under "Sweep Ctrl" in the "Analyzer Function" panel.

Only one of the two sweep systems can be active at any one time. If the user activates a sweep while another sweep is already active, the *already active* sweep is deactivated and a warning is issued. If an instrument or function which contains a sweep is activated while another sweep is already active, the new sweep is deactivated and an appropriate warning is issued.

When a sweep is *activated*, the measurement system first continues to run in continuous or single-measurement mode; the sweep system does not assume control of the measurement system until the sweep is started.

When the active sweep is *deactivated*, the measurement system switches back to continuous measurement.

## States of the Sweep System

The state of the sweep system is indicated above the 8<sup>th</sup> softkey. If the sweep system is activated, the current state is also indicated by the two LEDs above the START and SINGLE key.



The following states are possible:

<b>Off</b>	Sweep is deactivated; the measurement system is controlled directly by the user.
<b>Single</b>	Single sweep is being performed
<b>Cont</b>	Continuous sweep is being performed
<b>Waiting</b>	Sweep is waiting for a (re)start; has been reactivated or has been run at least once as a single sweep.
<b>Stopped</b>	Sweep has been stopped; can be continued or restarted.

### Continuous sweep

Continuous sweeps are started with the **START** key. The sweep state is indicated by "Sweep Cont" and illuminated **START LED**. When the sweep reaches the stop value of the X axis or the end of the X sweep list, it starts again at the start value. This is repeated until one of the following events occurs:



Pressing the **START** key stops the current sweep immediately, resets the MIN/MAX indicator, the MIN/MAX values, the limit violations of the measurement display and sweep traces, and causes the continuous sweep to be restarted.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key switches the instrument to single sweep mode. The remaining points are plotted on the trace and the sweep system then enters the "Sweep Waiting" state. The continuous sweep is reactivated by pressing the START key.

Remote-control command:  
INIT:CONT OFF



Pressing the **STOP/CONT** key causes the current measurement to be completed and then stops the sweep system ("Sweep Stopped" state). The continuous sweep is reactivated either using the START key (sweep starts from the beginning) or by pressing the STOP/CONT key again (sweep continues from the point at which it was stopped).

Remote-control command: -

#### Termination event

... stops the current sweep immediately and causes the continuous sweep to be restarted (see section ["Overview of the Sweep Options"](#) on page 4.143).

#### Z stop value reached

The continuous sweep is stopped; the sweep system changes to the "Sweep Waiting" state (only with 2-dimensional generator sweeps, see section ["Two-Dimensional Sweep"](#) on page 4.89).

**Single sweep**

Single sweeps are started by pressing the SINGLE key and are performed once only. When the stop value (of the X axis) has been reached, the sweep system switches to the "Sweep Waiting" state. With a 2-dimensional sweep, every new Z point (and the associated sweep over the X axis) must therefore be retriggered.

The sweep state is indicated by "Sweep Single"; the **START LED** and **SINGLE LED** light up. A current single sweep is interrupted or terminated by the following events:



Pressing the **START** key stops the current sweep immediately, resets the MIN/MAX indicator, the MIN/MAX values, the limit violations of the measurement display and sweep traces, and starts a *continuous* sweep.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key stops the current sweep immediately and causes the single sweep to be restarted.

Remote-control command:  
INIT:CONT OFF



Pressing the **STOP/CONT** key causes the current measurement to be completed and then stops the sweep system ("Sweep Stopped" state). The single sweep is reactivated either using the SINGLE key (sweep starts from the beginning) or by pressing the STOP/CONT key again (sweep continues from the point at which it was stopped).

Remote-control command: -

**Termination event**

... stops the current sweep immediately and causes the single sweep to be restarted (see section ["Overview of the Sweep Options"](#) on page 4.143).

**X stop value reached**

The single sweep is stopped; the sweep system changes to the "Sweep Waiting" state.

Remote-control command: -

**Terminated sweep**

The sweep system only enters this state if a single sweep or a 2-dimensional continuous sweep is terminated. No further measurements are performed; the measurement values, data sets and sweep traces are frozen. Sweep traces should only be read out via the remote-control station when the system is in this state.

The sweep state is indicated by "Sweep Waiting"; **none of the LEDs** light up.

A terminated single sweep is affected by the following events:



Pressing the **START** key resets the MIN/MAX indicator, the MIN/MAX values and the limit violations of the measurement display and sweep traces, and starts a *continuous* sweep.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key causes a single sweep to be restarted.

Remote-control command:  
INIT:CONT OFF



Pressing the **STOP/CONT** key starts "continuous *measurement*". The single sweep is reactivated by pressing the SINGLE key.

Remote-control command: -

**Termination event**

... starts "continuous *measurement*" (see section "[Overview of the Sweep Options](#)" on page 4.143).



**Stopped sweep**

The measurement system only assumes this state when the STOP/CONT key is pressed while a measurement is being performed. Valid measurement values and data sets from the sweep point last set are available. However, only some of the measurement values of the sweep trace are available. Sweep traces should *not* be read out via the remote-control station when the system is in this state.

The sweep state is indicated by "Sweep Stopped"; **none of the LEDs** light up.

A stopped sweep is affected by the following events:



Pressing the **START** key resets the MIN/MAX indicator, the MIN/MAX values and the limit violations of the measurement display and sweep traces, and starts a *continuous* sweep.

Remote-control command:  
INIT:CONT ON



Pressing the **SINGLE** key causes a single sweep to be restarted.

Remote-control command:  
INIT:CONT OFF



Pressing the **STOP/CONT** key restarts the sweep from the point at which it was stopped.

Remote-control command: -

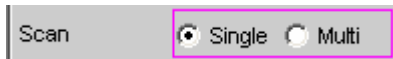
**Termination event**

... starts "continuous *measurement*" (see section "[Overview of the Sweep Options](#)" on page 4.143).

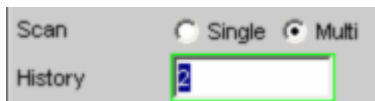
## Several Sweep Traces in One Diagram

Up to 2 traces can be displayed in every sweep window. There are two options for displaying the sweep traces. These options can be selected in the individual sweep windows:

- Each new sweep cycle deletes the old trace; only one trace (or trace pair) is visible at any one time (single-scan mode).



- Each new sweep cycle plots a new trace without deleting the old trace; all recorded traces are visible (multi-scan mode).



Since only a finite number of traces (i.e. the last 20 traces) can be stored in multi-scan mode, all the traces only remain visible until rescaling is performed. When rescaling is performed, the graphical display is deleted and the most recent traces are replotted making the graph easier to read. The number of traces to be replotted can be set in the "History" entry field.

## Level Measurements

The R&S UPV provides various level measurements which can be used to determine the AC or DC voltage component of a measurement signal using various methods.

- "RMS" determines the RMS of any given signal using a broadband analysis, optionally with suppression of a DC component contained in the signal.
- "RMS Selective" determines the RMS of a specific frequency inside or outside a selectable frequency band (by using a band-pass filter or a band-stop filter). Once again, it is possible to suppress a DC component contained in the signal.
- "DC" determines the DC component of any given signal.
- "Quasi Peak" determines the peak value of any given signal, the rise and fall of the measurement value occur with defined time constants.
- "Peak" determines the peak value of any given signal, the measurement value changes with the peak value without a delay.

The voltage of an analog signal is determined in volts and the amplitude of a digital signal is determined in FS. According to AES-17, a full-scale digital sinewave signal has a peak value *and* an RMS of 1.0 FS, i.e. in contrast to the analog signal, the RMS determined for a digital signal is higher by a factor of  $\sqrt{2}$ .

---

**Note:**

*Level measurement is also possible using the FFT analysis by means of integration via the frequency lines. If the measurement function FFT is selected, the RMS determined in this way is displayed as the function measurement value.*

---

The interval during which the level of the measurement signal is monitored can be specified by the user as the measurement time or the interval time.

With AC measurements, other digital filters or (in the analog analyzer) an analog notch filter can be looped into the measurement path in addition to the input filter.

## Filter Settings

### DC Suppress

Used to activate DC suppression (only with RMS measurements in the digital analyzer).



With the level measurements "RMS" and "RMS Selective", the user can decide whether DC levels are to be taken into consideration or suppressed in the RMS.

This parameter field is not available in the analog analyzer because the suppression function is already provided by the AC coupling which can be set up using the hardware.



DC suppression deactivated.

The DC component of the measurement signal is *not* suppressed ("DC coupling") and is included in the measurement result.

Remote-control command:

```
SENSe[1]:FUNction:DCSuppression OFF
```



DC suppression activated.

The DC component of the measurement signal is suppressed ("AC coupling"); the measurement result includes the AC component only.

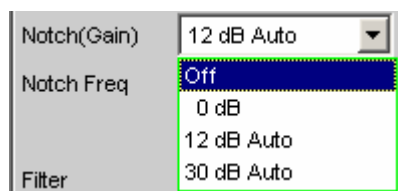
For DC suppression in the digital analyzer, the DC level is measured and subtracted from the total RMS value.

Remote-control command:

```
SENSe[1]:FUNction:DCSuppression ON
```

**Notch(Gain)**

Used to activate/deactivate the analog notch filter and select the post-gain. Only with AC level measurements in the analog analyzer.



The second-order analog notch filter can be activated for narrowband suppression of an unwanted frequency line. If the fundamental is suppressed with the notch filter, the residual signal can be amplified in order to increase the dynamic response. Three notch gain levels are available.

---

**Note:**  
*If frequency components occur outside the analyzer frequency range (out-of-band signals), the notch gain could cause overloading of the analyzer. In this case, the notch gain is reduced automatically, which is indicated by "Auto" in the list items 12 dB and 30 dB.*

---

- Off**                      The notch filter is *deactivated*; no additional parameter fields are displayed.

Remote-control command:  
 SENSE[1]:NOTCh OFF
- 0 dB**                      The notch filter is *activated*; the notch gain is *deactivated*. The notch frequency can be selected in the next parameter field.

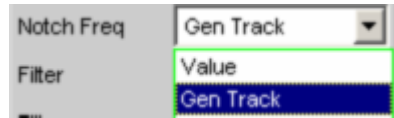
Remote-control command:  
 SENSE[1]:NOTCh DB0
- 12 dB Auto**              The notch filter is *activated*; the notch gain is 12 dB (is deactivated if out-of-band signals occur). The notch frequency can be selected in the next parameter field.

Remote-control command:  
 SENSE[1]:NOTCh DB12
- 30 dB Auto**              The notch filter is *activated*; the notch gain is 30 dB (is reduced gradually to 12 or 0 dB if out-of-band signals occur). The notch frequency can be selected in the next parameter field.

Remote-control command:  
 SENSE[1]:NOTCh DB30

**Notch Freq**

Used to select the center frequency of the notch filter (notch frequency); only with activated analog notch filter.

**Value**

The user can enter the notch-filter center frequency in the next parameter field. If "Value" is selected, the center frequency last active is displayed.



Remote-control command:  
 SENSE[1]:NOTCh:FREQuency:MODE FIXEd  
 SENSE[1]:NOTCh:FREQuency <nu>

**Gen Track**

The notch-filter center frequency is adopted from the generator panel (if possible). If the generator frequency is changed, the notch frequency also changes. If an unsuitable generator signal (e.g. noise) is set, an error message is output and the center frequency last valid is retained.

**Note:**

*If the Low-Distortion Generator option is used, "Gen Track" should be avoided on account of the rigid coupling to the generator's nominal frequency, otherwise measuring inaccuracy resulting from slight frequency offset could occur.*

Remote-control command:  
 SENSE[1]:NOTCh:FREQuency:MODE GENTrack

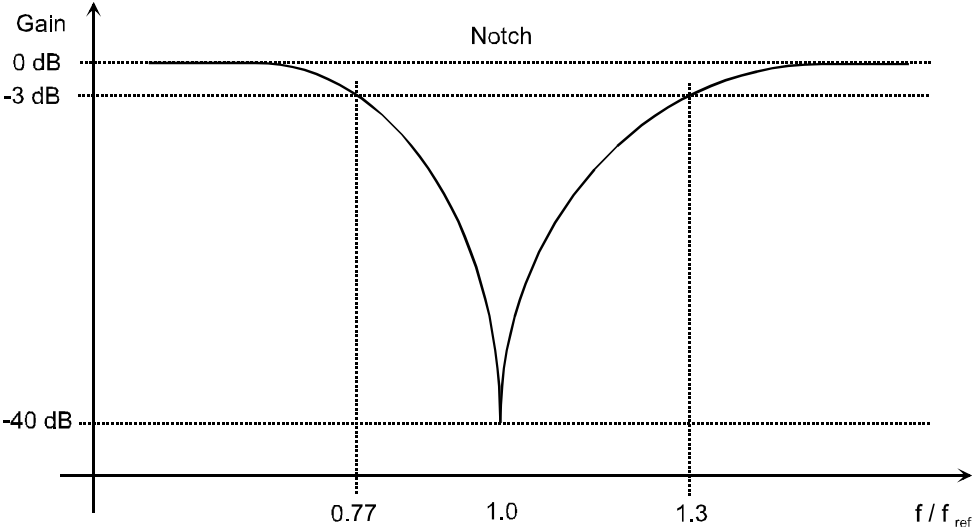
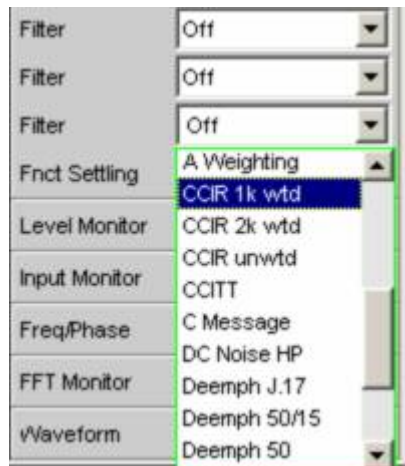


Figure 4-14 Characteristic of analog notch filter

**Filter**

Used to activate a digital filter in the measurement path. Depending on the selected level measurement method, up to 3 user-defined filters or weighting filters can be looped into the measurement path:

- RMS: max. 3 filters
- RMS Selective: max. 1 filter in addition to selection filter
- Peak: max. 3 filters
- Quasi Peak: max. 3 filters
- DC: *no* filters
- FFT: max. 3 filters



The user-defined filters are configured as Filter 01 to 09 in the Filter panel (see section ["User-Definable Filters"](#) on page 4.243) and can then be used in the analyzer (more than once if required).

The selectable weighting filters are described in section ["Weighting Filters"](#) on page 4.252.

**Note:**

*Irrespective of the digital filters selected here, it is also possible to loop an additional input filter ("Pre Filter") into the measurement path. Furthermore, the analog bandwidth can be limited using the "Bandwidth" parameter field, which has the same effect as an additional low-pass filter.*

Remote-control command:  
 SENSE[1]:FILTer2 <parameter>  
 SENSE[1]:FILTer3 <parameter>

List of <parameter>:  
 OFF,  
 UFIL1, UFIL2, UFIL3, UFIL4, UFIL5, UFIL6, UFIL7,  
 UFIL8, UFIL9,  
 AWE, CARM, CCIU, CCIR, CCIT, CMES, DEMP17, DCN,  
 DEMP5015, DEMP50, DEMP75, IECT, JITT, URUM, WRUM



## RMS Measurement, Broadband

Method used to measure the RMS of an AC voltage, either taking account of or disregarding a superimposed DC voltage. Any given signal shape can be measured.

Digital operation:

The true RMS value of the signal content is displayed as a full-scale value from 0.0 to 1.0. Depending on whether "DC Suppress" is activated or deactivated, a superimposed DC component is measured (deactivated) or suppressed (activated).

Analog operation:

Depending on the selected coupling, a superimposed DC component is measured (DC coupling) or suppressed (AC coupling).

Remote-control command:

```
SENSe[1]:FUNction RMS
```

### Meas Time

Used to select the measurement time for adapting the measurement speed to the signal shape or (with single-tone signals) to the signal frequency.

Short measurement times or a high degree of accuracy can be given priority according to the specific measurement requirements.

With the automatic measurement modes, the measurement time is adapted to the (measured) signal frequency, provided that a sufficiently strong AC signal with not too low a frequency ( $f = 10$  Hz) is available.

---

#### Note:

*With severely noise-corrupted or distorted signals and multi-tone signals, the automatic measurement modes (especially "Auto Fast") may no longer be able to clearly detect the signal period. To prevent measurement errors, such signals should therefore be measured using "Gen Track" or (if an external generator is used) using the "Value" measurement mode.*

---

**Auto Fast**

Where possible, the RMS measurement is performed over entire AC periods; with *high* frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed **1 %**.

With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 100 ms (corresponding to 1 period at 10 Hz).



Recommended for single-tone measurements using the low-distortion generator or an unknown external signal source if maximum measurement *speed* is desired.

Remote-control command:  
SENSe[1]:FUNction:APERture:MODE AFAST

**Auto**

Where possible, the RMS measurement is performed over entire AC periods; with *medium or high* frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed **0.05 %**.

With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 200 ms (corresponding to 2 periods at 10 Hz).

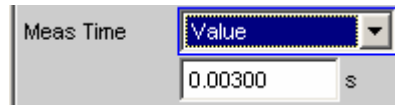


Recommended for single-tone measurements using the low-distortion generator or an unknown external signal source if maximum measurement *accuracy* is desired.

Remote-control command:  
SENSe[1]:FUNction:APERture:MODE AUTO

**Value**

The RMS measurement is performed over a preset time which must be entered in the parameter field below.



To *prevent* errors due to termination of measurements, the selected measurement time should be an integer multiple of the period. If the frequency of the signal to be measured is unknown or not constant, the selected measurement time should be as long as possible in order to *minimize* such errors.

Recommended for

- AC measurements of a known external signal source
- measurements of severely noise-corrupted or distorted signals of unknown frequency
- measurements of noise signals or multi-tone signals

Remote-control command:

```
SENSE[1]:FUNCTION:APERture:MODE VALue  
SENSE[1]:VOLTage:APERture <nu>
```

**Gen Track**

The RMS measurement is performed over (at least) 1 whole period of the generator signal; to allow this, the generator frequency is adapted to the sampling rate of the analyzer, if necessary. With high frequencies, the measurement time is increased to several periods in order to improve measurement accuracy.



Recommended for all AC measurements using the R&S UPV universal generator; particularly suitable for measuring severely noise-corrupted or distorted signals and for fast sweeps.

**Note:**

*If the Low-Distortion Generator option is used, "Gen Track" should be avoided on account of the rigid coupling to the generator's nominal frequency, otherwise measuring inaccuracy resulting from slight frequency offset could occur.*

**Note:**

*If the "Mod Dist" signal is used as the generator signal, the measurement time is based on the (usually dominant) "Lower Frequency".*

**Note:**

*If "Arbitrary" is used as the generator signal, the measurement time is synchronized to the number of samples in the loaded file. As a result, measurement is always performed over a complete period of the (repeatedly output) ARB signal.*

```
Remote-control command:
SENSE[1]:FUNCTION:APERture:MODE
GENTrack
```

See section "[Level Measurements](#)" on page 4.150 for further settings.

## RMS Measurement, Selective

Selective RMS measurement with narrowband band-pass filter or narrowband band-stop filter, either taking account of or disregarding a superimposed DC voltage. If a band-pass filter is used, the desired frequency component is *measured*; if a band-stop filter is used, this component is *suppressed*. Any given signal shape can be measured.

Remote-control command:  
SENSE[1]:FUNCTION RMSSelect

### Meas Time

Used to select the measurement time for adapting the measurement speed to the signal shape or (with single-tone signals) to the signal frequency.

Short measurement times or a high degree of accuracy can be given priority according to the specific measurement requirements.

With the automatic measurement modes, the measurement time is adapted to the (measured) signal frequency, provided that a sufficiently strong AC signal with not too low a frequency ( $f = 10$  Hz) is available.

---

#### Note:

*With severely noise-corrupted or distorted signals and multi-tone signals, the automatic measurement modes (especially "Auto Fast") may no longer be able to clearly detect the signal period. To prevent measurement errors, such signals should therefore be measured using "Gen Track" or (if an external generator is used) using the "Value" measurement mode.*

---

### Auto Fast

Where possible, the RMS measurement is performed over entire AC periods; with *high* frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed **1 %**.

With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 100 ms (corresponding to 1 period at 10 Hz).



Recommended for single-tone measurements using the low-distortion generator or an unknown external signal source if maximum measurement *speed* is desired.

Remote-control command:  
SENSE[1]:FUNCTION:APERTure:MODE AFAST

**Auto**

Where possible, the RMS measurement is performed over entire AC periods; with *medium or high* frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed **0.05 %**.

With very weak, low-frequency or pure DC signals, the maximum measurement time is limited to 200 ms (corresponding to 2 periods at 10 Hz).

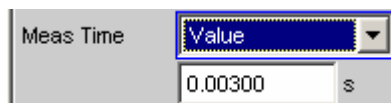


Recommended for single-tone measurements using the low-distortion generator or an unknown external signal source if maximum measurement *accuracy* is desired.

Remote-control command:  
`SENSE[1]:FUNCTION:APERTure:MODE AUTO`

**Value**

The RMS measurement is performed over a preset time which must be entered in the parameter field below.



To *prevent* errors due to termination of measurements, the selected measurement time should be an integer multiple of the period. If the frequency of the signal to be measured is unknown or not constant, the selected measurement time should be as long as possible in order to *minimize* such errors.

Recommended for

- AC measurements of a known external signal source
- measurements of severely noise-corrupted or distorted signals of unknown frequency
- measurements of noise signals or multi-tone signals

Remote-control command:  
`SENSE[1]:FUNCTION:APERTure:MODE VALue`  
`SENSE[1]:VOLTage:APERTure <nu>`

**Gen Track**

The RMS measurement is performed over (at least) 1 whole period of the generator signal; to allow this, the generator frequency is adapted to the sampling rate of the analyzer, if necessary. With high frequencies, the measurement time is increased to several periods in order to improve measurement accuracy.



Recommended for all AC measurements using the R&S UPV universal generator; particularly suitable for measuring severely noise-corrupted or distorted signals and for fast sweeps.

**Note:**

*If the Low-Distortion Generator option is used, "Gen Track" should be avoided on account of the rigid coupling to the generator's nominal frequency, otherwise measuring inaccuracy resulting from slight frequency offset could occur.*

**Note:**

*If the "Mod Dist" signal is used as the generator signal, the measurement time is based on the (usually dominant) "Lower Frequency".*

**Note:**

*If "Arbitrary" is used as the generator signal, the measurement time is synchronized to the number of samples in the loaded file. As a result, measurement is always performed over a complete period of the (repeatedly output) ARB signal.*

Remote-control command:  
SENSe[1]:FUNction:APERture:MODE  
GENTrack

## Bandwidth

Used to select the bandwidth and filter type (band-pass filter **BP...** or band-stop filter **BS...**).

**BP 1 %**  
**BS 1 %**

Band-pass filter / band-stop filter with the relative width of 1 % (geometrically symmetrical around the center frequency).

Bandwidth  (Band-Pass filter)

Bandwidth  (Band-Stop filter)

Remote-control command: -

**BP 3 %**  
**BS 3 %**

Band-pass filter / band-stop filter with the relative width of 3 % (geometrically symmetrical around the center frequency).

Bandwidth  (Band-Pass filter)

Bandwidth  (Band-Stop filter)

Remote-control command: -

**BP 1/12 Oct**  
**BS 1/12 Oct**

Band-pass filter / band-stop filter with the relative width of one twelfth octave (geometrically symmetrical around the center frequency).

Bandwidth  (Band-Pass filter)

Bandwidth  (Band-Stop filter)

The relative bandwidth of one twelfth octave is ~ 6 %.

(Calculated from  $\sqrt[24]{2} - \frac{1}{\sqrt[24]{2}} = 0.0577 = 5.77\%$ )

Remote-control command: -



**BP 1/3 Oct**  
**BS 1/3 Oct**

Band-pass filter / band-stop filter with the relative width of one third octave (geometrically symmetrical around the center frequency).



The relative bandwidth of one third octave is ~ 23 %.  
(Calculated from  $\sqrt[6]{2} - \frac{1}{\sqrt[6]{2}} = 0.2315 = 23.15\%$ )

**Note:**

*With the third-octave filter, the 0.1 dB bandwidth is reduced until an attenuation of approx. 3 dB is obtained for the cutoff frequencies. The effective bandwidth is therefore smaller than the precise bandwidth determined by calculation.*

Remote-control command: -

**BP 1/3 Oct**  
**Fast**  
**BS 1/3 Oct**  
**Fast**

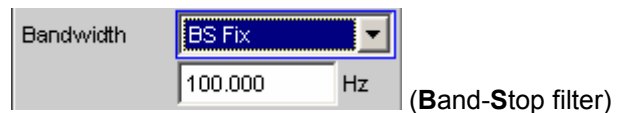
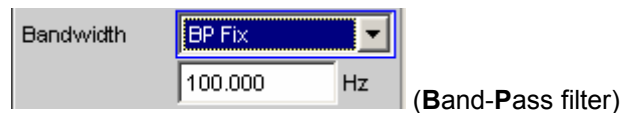
Very fast settling third-octave filter (see above) with only 40 % attenuation.



Remote-control command: -

**BP Fix**  
**BS Fix**

Band-pass filter / band-stop filter with selectable, arithmetically symmetrical bandwidth which must be entered in the parameter field below.



Remote-control command: -

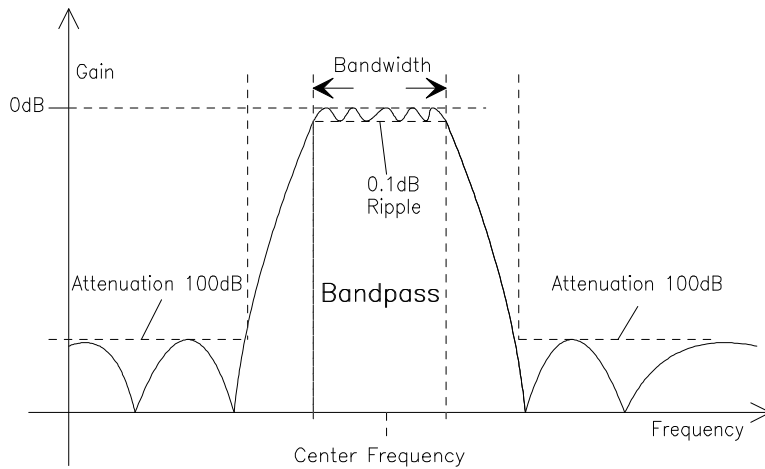
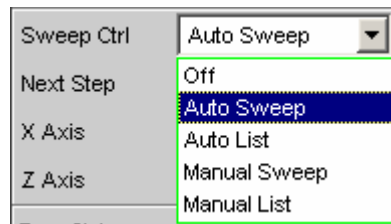


Figure 4-15 Filter characteristic of an RMS Selective band-pass filter

### Sweep Ctrl

Used to activate and configure or deactivate the band-pass sweep / band-stop sweep in the analyzer sweep system.



In the analog analyzer, the notch frequency of the analog notch filter (which can be enabled if required) is also swept.

#### Note:

The sweeps are also deactivated implicitly when the generator sweep is activated.

#### Off

The band-pass sweep / band-stop sweep is *deactivated*; the band center frequency can be specified in the "Freq Mode" parameter field. If the generator sweep system is also deactivated, the START, SINGLE and STOP/CONT keys affect the measurement system:

- START starts a continuous measurement
- SINGLE starts a single measurement or continues an already started continuous measurement as a single measurement.
- STOP/CONT stops an active measurement or starts a stopped or completed measurement as a continuous measurement.

Remote-control command:  
SENSe:SWEep:CONTRol OFF

**Auto Sweep** The band-pass sweep / band-stop sweep is *activated*; the sweep stepping is performed automatically; the sweep axis is calculated from the start value, stop value and step size or point number.

Remote-control command:  
SENSE:SWEEP:CONTROL ASWEEP

**Auto List** The band-pass sweep / band-stop sweep is *activated*; the sweep stepping is performed automatically; the sweep axis is determined from the predefined list of sweep points (usually loaded as a file).

Remote-control command:  
SENSE:SWEEP:CONTROL ALIST

**Manual Sweep** The band-pass sweep / band-stop sweep is *activated*; the sweep stepping is performed manually; the sweep axis is calculated from the start value, stop value and step size or point number.

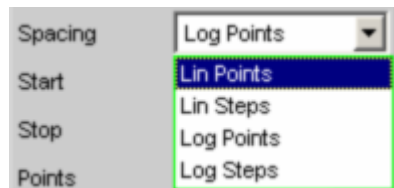
Remote-control command:  
SENSE:SWEEP:CONTROL MSWEEP

**Manual List** The band-pass sweep / band-stop sweep is *activated*; the sweep stepping is performed manually; the sweep axis is determined from the predefined list of sweep points (usually loaded as a file).

Remote-control command:  
SENSE:SWEEP:CONTROL MLIST

**Spacing**

Used to select the sweep range spacing, i.e. the way in which the sweep points are distributed on the sweep axis. Only visible for activated band-pass / band-stop sweep.



**Lin Points** The sweep range is divided linearly by specifying a number of points (linear sweep). This number is entered in the "Points" parameter field.

Should be selected if equidistant, linear spacing of *all* points is required.

Remote-control command:  
SENSe:SWEEp:SPACing LINPoints

**Lin Steps** The sweep range is divided into intervals of a specified linear step size starting at "Start" (linear sweep). This step size is entered in the "Step" parameter field.

Remote-control command:  
SENSe:SWEEp:SPACing LINSteps

**Log Points** The sweep range is divided logarithmically by specifying a number of points (logarithmic sweep). This number is entered in the "Points" parameter field.

Should be selected if equidistant, logarithmic spacing of *all* points is required.

Remote-control command:  
SENSe:SWEEp:SPACing LOGPoints

**Log Steps** The sweep range is divided into intervals of a specified logarithmic step size starting at "Start" (logarithmic sweep). Each sweep point is calculated by multiplying the previous point by a constant factor. This factor is entered in the "Step" parameter field.

Remote-control command:  
SENSe:SWEEp:SPACing LOGSteps

**Start**

Used to enter the start value for the band-pass / band-stop center frequency. Only visible for activated band-pass / band-stop sweep.

Start	<input type="text" value="20000.0"/>	Hz
-------	--------------------------------------	----

The start and stop value implicitly determine the sweep direction: If the start value is less than the stop value, an upward sweep is performed, otherwise a downward sweep will be performed. If a start value identical to the stop value is entered, the stop value is automatically loaded with the old start value. In this way, it is possible to change the sweep direction by entering just one value.

Remote-control command:  
SENSe:SWEep:START <nu>

**Stop**

Used to enter the stop value for the band-pass / band-stop center frequency. Only visible for activated band-pass / band-stop sweep.

Stop	<input type="text" value="20.0000"/>	Hz
------	--------------------------------------	----

The start and stop value implicitly determine the sweep direction: If a stop value identical to the start value is entered, the start value is automatically loaded with the old stop value.

Remote-control command:  
SENSe:SWEep:STOP <nu>

**Points**

Used to enter the number of sweep points for the band-pass / band-stop center frequency. Only visible for activated band-pass / band-stop sweep if "Lin Points" or "Log Points" is set for "Spacing".

Points	<input type="text" value="30"/>
--------	---------------------------------

The sweep range is divided into "Points – 1" (linear or logarithmic) equidistant steps. At least 2 points (start and stop value) are required.

A maximum of 1024 points can be selected.

Remote-control command:  
SENSe:SWEep:POINTs <nu>

**Step**

Used to enter the (linear or logarithmic) step size for the band-pass / band-stop center frequency. Only visible for activated band-pass / band-stop sweep if "Lin Steps" or "Log Steps" is set for "Spacing".

The entry range is limited automatically so that at least one and at most 1023 steps exist (corresponding to 1024 sweep points).

With *linear* step, the size of the step must always be entered, i.e. the numeric value is positive even if the start value is greater than the stop value. The physical unit is the same as that used when specifying "Start" and "Stop".

 (Example for lin. frequency sweep)

With *logarithmic* step, the factor must be entered by which each sweep point is to be multiplied in order to move to the next sweep point. Swapping the start and stop value (reversal of the sweep direction) therefore produces the reciprocal value. The closer the numeric value is to 1.0, the more sweep steps will be performed.

 (Example for log. downward sweep)

**Note:**

*Since the last step of the sweep is automatically adapted such that it corresponds exactly to the stop value, it may deviate by max. 50 % from the selected step size. If this is to be avoided, either the start / stop value must be corrected accordingly or the sweep spacing must be set using the "Points" parameter.*

Remote-control command:  
SENSe:SWEep:STEP <nu>

**Filename**

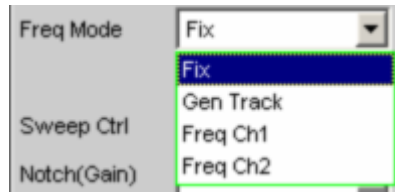
Used to enter the file name for the list of band-pass / band-stop center frequencies (frequency sweep list). Only visible for activated band-pass / band-stop list sweep.



Remote-control command: -

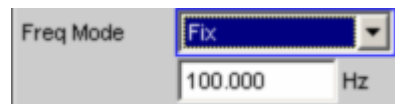
**Freq Mode**

Used to determine the band-pass / band-stop center frequency. In the analog analyzer, this field is used to determine the notch frequency of the analog notch filter (which can be enabled if required).



**Fix**

Fixed band-pass / band-stop center frequency – in the analog analyzers, also the notch frequency if notch is activated. The center frequency must be entered in the parameter field below.



Remote-control command: -

**Gen Track**

The band-pass / band-stop center frequency – in the analog analyzers, also the notch frequency if notch is activated – changes with the generator (*nominal*) frequency. This can be changed by means of manual entry in the Generator Function panel or owing to a generator frequency sweep. By entering a factor in the next parameter field, the user can select whether the center frequency is to be identical to the generator frequency (factor = 1) or a multiple of the generator frequency. Setting a whole number for this factor will allow individual harmonics to be measured.

**Note:**

*If the Low-Distortion Generator option is used, "Gen Track" should be avoided on account of the rigid coupling to the generator's nominal frequency, otherwise measuring inaccuracy resulting from slight frequency offset could occur.*

An error message is output if an unsuitable signal function is selected in the generator (e.g. a multi-tone signal or noise signal).

Recommended when using the internal R&S UPV universal generator.

Remote-control command: -

**Freq Ch1  
Freq Ch2**

The band-pass / band-stop center frequency – in the analog analyzers, also the notch frequency if notch is activated – changes with the frequency measured in Channel 1 and 2.

Recommended when using the low-distortion generator or an external signal source.

Remote-control command: -

**Factor**

Used to enter the factor by which the center frequency of the band-pass filter or band-stop filter is to be higher than the generator frequency. Only visible in "Freq Mode Gen Track".



Setting an integer factor greater than 1 will therefore allow an individual harmonic to be measured. If the fundamental is to be selected, the factor must be set to 1.

**Note:**

*The factor does not affect the notch filter frequency. In "Freq Mode Gen Track", the notch filter is set to exactly the generator frequency without taking "Factor" into consideration so that a higher dynamic response can be achieved by means of (analog) suppression of the fundamental irrespective of the measurement task.*

Remote-control command: -

See section "[Level Measurements](#)" on page 4.150 for further settings.



# Peak Measurement

Measurement of the peak value of any given signal, and the rise and fall of the measurement value all occur without a delay. The measurement value contains both AC and DC components.

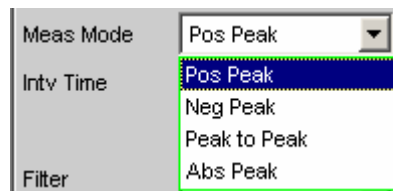
Remote-control command:  
`SENSe[1]:FUNction PEAK`

**Note:**

*If a squarewave signal is applied, it is limited with respect to bandwidth by the upper measurement limit of the selected analyzer, whereby the overshoots occur at the edges (Gibbs phenomenon). The overshoots are also measured during the peak analysis, which means that the returned measurement value may be greater than the input peak. FS values greater than 1 may be measured, especially in the digital range.*

**Meas Mode**

Used to select the measurement mode.



**Pos Peak**      The highest positive voltage value is measured.

Remote-control command:  
`SENSe[1]:FUNction:MMODE PPEak`

**Neg Peak**      The (numerically) highest negative voltage value is measured.

Remote-control command:  
`SENSe[1]:FUNction:MMODE NPEak`

**Peak to Peak**      The difference between the highest and lowest level is measured (peak-to-peak voltage).

Remote-control command:  
`SENSe[1]:FUNction:MMODE PTOPeak`

**Abs Peak**      The numerically highest (positive or negative) voltage value is measured.

Remote-control command:  
`SENSe[1]:FUNction:MMODE PABSolut`

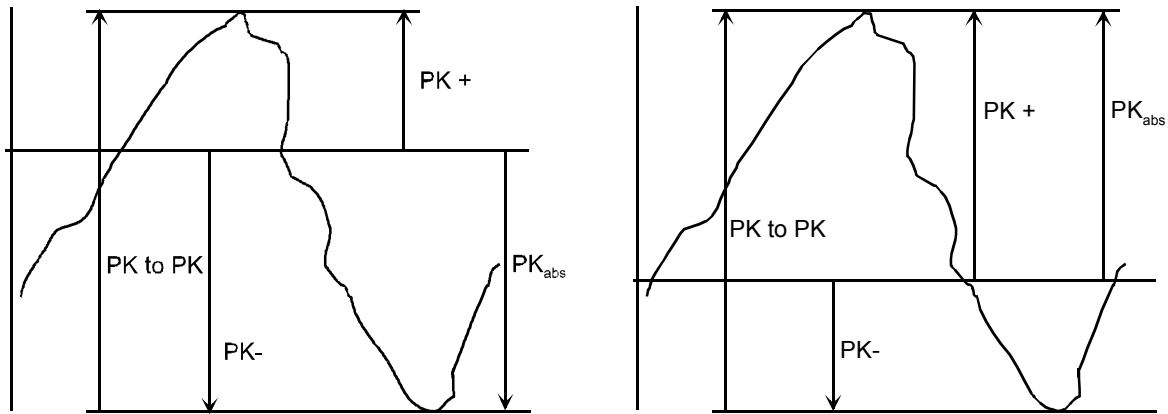
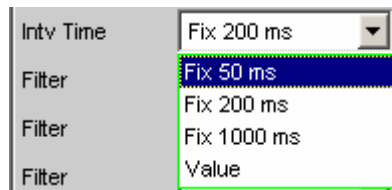


Figure 4-16 Result of Peak measurement on 2 example signals depending on selected measurement mode

### Intv Time

Used to select the measurement interval within which the peak search is to be performed. When the interval time has expired, the peak value memory is reset and the next peak value is sought.



**Fix 50 ms** Measurement interval 50 ms.

Remote-control command:  
SENSE[1]:VOLTage:INTVtime:MODE SFAST

**Fix 200 ms** Measurement interval 200 ms.

Remote-control command:  
SENSE[1]:VOLTage:INTVtime:MODE FAST

**Fix 1000 ms** Measurement interval 1000 ms.

Remote-control command:  
SENSE[1]:VOLTage:INTVtime:MODE SLOW

**Value** The interval time is entered in the parameter field below.



Remote-control command:  
SENSE[1]:VOLTage:INTVtime:MODE VALue  
SENSE[1]:VOLTage:INTVtime <nu>

See section "[Level Measurements](#)" on page 4.150 for further settings.

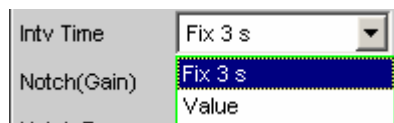
## Quasi Peak Measurement

Measurement of the peak value of any given signal, and the rise and fall of the measurement value all occur with defined time constants. The measurement is implemented as an RFI voltage measurement to CCIR 468-4 and DIN 45405.

Remote-control command:  
`SENSE[1]:FUNCTION QPEak`

### Intv Time

Used to select the measurement interval within which the Quasi Peak measurement is to be performed. When the interval time has expired, the peak value memory is reset and the next peak value is determined.



#### Fix 3 s

Measurement interval 3000 ms.

Remote-control command:  
`SENSE[1]:VOLTage:INTVtime:MODE FIXed`

#### Value

The interval time is entered in the parameter field below.



#### Note:

*In order to obtain settled measurement values, the measurement time should not be less than 3 seconds for triggered measurements and sweeps.*

Remote-control command:  
`SENSE[1]:VOLTage:INTVtime:MODE VALue`  
`SENSE[1]:VOLTage:INTVtime <nu>`

See section "[Level Measurements](#)" on page 4.150 for further settings.

## DC Voltage Measurement

Measurement of the DC voltage component of an analog or digital signal. The setting selected under "Meas Time" determines the method used to measure the DC voltage. One or more superimposed AC components can be suppressed depending on the used measurement method.

If a single AC voltage is superimposed on the DC voltage to be measured, the specified measurement time has different effects with respect to the AC signal period:

- If the measurement time is an integer multiple of the AC signal period, the AC voltage component is not included in the DC measurement result (*integration effect*, steady display).
- If the measurement time is greater than the signal period but is *not* an integer multiple, the measurement value varies over time: The AC voltage component causes fluctuating DC measurement values.
- If the measurement time is less than the AC signal period, the DC measurement result follows the AC voltage characteristic.

With superimposed AC voltage, the selected measurement speed is therefore of great importance.

- If no AC component or noise is superimposed, it is possible to perform measurements with a short measurement time.
- If noise only is superimposed, measurement should be performed with longer measurement times.
- If a *single* AC component of *known* frequency is superimposed, measurement should be performed with a fixed measurement time over entire AC signal periods.
- If a *single* AC component of *unknown* but *constant* frequency is superimposed, measurement can be performed with the fast automatic measurement time ("Auto Fast").
- If *several* AC components are superimposed, measurement should be performed with the slower automatic measurement time ("Auto").

Remote-control command:  
SENSE[1]:FUNCTION DC

**Meas Time**

Used to select the measurement time to adapt the measurement speed to the signal shape or to the signal frequency of a superimposed AC component.

**Auto Fast**

Where possible, the measurement is performed over complete periods of a superimposed AC component; with high frequencies, the measurement time is increased so that the maximum algorithmic error does not exceed 1 %.  
With extremely weak or AC-free signals, the upper limit for the measurement time is increased to 100 ms.



Recommended for signals on which a *single* AC component is superimposed and if the maximum measurement *speed* is to be reached.

**Note:**

*With superimposed noise or multi-tone signals, the signal period can no longer be detected properly. To prevent measurement errors, such signals should therefore be measured using the FFT-based method ("Auto") or using a fixed (but not too short) measurement time ("Value").*

Remote-control command:  
SENSE[1]:FUNCTION:APERTure:MODE AFast

**Auto**

Measurement is performed by FFT analysis of the measurement signal. This allows the DC component to be precisely determined even in the case of a superimposed multi-tone signal.



Recommended for signals on which *several* AC components are superimposed, and for unknown signals.

Remote-control command:  
SENSE[1]:FUNCTION:APERTure:MODE AUTO

**Fix 200 ms**

Measurement is performed over a fixed measurement time of 200 ms.

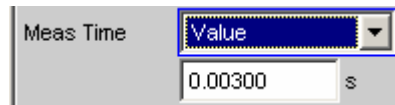


Recommended for signals on which *no* AC components are superimposed.

Remote-control command: -

**Value**

Measurement is performed over a preset time which must be entered in the parameter field below.



A *short* measurement time should be selected only if no significant components (AC or noise) are superimposed on the DC signal.

With superimposed AC voltage of *known* frequency, the measurement time should be an integer multiple of the AC signal period.

With *unknown* signals, the measurement time should be as long as possible (in order to *minimize* measurement errors).

Recommended for

- fast measurement of pure DC signals
- measurement of signals on which a single constant AC component of *known period* is superimposed.

Remote-control command:

```
SENSe[1]:FUNCTION:APERTure:MODE VALue  
SENSe[1]:VOLTage:APERTure <nu>
```

## Distortion Measurements

The R&S UPV provides various methods for measuring distortions. These methods can be used to determine harmonic and intermodulation distortions of a DUT. The measurement signals required in each case can be generated by the internal generator (recommended) or by an external signal source.

- "THD" ("total harmonic distortion") is a distortion measurement over the first 8 harmonics or over any given combination of the first 8 harmonics. The noise between the harmonics is *not* measured. An ultra-pure sinewave signal is required as the measurement signal.
- "THD+N & SINAD" ("total harmonic distortion + noise") is a distortion measurement which measures the energy of the broadband noise *and* (optionally) of all harmonics within a selectable frequency band. An ultra-pure sinewave signal is required as the measurement signal.
- "Mod Dist" is a modulation factor analysis which determines the *total* intermodulation factor of the 2nd and 3rd order a low-frequency interfering signal to a high-frequency useful signal. The interfering signal should have the same or a higher amplitude than the useful signal (preferably an amplitude ratio of 4 : 1).
- "DFD" is a difference-tone factor analysis which determines the 2nd and 3rd order intermodulation products generated by two sinewave signals of the same amplitude.

---

**Note:**

*The individual distortion components can be assessed visually using the "bargraph" or (Post) FFT.*

---

---

**Note:**

*The measurement values can only have the full dynamic range if both the signal source and the analyzer are at full-scale level. If the measurement values are worse than expected, the following rules should be checked and observed.*

---

- The *digital generator* should use all available audio bits, the (overall) signal should have a level of 1.0 FS and as little dither as possible.
- The *analog generator* should be operated in the optimum "Volt Range", preferably in the "Auto" mode. If the "Fix" mode is used, it is important to ensure that the selected range is not significantly higher than the set (total) voltage.
- The *digital analyzer* should use all available audio bits.
- The *analog analyzer* should be operated in the optimum "Range", preferably in the "Auto" mode. If the "Fix" or "Lower" mode is used, it is important to ensure that the selected range is not significantly higher than the applied total voltage.

## Dynamic Mode

### Dynamic Mode

Used to adapt the attainable dynamic range to the quality of the DUT. Only available in the analog analyzer; the digital analyzer always performs measurements with the full dynamic range (without any reduction in speed).



Measurements performed with a high dynamic range ("**Precision**") take longer. Conversely, the dynamic range of the R&S UPV analyzer is not fully utilized if a short measurement time is selected ("**Fast**"). The decision as to whether a fast measurement would be sufficient or whether a precision measurement is required should therefore be made depending on the DUT (by comparing the fast and precision measurement). If the measurement value from the precision measurement is not better than that from the fast measurement, the user can decide against a high dynamic range in favour of a shorter measurement time.



A fast measurement with low dynamic range is performed (fast measurement).

Remote-control command:  
SENSE[1]:FUNCTION:DMODE FAST



A precision measurement with maximum dynamic range but a longer measurement time is performed. Following preliminary measurement to determine the fundamental frequency and the total level, the main measurement is performed with activated analog notch filter (to reject the fundamental) and post-gain of the residual signal (to increase the dynamic range). The total measurement time is just over twice that required for the "Fast" dynamic mode.

---

#### **Note:**

*If the dynamic range of the measurement signal (including any out-of-band signals) is lower than 30 dB, the post-gain is reduced step by step to 12 or 0 dB in order to prevent overranging. This "notch-ranging" once again increases the measurement time; the measurement value is, however, no more accurate than that obtained using the "Fast" measurement. The "Fast" dynamic mode should therefore be selected in such cases.*

---

Remote-control command:  
SENSE[1]:FUNCTION:DMODE PRECISION



## THD

"THD" ("total harmonic distortion") is a distortion measurement over the first 8 harmonics or over any given combination of the first 8 harmonics (d2 to d9) whereby the amplitudes of the individual harmonics are measured selectively. The root from the squared sum of the harmonics can be displayed either as an RMS or as a ratio to the total RMS. Unlike with the THD+N measurement, the noise between the harmonics is *not* measured.

An ultra-pure sinewave signal is required as the measurement signal. The selected frequency of this sinewave signal should be such that the significant components of the distortion spectrum are still below the upper measurement limit.

The "Sine" signal function of the internal generator is recommended as the *signal source*. If the optional low-distortion generator is available, it should be activated for measurements on low-distortion DUTs. The sinewave level and frequency can be varied or swept.

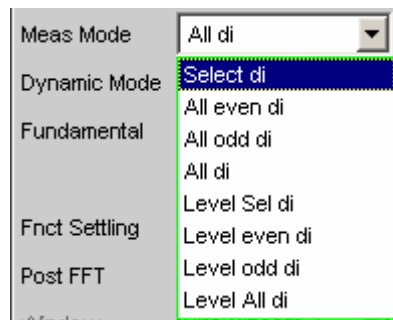
Remote-control command:  
SENSE[1]:FUNCTION THD

See section "[THD+N / SINAD](#)" on page 4.186 for alternative distortion measurement.

See section "[Distortion Measurements](#)" on page 4.178 for further distortion measurements.

### Meas Mode

Used to select the harmonics to be taken into consideration in the THD measurement value and to select the calculation formula for the measurement value.



#### Note:

*All 8 harmonics (and the fundamental) are always displayed in the graphic irrespective of the selected measurement mode.*

The term "**Level**" indicates that the measurement result is displayed as an RMS and is *not* referenced to the total RMS (as is customary with distortion measurements).

**Select di** The distortion of any given combination of harmonics d2 to d9 (root from the squared sum of the selected harmonics) is measured *referenced* to the total RMS.

$$U_{THD} [dB] = 20 * \log \frac{\sqrt{U_{d2}^2 + U_{d3}^2 + \dots}}{\text{Gesamteffektivwert}}$$

The measurement value can be displayed in % as well as in dB.

Remote-control command:  
SENSe[1]:FUNction:MMODE SElectdi

**All even di** The distortion of all *even* harmonics d2 to d8 (root from the squared sum of the even harmonics) is measured *referenced* to the total RMS.

$$U_{THD} [dB] = 20 * \log \frac{\sqrt{U_{d2}^2 + U_{d4}^2 + U_{d6}^2 + U_{d8}^2}}{\text{Gesamteffektivwert}}$$

The measurement value can be displayed in % as well as in dB.

Remote-control command:  
SENSe[1]:FUNction:MMODE DEVen

**All odd di** The distortion of all *odd* harmonics d3 to d9 (root from the squared sum of the odd harmonics) is measured *referenced* to the total RMS.

$$U_{THD} [dB] = 20 * \log \frac{\sqrt{U_{d3}^2 + U_{d5}^2 + U_{d7}^2 + U_{d9}^2}}{\text{Gesamteffektivwert}}$$

The measurement value can be displayed in % as well as in dB.

Remote-control command:  
SENSe[1]:FUNction:MMODE DODD

**All di** The distortion of all harmonics d2 to d9 (root from the squared sum of all 8 harmonics) is measured *referenced* to the total RMS.

$$U_{THD} [dB] = 20 * \log \frac{\sqrt{U_{d2}^2 + U_{d3}^2 + \dots + U_{d8}^2 + U_{d9}^2}}{\text{Gesamteffektivwert}}$$

The measurement value can be displayed in % as well as in dB.

Remote-control command:  
SENSe[1]:FUNction:MMODE DALL

**Level Select di**

The *distortion voltage* of any given combination of harmonics d2 to d9 (root from the squared sum of the selected harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d2}^2 + U_{d3}^2 + \dots}$$

The measurement value is displayed in voltage units (volts or FS).

The desired harmonics are selected in the parameter fields below.

Remote-control command:  
SENSe[1]:FUNCTION:MMODE LSElectdi

**Level even di**

The *distortion voltage* of all *even* harmonics d2 to d8 (root from the squared sum of the even harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d2}^2 + U_{d4}^2 + U_{d6}^2 + U_{d8}^2}$$

The measurement value is displayed in voltage units (volts or FS).

Remote-control command:  
SENSe[1]:FUNCTION:MMODE LDEVen

**Level odd di**

The *distortion voltage* of all *odd* harmonics d3 to d9 (root from the squared sum of the even harmonics) is measured.

$$U_{THD}[V] = \sqrt{U_{d3}^2 + U_{d5}^2 + U_{d7}^2 + U_{d9}^2}$$

The measurement value is displayed in voltage units (volts or FS).

Remote-control command:  
SENSe[1]:FUNCTION:MMODE LDODd

**Level all di**

The *distortion voltage* of all harmonics d2 to d9 (root from the squared sum of all 8 harmonics) is measured.

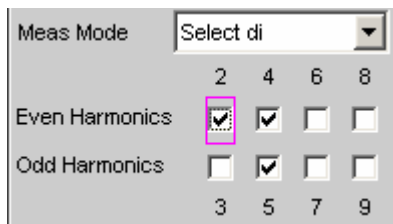
$$U_{THD}[V] = \sqrt{U_{d2}^2 + U_{d3}^2 + \dots + U_{d8}^2 + U_{d9}^2}$$

The measurement value is displayed in voltage units (volts or FS).

Remote-control command:  
SENSe[1]:FUNCTION:MMODE LDALl

**Even Harmonics**

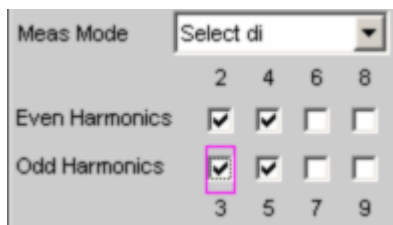
Used to select the desired *even* harmonics; only available if "(Level) Select di" is selected under "Meas Mode".



Remote-control command:  
 SENSE[1]:FUNCTION:DISTortion<i> ON | OFF  
 <i> designates the harmonic 2, 4, 6, 8

**Odd Harmonics**

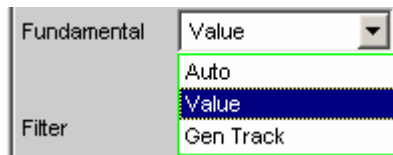
Used to select the desired *odd* harmonics; only available if "(Level) Select di" is selected under "Meas Mode".



Remote-control command:  
 SENSE[1]:FUNCTION:DISTortion<i> ON | OFF  
 <i> designates the harmonic 3, 5, 7, 9

**Fundamental**

Used to determine the fundamental frequency. With precision measurement (in the analog analyzer only), this field is also used to determine the notch frequency of the automatically activated analog notch filter.



**Auto**

The fundamental frequency is determined (separately for each channel) by means of internal frequency measurement.

Recommended when using the low-distortion generator or an external signal source.

Remote-control command:  
 SENSE[1]:VOLTage:FUNDamental:MODE AUTO

**Value**

Fixed fundamental frequency; the value must be entered in the parameter field below.



Recommended for signals with a high noise component if an external generator is used as the signal source.

```
Remote-control command:
SENSe[1]:VOLTage:FUNDamental:MODE
VALue
SENSe[1]:VOLTage:FUNDamental <nu>
```

**Gen Track**

The fundamental frequency changes with the generator (*nominal*) frequency. The generator frequency may change as a result of manual entries in the Generator Function panel or owing to a generator frequency sweep. Setting reliability in the case of signals with a high noise component is thus improved and measurement speed is increased.

**Note:**

*If the Low-Distortion Generator option is used, "Gen Track" should be avoided on account of the rigid coupling to the generator's nominal frequency, otherwise measuring inaccuracy resulting from slight frequency offset could occur.*

An error message is output if an unsuitable signal function is selected in the generator (e.g. a multi-tone signal or interfering signal).

Recommended when using the internal universal generator.

```
Remote-control command:
SENSe[1]:VOLTage:FUNDamental:MODE
GENTrack
```

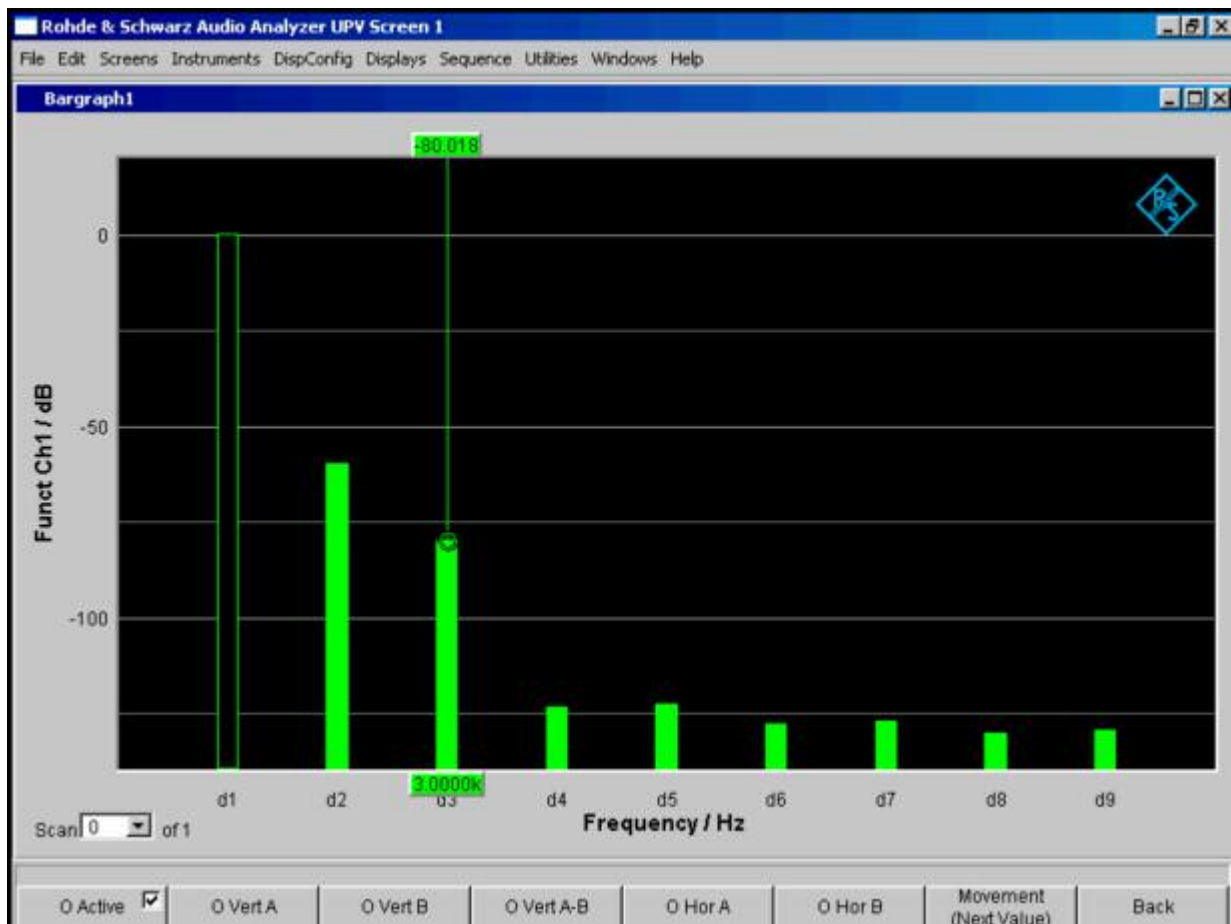


Figure 4-17 THD measurement of a 1 kHz sinewave signal with two harmonics of -60 dB and -80 dB

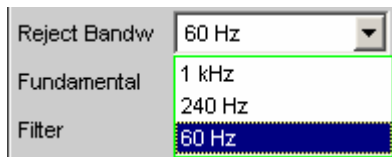
See section *"Distortion Measurements"* on page 4.178 for further settings.

## THD+N / SINAD

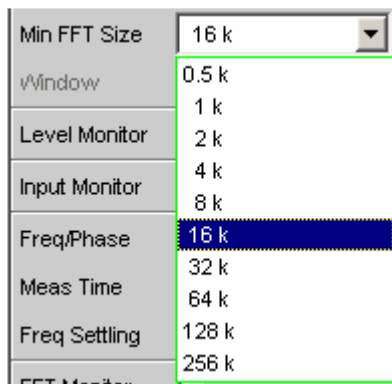
"THD+N & SINAD" ("total harmonic distortion + noise") is a distortion measurement which measures and displays the energy of the broadband noise *without the fundamental* (residual signal) within a selectable frequency band (optionally, the energy can also be displayed referenced to the total energy). This measurement function allows different measurement modes; it is also possible to eliminate the harmonics, except for the fundamental, so that the measurement value only contains non-harmonic components and noise.

An FFT is used to record the spectrum, filter out the fundamental and calculate the total remaining energy (residual spectrum) – comprising of harmonics and broadband noise – within the band limits specified with "Frq Lim Low" and "Frq Lim Upp". The FFT value is automatically adapted to the measured fundamental frequency; the lower the frequency is, the longer the required FFT and, therefore, the integration time will be. The user can select the *minimum* FFT value:

- implicitly by selecting the rejection bandwidth (with deactivated Post FFT)



- explicitly by selecting the minimum FFT length ("Min FFT Size"; with activated Post FFT)



Here a compromise must be made between measurement speed and measurement accuracy:

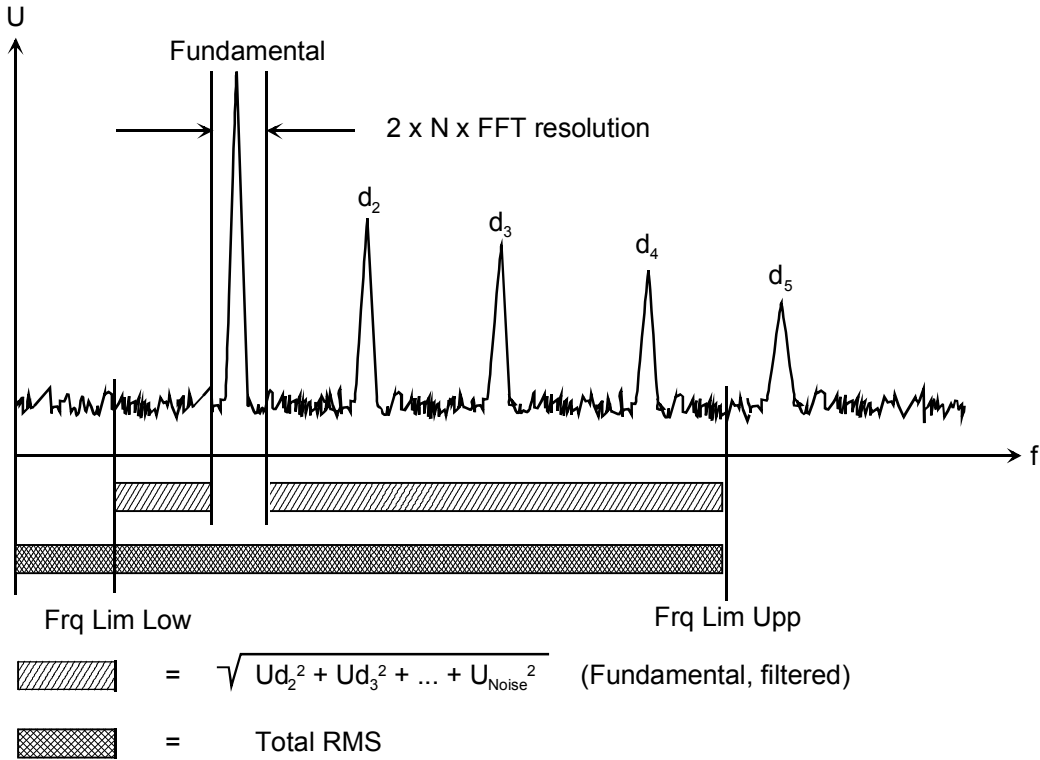
- A small (initial) FFT length and a large rejection bandwidth ("Rejection Bandwidth") mean a short measurement time; the filtered-out sideband of the fundamental is, however, relatively large. Non-harmonic signal components close to the fundamental are not measured.
- A large (initial) FFT length means a long sampling time; the filtered-out sideband of the fundamental is, however, relatively small so that signal components (non-harmonics and noise) close to the fundamental are also measured.

If the selected FFT value is not large enough to determine the fundamental of the measurement signal, the length of the FFT is increased gradually by a factor of 2.

The energy of the noise and (if applicable) the harmonics can be displayed either as an RMS or as a ratio to the total RMS. The total RMS is band-limited to "Frq Lim Upp".

An ultra-pure sinewave signal is required as the measurement signal. The selected frequency of this sinewave signal should be such that the significant components of the distortion spectrum are still below the upper measurement limit.

The "Sine" signal function of the internal generator is recommended as the *signal source*. If the optional low-distortion generator is available, it should be activated for measurements on low-distortion DUTs. The sinewave level and frequency can be varied or swept.



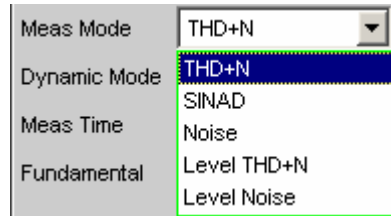
```
Remote-control command:
SENSE[1]:FUNCTION THDNsdr
```

See section "THD" on page 4.180 for alternative distortion measurement.  
 See section "Distortion Measurements" on page 4.178 for further distortion measurements.



**Meas Mode**

Used to select the THD+N measurement method and the calculation formula for the measurement value.



The term "**Level**" indicates that the measurement result is displayed as an RMS and is *not* referenced to the total RMS (as is customary with distortion measurements).

With the **Noise** measurements, it is also possible to filter all harmonics (except the fundamental) out of the overall signal.

**Note:**

The noise energy of the respective sideband is also filtered out with each harmonic so that with very low frequencies (and, theoretically, with large numbers of harmonics) a large part of the noise energy is lost. To counter this, measurement is performed with a very fine frequency resolution, which (compared to the THD+N measurement) results in a considerably longer measurement time. The Level measurement modes should therefore only be used for high frequencies.

**THD+N**

The *total* distortion (broadband noise *and* harmonics, *referenced* to the total RMS) is measured.

$$U_{THD+N} [dB] = 20 * \log \frac{\sqrt{U_{d2}^2 + U_{d3}^2 + \dots + U_{Noise}^2}}{\text{Gesamteffektivwert}}$$

The total RMS is band-limited to "Frq Lim Upp".  
The measurement value can be displayed in % as well as in dB.

Remote-control command:  
SENSe[1]:FUNction:MMODE THDN

**SINAD**

Measurement *method* similar to THD+N, but the result is displayed as a *positive* dB value, i.e. the total RMS is referenced to the residual signal (overall spectrum without fundamental).

$$U_{SINAD} [dB] = 20 * \log \frac{\text{Gesamteffektivwert}}{\sqrt{U_{d2}^2 + U_{d3}^2 + \dots + U_{Noise}^2}}$$

Remote-control command:  
SENSe[1]:FUNction:MMODE SNDRatio

**Noise**

The *noise factor* (broadband noise *without* harmonics, *referenced* to the total RMS) is measured.

$$U_{Noise} [dB] = 20 * \log \frac{\sqrt{U_{Noise}^2}}{Gesamteffektivwert}$$

The total RMS is band-limited to "Frq Lim Upp".  
The measurement value can be displayed in % as well as in dB.

Remote-control command:  
SENSe[1]:FUNCTION:MMODE NOISe

**Level THD+N**

The *total distortion voltage* (comprising of broadband noise *and* the harmonics) is measured.

$$U_{THD+N} [V] = \sqrt{U_{d2}^2 + U_{d3}^2 + \dots + U_{Noise}^2}$$

The measurement value is displayed in voltage units (volts or FS).

Remote-control command:  
SENSe[1]:FUNCTION:MMODE LTHDn

**Level Noise**

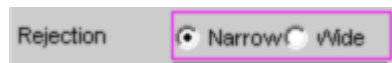
The *noise voltage* (broadband noise *without* the harmonics) is measured.

The measurement value is displayed in voltage units (volts or FS).

Remote-control command:  
SENSe[1]:FUNCTION:MMODE LNOISe

**Rejection**

Used to select the fundamental rejection. Only available in "Dynamic Mode Fast" or in the digital analyzer.



**Narrow**

The fundamental is suppressed extremely narrowly. As a result, it is also possible to detect noise components which are immediately next to the carrier.

Remote-control command:  
`SENSe[1]:THDN:REJection NARRow`

**Wide**

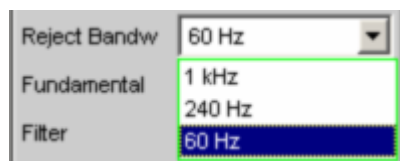
A digital notch filter with properties identical to those previously implemented in analog measuring instruments is used to reject the fundamental. The broader filtering range produces slightly better measurement values since noise components close to the carrier are also suppressed. Recommended if the measurement results are to be comparable to those of analog measuring instruments.

Remote-control command:  
`SENSe[1]:THDN:REJection WIDE`

**Reject Bandw**

Used to select the rejection bandwidth ("Rejection Bandwidth") by implicitly entering the *initial* FFT value.

Only functions with deactivated Post FFT; with activated Post FFT, the initial FFT value must be specified explicitly by the user.



The larger the bandwidth is (absolute frequency band around the fundamental), the smaller the initial FFT and the higher the measurement speed will be.

The actual initial value of the FFT is determined automatically taking the sampling rate, the analog bandwidth and the dynamic range of the used analyzer into consideration.

The *final* value of the FFT is determined by the frequency of the measurement signal; it is increased automatically with low frequencies.

Apart from the measurement frequency, the actual measurement time also depends on the analog bandwidth and sampling frequency.

**Note:**

*When the Post FFT is activated, the internally calculated initial FFT value is entered in the "Min FFT Size" parameter field. It can then be freely changed by the user.*

**1 kHz**

The rejection bandwidth is 1 kHz, i.e. 500 Hz below and above the fundamental.

The initial FFT value is very small (e.g. 1 k at 22 kHz analog bandwidth and 48 kHz sampling rate) and the measurement time is very short (especially at high frequencies).

Non-harmonic signal components close to the fundamental are not measured.

Recommended for fast measurement of the harmonics.

```
Remote-control command:
SENSe[1]:FUNCTION:APERTure:MODE WIDE
```

**240 Hz**

The rejection bandwidth is 240 Hz, i.e. 120 Hz below and above the fundamental.

The initial FFT value is at least 4 k.

Compromise between measurement time and loss of sideband energy.

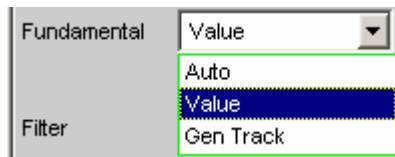
```
Remote-control command:
SENSe[1]:FUNCTION:APERTure:MODE MEdium
```

**60 Hz** The rejection bandwidth is 60 Hz, i.e. only 30 Hz below and above the fundamental. The initial FFT value is not below 16 k. Recommended for measuring signal components close to the fundamental and especially for noise measurements as this bandwidth ensures that the fundamentals and harmonics are suppressed as narrowly as possible.

Remote-control command:  
`SENSe[1]:FUNction:APERture:MODE NARRow`

**Fundamental**

Used to determine the fundamental frequency. With precision measurement (in the analog analyzer only), this field is also used to determine the notch frequency of the automatically activated analog notch filter.



**Auto** The fundamental frequency is determined (separately for each channel) by means of internal frequency measurement.

Recommended when using the low-distortion generator or an external signal source.

Remote-control command:  
`SENSe[1]:VOLTage:FUNDamental:MODE AUTO`

**Value** Fixed fundamental frequency; the value must be entered in the parameter field below.



Recommended for signals with a high noise component if an external generator is used as the signal source.

Remote-control command:  
`SENSe[1]:VOLTage:FUNDamental:MODE VALue`  
`SENSe[1]:VOLTage:FUNDamental <nu>`

**Gen Track**

The fundamental frequency changes with the generator (*nominal*) frequency. The generator frequency may change as a result of manual entries in the Generator Function panel or owing to a generator frequency sweep. Setting reliability in the case of signals with a high noise component is thus improved and measurement speed is increased.

---

**Note:**

*If the Low-Distortion Generator option is used, "Gen Track" should be avoided on account of the rigid coupling to the generator's nominal frequency, otherwise measuring inaccuracy resulting from slight frequency offset could occur.*

---

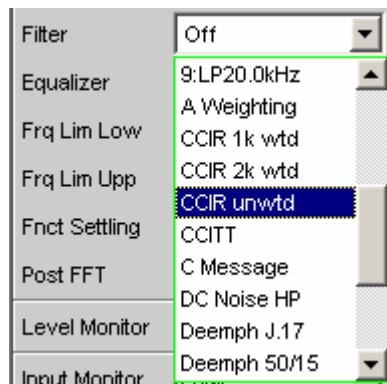
An error message is output if an unsuitable signal function is selected in the generator (e.g. a multi-tone signal or interfering signal).

Recommended when using the internal universal generator.

```
Remote-control command:  
SENSe[1]:VOLTage:FUNDamental:MODE  
GENTrack
```

**Filter**

Used to activate a digital filter (user-definable filter or weighting filter) in the measurement path.



The available weighting filters are described in section ["Weighting Filters"](#) on page 4.252.

---

**Note:**  
*Irrespective of the digital filter selected here, it is also possible to loop an additional input filter ("Pre Filter"), into the measurement path. The upper band limit can be limited using the "Bandwidth" or "Frq Lim Upp" parameter field, which has the same effect as an additional low-pass filter.*

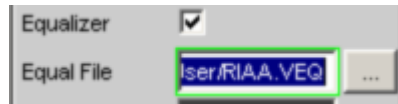
---

Remote-control command:  
 SENSE[1]:FILTer <parameter>

List of <parameter>:  
 OFF, UFIL1 ... UFIL9,  
 AWE, CARM, CCIU, CCIR, CCIT, CMES, DEMP17, DCN,  
 DEMP5015, DEMP50, DEMP75, IECT, JITT, URUM, WRUM

## Equalizer

Used to activate an equalization table which contains frequency information and the associated voltage gain factors. This table can be used to, for example, equalize the frequency response of a transmission path so that the measurement point can be transformed to a different reference point.



Every FFT bin of the recorded spectrum is multiplied by a frequency-dependent equalization factor which, if necessary, is calculated by means of interpolation between the two adjacent frequency support points of the equalization table. The FFT spectrum equalized in this way is then used as the basis for calculating the distortion.

Equalization of the FFT spectrum is an interesting alternative to filtering the input signal since the equalization file can be generated easily from the frequency response to be equalized and does not have to be available as a coefficient or pole/zero file.



The equalizer is deactivated; the THD+N value is calculated from the *original* FFT spectrum.

```
Remote-control command:
SENSe[1]:VOLTage:EQAlize OFF
```

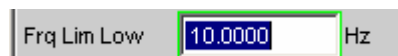


The equalizer is activated; the THD+N value is calculated from the *equalized* FFT spectrum. The parameter field (shown above) in which the equalization file is loaded appears.

```
Remote-control command:
SENSe[1]:VOLTage:EQAlize ON
MMEMory:LOAD:IEQualize 'filename'
```

## Frq Lim Low

Used to enter the lower band limit for calculating the distortion voltage; this limit does not affect calculation of the total RMS.



```
Remote-control command:
SENSe[1]:FREQuency:LIMit:LOWer <nu>
```



**Frq Lim Upp**

Used to enter the upper band limit for calculating the distortion voltage and the total RMS.



Frq Lim Upp  Hz

**Note:**

*If the fundamental of the measurement signal is above "Frq Lim Upp", the referenced measurements (THD+N, SINAD and Noise) should not be performed because the energy of the fundamental is filtered out in the reference value.*

Remote-control command:

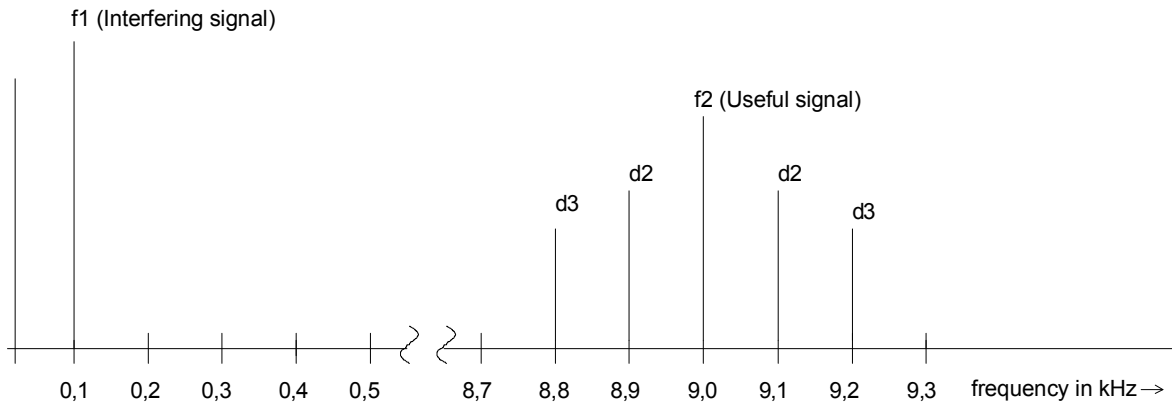
```
SENSe[1]:FREQuency:LIMit:UPPer <nu>
```

See section "[Distortion Measurements](#)" on page 4.178 for further settings.

## MOD DIST

"Mod Dist" is a modulation factor analysis which determines the intermodulation of a low-frequency (dominant) interfering signal to a high-frequency useful signal. According to IEC 60268 Part 3, the interfering signal should be 60 Hz, the useful signal 7 kHz and the amplitude ratio 4 : 1. The R&S UPV measures the 2<sup>nd</sup> and 3<sup>rd</sup> order intermodulation products selectively (measurements are therefore largely unaffected by noise) and calculates their squared sum. Contrary to the recommendation in IEC 60268, the *total* intermodulation factor is therefore measured to ensure that this measurement method is comparable to the customary SMPTE measurement method.

The "Mod Dist" signal function of the internal universal generator is recommended as the *signal source*. This allows the frequencies of the interfering and useful signal as well as their amplitude ratio to be varied. Furthermore, it is also possible to sweep the total level and useful frequency.



$$d2 = \frac{|U_{(f1+f2)}| + |U_{(f2-f1)}|}{U_{(f2)}} \quad 2^{\text{nd}} \text{ order intermodulation product}$$

$$d3 = \frac{|U_{(f2-2f1)}| + |U_{(f2+2f1)}|}{U_{(f2)}} \quad 3^{\text{rd}} \text{ order intermodulation product}$$

$$\text{MOD DIST [dB]} = 20 * \lg(\sqrt{d2^2 + d3^2}) \quad \text{Total intermodulation factor in dB}$$

Remote-control command:  
SENSE[1]:FUNCTION MDIST

See section "[DFD](#)" on page 4.199 for alternative intermodulation measurement.

See section "[Distortion Measurements](#)" on page 4.178 for further distortion measurements.

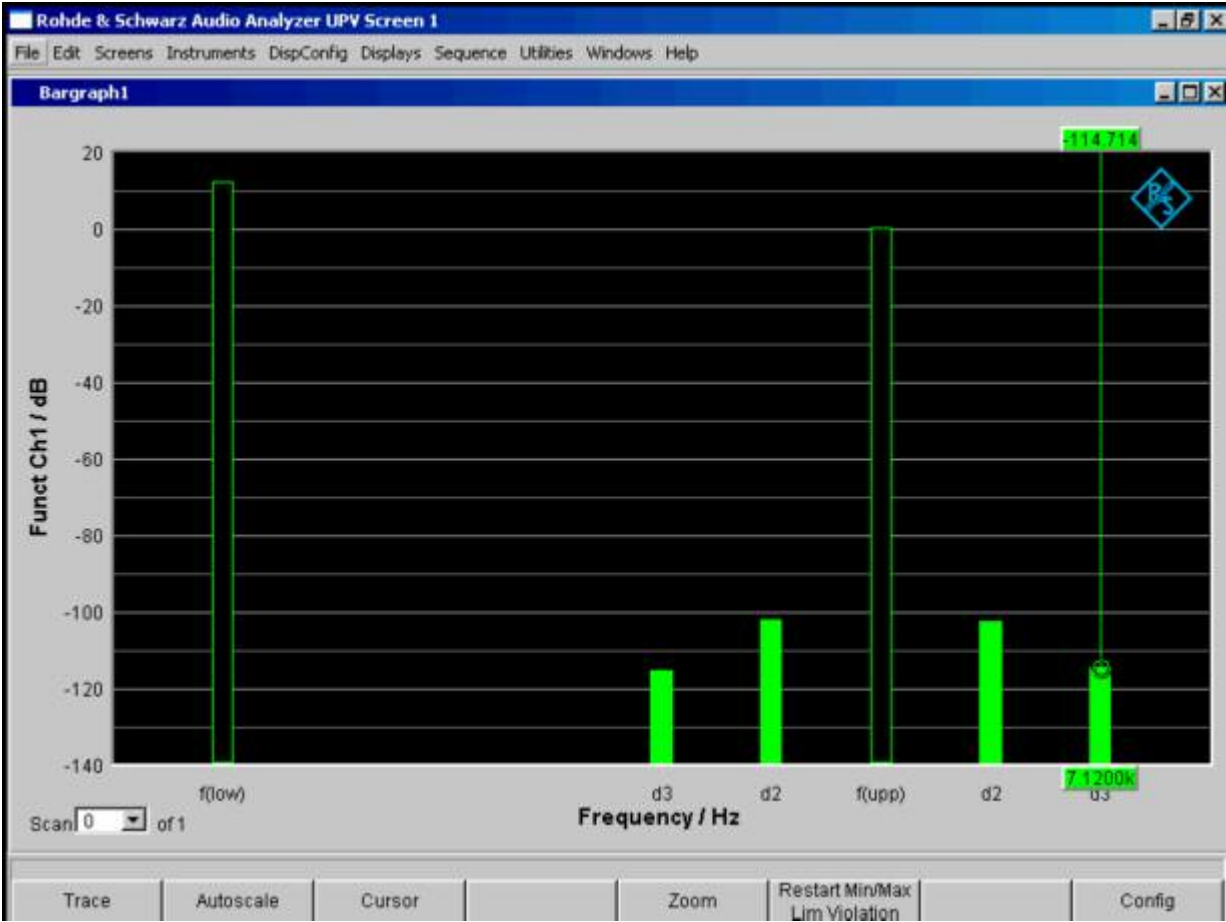


Figure 4-18 Mod-Dist measurement with 7 kHz useful signal and quadrupled interferer at 60 Hz

See section "Distortion Measurements" on page 4.178 for settings.

## DFD

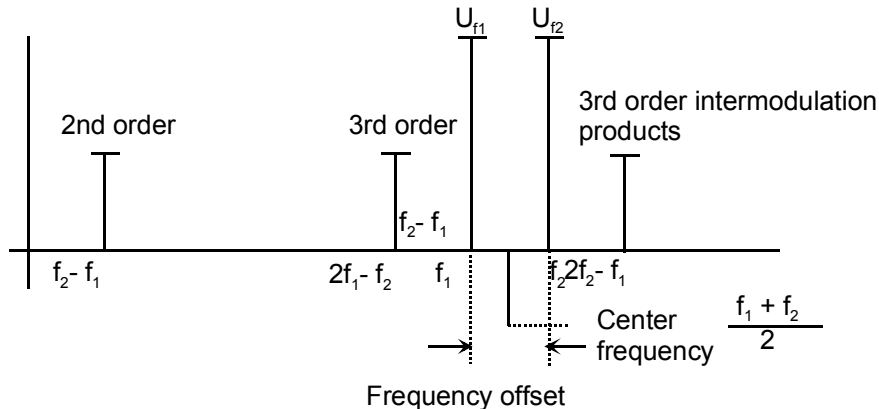
"DFD" is a difference-tone factor analysis which determines the intermodulation products generated by two sinewave signals of the same amplitude. Depending on the selected measurement mode, the R&S UPV measures the 2<sup>nd</sup> or 3<sup>rd</sup> intermodulation products selectively in accordance with DIN IEC 60268 Part 3 (measurements are therefore largely unaffected by noise). The arithmetic center frequency of the double-tone signal should be selected from the third-octave band (5, 6.3, 8, 10, 12.5, 16, 20 kHz) and the frequency difference should be 80 Hz.

The "DFD" signal function of the internal universal generator is recommended as the *signal source*. This allows the center frequency and difference frequency (for IEC 60268) and the upper frequency and difference frequency (for IEC 60118) to be varied. Furthermore, it is also possible to sweep the center frequency and upper frequency.

Remote-control command:  
SENSe[1]:FUNCTION DFD

See section "[MOD DIST](#)" on page 4.197 for alternative intermodulation measurement.

See section "[Distortion Measurements](#)" on page 4.178 for further distortion measurements.



### Meas Mode

Used to select the order of the intermodulation products and the measurement standard.

Meas Mode	d2 (IEC 268)
Dynamic Mode	d2 (IEC 268)
Funct Settling	d3 (IEC 268)
Post FFT	d2 (IEC 118)
	d3 (IEC 118)

With IEC 60268, the measured intermodulation products are referenced to double the upper frequency; with IEC 60118, the measured intermodulation products are referenced to the undoubled upper frequency only. The results to IEC 60268 are therefore approx. 6 dB better than the results to IEC 60118.

**d2 (IEC 268)** Measurement of the 2<sup>nd</sup> order intermodulation product referenced to *double* the upper frequency level (to IEC 60268):

$$d_2 [\text{dB}] = 20 \times \lg \frac{|U_{(f_2 - f_1)}|}{2 \times U_{(f_2)}}$$

Remote-control command:  
SENSe[1]:FUNCTION:MMODE D2\_268

**d3 (IEC 268)** Measurement of the 3<sup>rd</sup> order intermodulation products referenced to *double* the upper frequency level (to IEC 60268):

$$d_3 [\text{dB}] = 20 \times \lg \frac{|U_{(2f_2 - f_1)}| + |U_{(2f_1 - f_2)}|}{2 \times U_{(f_2)}}$$

Remote-control command:  
SENSe[1]:FUNCTION:MMODE D3\_268

**d2 (IEC 118)** Measurement of the 2<sup>nd</sup> order intermodulation product referenced to the *undoubled* upper frequency level (to IEC 60118):

$$d_2 [\text{dB}] = 20 \times \lg \frac{|U_{(f_2 - f_1)}|}{U_{(f_2)}}$$

Remote-control command:  
SENSe[1]:FUNCTION:MMODE D2\_118

**d3 (IEC 118))** Measurement of the lower 3<sup>rd</sup> order intermodulation product referenced to the *undoubled* upper frequency level (to IEC 60118):

$$d_3 [\text{dB}] = 20 \times \lg \frac{|U_{(2f_1 - f_2)}|}{U_{(f_2)}}$$

Remote-control command:  
SENSe[1]:FUNCTION:MMODE D3\_118

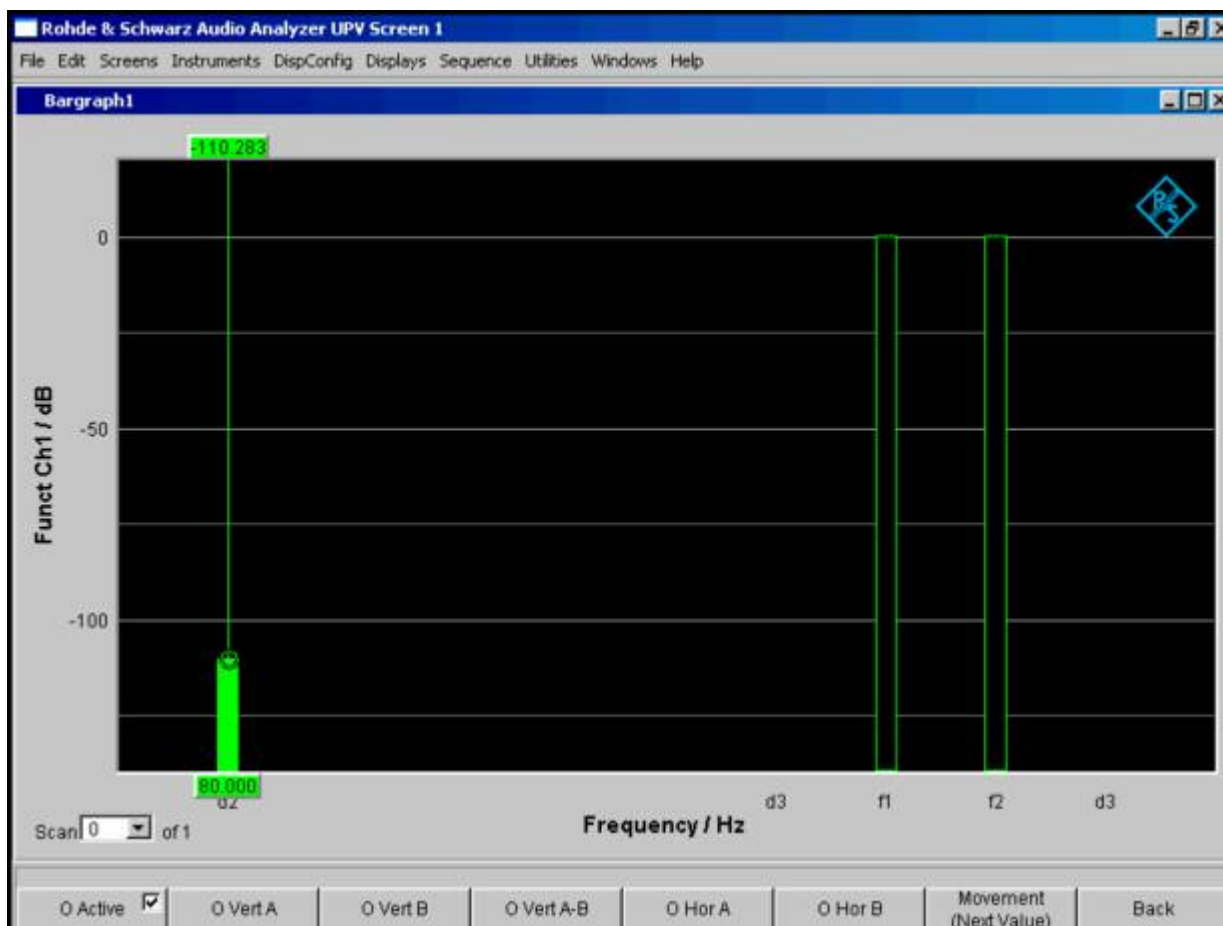


Figure 4-19 DFD-d2 measurement in accordance with IEC 60118

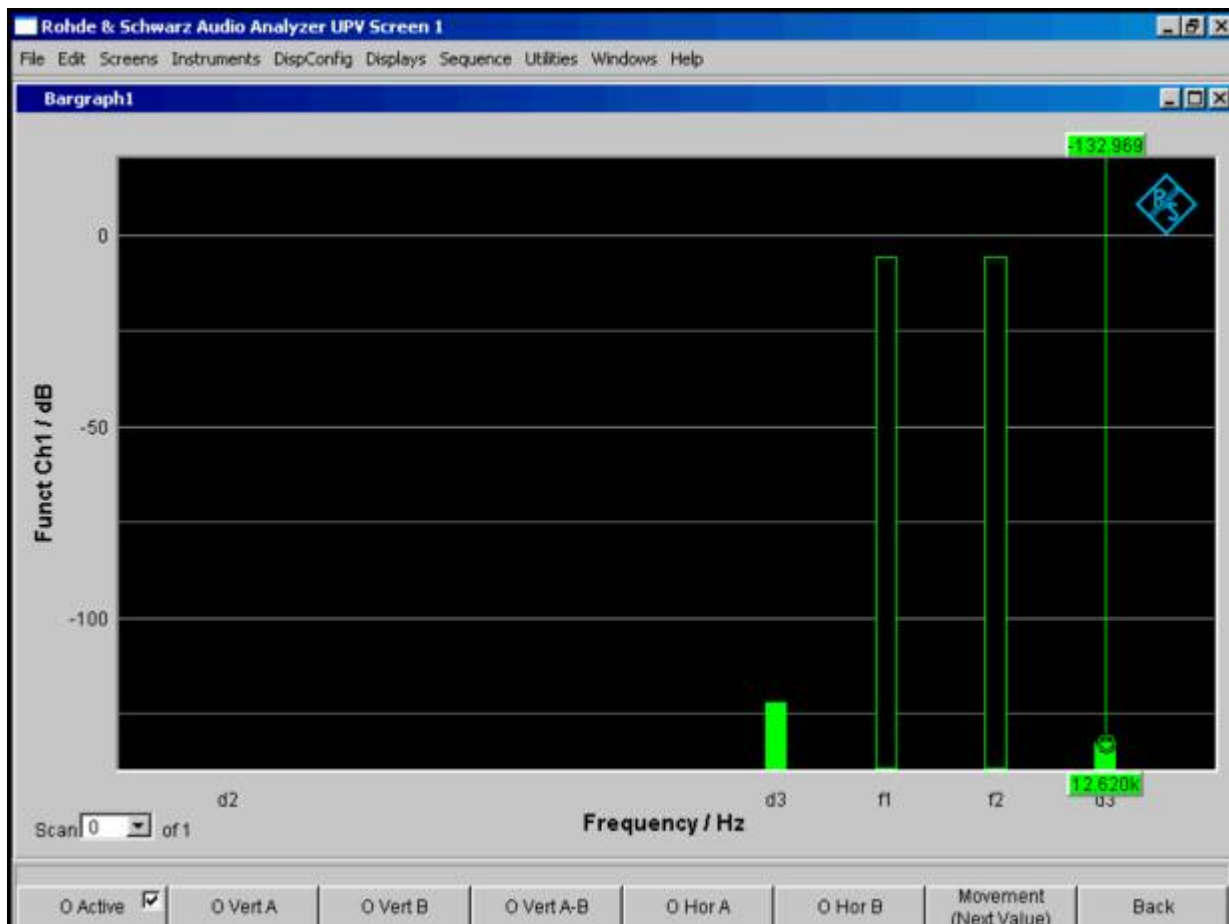


Figure 4-20 DFD-d3 measurement in accordance with IEC 60268

See section "[Distortion Measurements](#)" on page 4.178 for further settings.

## DIM (dynamic intermodulation distortion analysis)

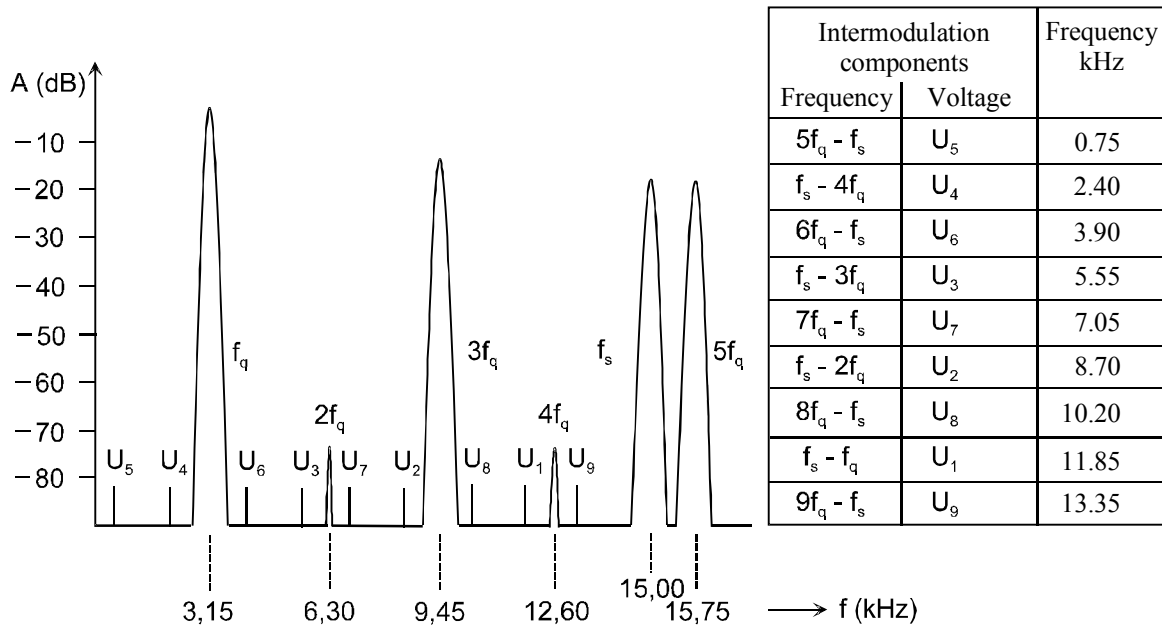
DIM is an analysis of intermodulation distortion that determines the nine components of dynamic intermodulation in the audio range caused by a mixture of a low-frequency squarewave signal and a high-frequency sine signal. It is mainly used to determine the nonlinear distortion of amplifiers that are forced to operate up to their maximum rise speed due to the short rise time of the squarewave signal.

According to Part 3 of IEC 60268, the amplifier is to be operated under nominal conditions (fully loaded). The squarewave signal with the basic frequency of 3.15 kHz has to be limited to 30 kHz (or, optionally, 100 kHz) via a one-contact lowpass filter. The peak amplitude of the sinwave signal with a frequency of 15 kHz must be 12 dB below the squarewave signal. In sound broadcasting, the squarewave/sinwave combination of 2.96 kHz/14 kHz is used.

The Audio Analyzer R&S UPV supports both frequency pairs and automatically determines the combination that is created in each case provided that the frequency drift is within the tolerance range stipulated by DIN IEC.

The DIM signal function of the internal basic generator is recommended as the *signal source* (reference). This signal function provides a standard-compliant frequency setting – including with respect to frequency accuracy.

Remote-control command:  
SENSE[1]:FUNCTION DIM



The measurement result is the rms value of the selectively measured intermodulation components (up to 9th order) relative to the rms value of the sinwave signal and is displayed in dB (or, optionally, in %).

$$d[dB] = 20 \times \lg \frac{\sqrt{U_1^2 + U_2^2 + U_3^2 \dots + U_9^2}}{U_s}$$

See section **"MOD DIST"** on page 4.197 for alternative intermodulation measurement.

For further information of distortion measurements, see section **"Distortion Measurements"** on page 4.178.

Since the used frequency pair is recognized automatically, you do not have to make any *special* settings.



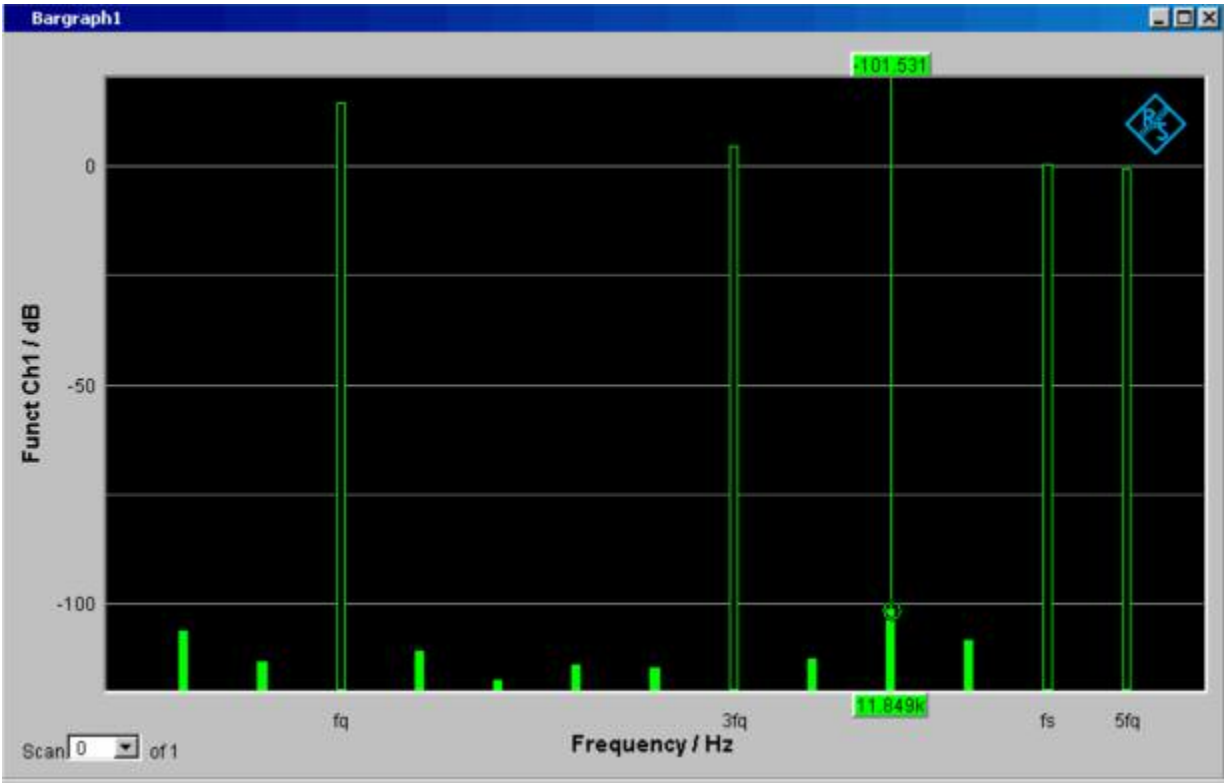


Figure 4-21 DIM measurement with 3.15 Hz squarewave signal and 15 kHz sinwave signal

See section "Distortion Measurements" on page 4.178 for further settings.

## FFT Analysis

The FFT analysis (**F**ast **F**ourier **T**ransformation) allows the input signal to be displayed in the spectral range (frequency range). The (digitalized) input signal is recorded over a selectable time period and transformed into the frequency range by means of a fast DFT (**D**iscrete **F**ourier **T**ransformation). The result is a "list" of equidistant frequency lines (bins) which indicate the magnitude or the phase of the respective frequency components. The graphical display of the magnitude or phase bins is referred to as a spectrum or spectral display.

According to system theory, the FFT analysis assumes that the signal is periodic, i.e. it continues continuously beyond the observed time period. Since this ideal state only exists in a few exceptional cases, the input signal can if required be weighted using a window which attenuates both ends of the observed signal section with respect to zero.

The recording time for the FFT, i.e. the length of the measurement interval (integration time), is determined using the FFT size and, like the frequency resolution, also depends on the used sampling rate and bandwidth.

3 different types of FFT can be selected in the R&S UPV:

- The **FFT Monitor** can be activated for any measurement function and allows continuous (or overlapping) frequency analysis of the input signal. Calculation is performed with an FFT size of 8 k points and single precision. Only FFT windows with good frequency selectivity can be selected. The Monitor FFT is displayed in the "FFT Monitor" graphical window.
- The **Post FFT** for distortion measurements are calculated with double precision with up to 256 k points thus ensuring a very high frequency resolution and dynamic response. The size of the FFT and the used window cannot be selected, but instead are preset according to the requirements of the respective measurement function. The Post FFT is displayed in the "FFT Function" graphical window.
- The **FFT as measurement function** (Function FFT) is, like the Post FFT, also calculated with double precision but additionally allows a number of other functions such as averaging and zooming (limiting the frequency range to increase the frequency resolution) as well as free selection of the FFT size and window. The Function FFT is displayed in the "FFT Function" graphical window.

## FFT Size

The size of the FFT (FFT Size) together with the sampling rate and bandwidth determines the length of the measurement interval (integration time) and thus the frequency resolution of the calculated spectrum. The following correlations apply:

- Integration time = FFT size / Sampling rate
- Number of lines = FFT size / 2
- Frequency resolution = Sampling rate / FFT size = 1 / Integration time

Therefore, if a higher sampling rate and bandwidth are used, a higher FFT size will be required to produce the same frequency resolution.

---

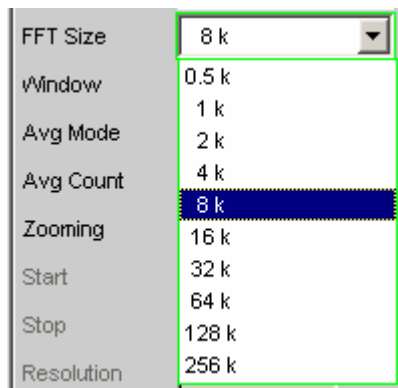
**Note:**

*In the analog analyzer, the internal sampling rate is determined by the selected bandwidth.*

---

**FFT Size (Function FFT)**

Size of the Function FFT, can be set in powers of 2 from 512 (0.5 k) to 256 k.



The measurement time also doubles with each increase in FFT size. Unnecessarily high FFT sizes should be avoided in order to reduce measurement times.

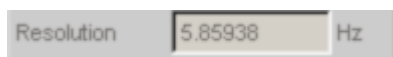
Remote-control command:  
`SENSe[1]:FUNCTION:FFT:Size <parameter>`

List of <parameter>:  
 S512, S1K, S2K, S4K, S8K, S16K, S32K, S64K, S128K, S256K

The FFT size for the Post FFT cannot be selected by the user but instead is preset by the respective measurement function according to the frequency of the measurement signal. The FFT size for the Monitor FFT cannot be selected by the user but instead is permanently set to 8 k. Other variables which appear as display fields in the group of FFT parameter fields are derived from the FFT size:

**Resolution**

Displays the frequency resolution.



The frequency resolution is the quotient of sampling rate and FFT size.

Remote-control command: (query only)  
`SENSe[1]:FUNCTION:FFT:RESolution?`

**Meas Time**

Displays the integration time.



The integration time is the quotient of FFT size and sampling rate.

Remote-control command: (query only)  
`SENSe[1]:FUNCTION:FFT:MTIME?`

**Note:**

*Not only the integration time but also the time required to calculate the transformation and graphical display increase with increasing FFT size. This results in an overproportional increase in the total measurement time. Unnecessarily high FFT sizes should therefore be avoided in order to reduce the measurement time.*

---

## Window Function

According to system theory, the FFT analysis requires a periodic signal which continues continuously beyond the observed time period. Normally, however, there is no continuous continuation (even with periodic signals). The FFT would interpret any discontinuity at the boundaries of the signal section as a pulse whose (white) spectrum would be superimposed on the useful signal spectrum.

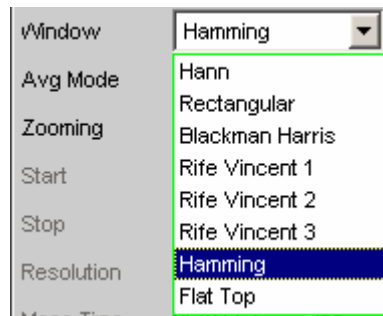
In order to prevent this "leakage" effect, the input signal is weighted using a window which attenuates both ends of the observed signal section with respect to zero. As a result, the signal is continuous for the FFT; there is, however, a reduction in selectivity, indicated by a relatively wide bell-shaped curve. By selecting the window function, the user makes a compromise between selectivity (frequency selectivity, width of bell-shaped curve at top), crosstalk between adjacent lines (width of bell-shaped curve at bottom), slope of the bell-shaped curve and "leakage" suppression in the far-off range. Selecting the rectangular window deactivates windowing.

### Window

Used to select the window function.

With the Post FFT, the window cannot be selected by the user but instead is preset by the respective measurement function and displayed here.

Only the "Hann" and "Rife Vincent" windows can be selected for the Monitor FFT.



### Hann

This window combines selectivity with good leakage suppression in the "far-off range " but has a relatively wide bell-shaped curve around the signal lines.

Recommended application: Standard window.

Remote-control command:

SENSe[1]:FUNction:FFT:WINDow HANNing

### Rectangular

Window function deactivated (by using a rectangular window with a constant weighting of 1).

If the signal fits in the section for the FFT exactly with an integer multiple of periods, there is no discontinuity at the section boundaries. A window is then not required and the maximum frequency resolution is possible. This feature may be of advantage when using a special generator signal ("FFT noise") as it allows fast measurement of frequency responses at specific frequencies. (see Noise, Fast Frequency Response Measurement)

Recommended application: Only suitable for special signals.

```
Remote-control command:
SENSe[1]:FUNction:FFT:WINDow
RECTangular
```

**Blackman  
Harris**

Only for Function FFT.  
The slope of the bell-shaped curve up to approx. 80 dB is very steep; however, this window has considerable "leakage" for values under 80 dB.

```
Remote-control command:
SENSe[1]:FUNction:FFT:WINDow
BLACKman_harris
```

**Rife Vincent 1  
Rife Vincent 2  
Rife Vincent 3**

The suppression of far-off interference is very good for all 3 windows. The width of the bell-shaped curve at the bottom of the individual lines drops and the width at the top increases as the Rife Vincent number increases. It is therefore possible to set various compromises between frequency resolution and the suppression of adjacent lines.  
Recommended application: For precise frequency determination.

```
Remote-control command:
SENSe[1]:FUNction:FFT:WINDow RIF1
SENSe[1]:FUNction:FFT:WINDow RIF2
SENSe[1]:FUNction:FFT:WINDow RIF3
```

**Hamming**

This window does not provide any significant advantages; it was implemented simply to complete the range.

```
Remote-control command:
SENSe[1]:FUNction:FFT:WINDow HAMMING
```

**Flat Top**

Only for Function FFT.  
Here, the region around the carrier is deliberately distorted to such an extent that at least two adjacent lines (in the case of excitation with one sinewave line only) always have roughly the same magnitude.  
This allows the amplitude to be read off very precisely from the graph. In contrast, the frequency selectivity is rather poor.  
Recommended application: For precise level determination.

```
Remote-control command:
SENSe[1]:FUNction:FFT:WINDow FLATtop
```

## FFT Monitor

The FFT Monitor can be activated irrespective of the selected measurement function. Blocks with a fixed size of 8 k points are recorded for the calculation and transformed with single precision, whereby the individual blocks form a continuous sequence. As a result, at least 6 images per second (with 48 kHz sampling rate and 22 kHz bandwidth) can be displayed.

Optionally, the blocks can also be calculated in an overlapping sequence (not with 250 kHz bandwidth), which increases the refresh rate (with maximum overlapping) to 12 / s.

Measurement is performed in the "monitor" level, i.e. downstream of the input filter and notch filter.

FFT Function is available for applications where a high dynamic range and/or a fine frequency resolution are required.

The FFT Monitor is optimized for frequency selectivity; this is why the FFT window can only be selected for the "Hann" window and "Rife Vincent" windows.

The Monitor FFT of a measurement channel is displayed in the "FFT Monitor" graphical window either as a magnitude or phase. Since 2 traces can be displayed at the same time, it is possible to record

- the magnitude *and* phase of *one* channel
- the magnitude *or* phase of *both* channels
- the magnitude *or* phase of *one* channel and one reference signal

It is possible to access the last 20 measurements (scans) of any trace.

### FFT Monitor

Used to activate the FFT Monitor; the *graphic* is configured and displayed in the configuration and graphical window "FFT Monitor".

FFT Monitor	<input checked="" type="checkbox"/>
Overlapping	<input checked="" type="checkbox"/> 50.0000 %
FFT Size	8 k
Window	Rife Vincent 2
Resolution	5.85938 Hz
Meas Time	170.667 ms



FFT Monitor deactivated.  
Recommended for increasing the measurement speed (e.g. for sweeps or remote-control mode).

Remote-control command:  
SENSe5:FUNCTION OFF



FFT Monitor activated; the parameter fields shown above appear.

Remote-control command:  
SENSe5:FUNCTION ON

**Overlapping**

Used to activate and configure overlapping for two consecutive Monitor FFT blocks.



Overlapping (max. 50 %) increases the refresh rate of the FFT. Furthermore, in this mode it is also possible to record signal components which have been suppressed by window suppression (continuous FFT only).

With high sampling rate and bandwidths, the overlapping should be reduced or deactivated, otherwise the high refresh rate of the FFT will reduce the measurement speed; overlapping cannot be selected for a bandwidth of 250 kHz.

Remote-control command: -



## Post FFT

For distortion measurements, the Post FFT displays the frequency spectrum recorded for calculating the measurement values. It can be activated for the measurement functions THD+N & SINAD, THD, DFD, Mod Dist and DIM.

*Measurement* is performed in the same level as the associated measurement function, i.e. downstream of all filters.

The respective measurement function adjusts the FFT size and window to its specific requirements. For example, the required FFT size increases as the signal frequency decreases. The settings for the Post FFT cannot therefore be selected by the user and can vary from measurement to measurement.

The Post FFT is *calculated* with double precision with up to 256 k points thus ensuring a very high frequency resolution and dynamic response.

The Post FFT of a measurement channel is *displayed* in the graphical windows "FFT, Panel 1" or "FFT, Panel 2" either as a magnitude or phase. Since 2 traces are displayed in each graphical window, the magnitude *and* phase of *both* channels can be recorded simultaneously.

### Post FFT

Used to activate the Post FFT; the *graphic* is configured and displayed in the configuration and graphical window "FFT, Panel 1" or "FFT, Panel 2".



Post FFT deactivated.  
Recommended for increasing the measurement speed (e.g. for sweeps or remote-control mode).

Remote-control command:  
SENSE[1]:FUNCTION:FFT:STATE OFF



Post FFT activated; all other settings are determined dynamically by the associated measurement function.

Remote-control command:  
SENSE[1]:FUNCTION:FFT:STATE ON

## FFT Measurement Function

The FFT can be selected as a separate measurement function (Function FFT). Unlike the other FFT analyses, all FFT parameters can be determined by the user. The following additional functions are also available:

- Delay compensation
- DC suppression (digital only)
- Filtering (3 user-definable filters and – in the analog analyzer – 1 analog notch)
- Averaging
- Zoom FFT

*Measurement* is performed in the same level as the other measurement functions, i.e. downstream of all filters.

The Function FFT is *calculated* with double precision with up to 256 k points thus ensuring a very high frequency resolution and dynamic response.

The Function FFT of a measurement channel is *displayed* in the graphical windows "FFT, Panel 1" or "FFT, Panel 2" either as a magnitude or phase. Since 2 traces are displayed in each graphical window, the magnitude *and* phase of *both* channels can be recorded simultaneously.

**Function**

Used to change the measurement function to FFT analysis. The band-limited and, possibly, filtered RMS is displayed as the function measurement result. The RMS is calculated by means of integration over all magnitude frequency lines from "Start" to "Stop". The frequency and phase value derived from the FFT is displayed as the "Freq/Phase" measurement result if "Precision" is set as "Meas Time" for the frequency measurement.

Function	FFT	
Delay Ch1	0.00000	s
Notch(Gain)	Off	
Filter	Off	
Filter	Off	
Filter	Off	
FFT Size	8 k	
Window	Rife Vincent 2	
Avg Mode	<input checked="" type="radio"/> Exp <input type="radio"/> Normal	
Avg Count	1	
Zooming	<input type="checkbox"/>	
Start	0.00000	Hz
Stop	22000.0	Hz
Resolution	5.85938	Hz
Meas Time	170.667	ms

The panel section shown above shows a "broadband" analog FFT, i.e. the zooming function is not used. With this FFT, the "Start" value is always 0.0 Hz and the "Stop" value is the selected bandwidth (analog analyzer) or half the sampling rate (digital analyzer). "Resolution" and "Meas Time" are derived from the selected "FFT Size".

```
Remote-control command:
SENSE[1]:FUNCTION FFT
```

**Delay Ch1**

Used to activate the delay compensation.



This compensates delay differences of the DUT.

The time by which Channel 1 is to be delayed relative to Channel 2 is entered. If the delay of Channel 2 is shorter than that of Channel 1, this can be compensated by entering a negative time.

The compensation of delay differences is particularly useful for phase measurements since a time offset of both measurement signals causes a frequency-dependent phase displacement and can thus invalidate the phase measurement result.

Remote-control command:  
SENSE[1]:CHANnel:DELay <nu>

**DC Suppress**

Used to activate DC suppression (in the digital analyzer only).



For DC suppression in the digital analyzer, the DC level is measured in the Monitor level and subtracted from the input samples.

This parameter field is not available in the analog analyzer because the suppression function is already provided by the AC coupling which can be set up using the hardware.



DC suppression deactivated.

The DC component of the measurement signal is *not* suppressed ("DC coupling") and is included in the measurement result and the graphical display. Recommended when using a high-pass or band-pass filter because additional DC suppression is not necessary in these cases and would increase the calculation time (slightly).

Remote-control command:  
SENSE[1]:FUNction:DCSuppression OFF



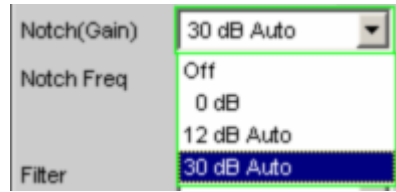
DC suppression activated.

The DC component of the measurement signal is suppressed ("AC coupling"); the measurement result and the graphical display only include the AC component.

Remote-control command:  
SENSE[1]:FUNction:DCSuppression ON

**Notch(Gain)**

Used to activate the analog notch filter (in the analog analyzer only) and select the notch gain.



In the analog analyzer, a second-order analog notch filter can be activated for narrowband suppression of unwanted frequency lines. When the notch filter is activated, the user can choose between 3 different gain factors.

**Note:**

*If frequency components occur outside the analyzer frequency range, the notch gain could cause overloading of the analyzer. In this case, the notch gain is reduced step by step, which is indicated by "Auto" in the list items 12 dB and 30 dB.*

**Off**                      Analog notch filter deactivated.

Remote-control command:  
SENSe[1]:NOTCh OFF

**0 dB**                      Analog notch filter activated; no gain in effect.

Remote-control command:  
SENSe[1]:NOTCh DB0

**12 dB Auto**              Analog notch filter activated; gain 12 dB.

Remote-control command:  
SENSe[1]:NOTCh DB12

**30 dB Auto**              Analog notch filter activated; gain 30 dB.

Remote-control command:  
SENSe[1]:NOTCh DB30

**Notch Freq**

Numeric or automatic selection of the notch-filter center frequency; only appears in the analog analyzer if "Notch(Gain)" is activated.

**Value**

The user can enter the notch-filter center frequency in the next parameter field. If "Value" is selected, the center frequency last active is displayed.



Remote-control command:  
 SENSE[1]:NOTCh:FREQUency:MODE FIXed  
 SENSE[1]:NOTCh:FREQUency <nu>

**Gen Track**

The notch-filter center frequency is adopted from the generator panel (if possible). If the generator signals are unsuitable (e.g. noise), an error message is output and the center frequency last valid is retained.



Remote-control command:  
 SENSE[1]:NOTCh:FREQUency:MODE GENTrack

**Filter**

3 separate filters can be looped into the measurement path. Apart from those filters which can be user-defined in the filter panel, filters can also be selected from a set of supplied weighting filters. Selecting "OFF" deactivates the respective filter.

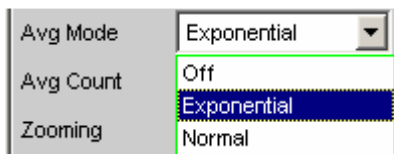


Remote-control command:  
 SENSE[1]:FILTer <parameter>  
 SENSE[1]:FILTer2 <parameter>  
 SENSE[1]:FILTer3 <parameter>

List of <parameter>:  
 OFF,  
 UFIL1, UFIL2, UFIL3, UFIL4, UFIL5, UFIL6, UFIL7,  
 UFIL8, UFIL9,  
 AWE, CARM, CCIU, CCIR, CCIT, CMES, DEMP17, DCN,  
 DEMP5015, DEMP50, DEMP75, IECT, JITT, URUM, WRUM

**Avg Mode**

Used to activate the averaging function and select the averaging method.



When averaging is activated, an additional parameter field appears in which the average count can be specified.

**OFF** No averaging; each FFT analysis result is displayed immediately and is independent of previous analyses.

Remote-control command:  
SENSE[1]:FUNCTION:FFT:AVERAge:MODE OFF

**Exponential** Averaging is performed continuously and displayed. When the current result is calculated, the previous measurements are taken into consideration using a constant factor. The weighting of the current measurement ( $n$ ) and of the previous measurements ( $n-1$ ) is determined by the selectable average count ( $k$ ); the displayed result of the  $n^{\text{th}}$  measurement ( $n \geq 2$ ) is derived using the following formula:

$$AVG(n) = \frac{1}{k} \cdot FFT(n) + \frac{k-1}{k} \cdot AVG(n-1)$$

Remote-control command:  
SENSE[1]:FUNCTION:FFT:AVERAge:MODE  
EXPOnential

**Normal** The specified number of FFT cycles is performed, the partial results added together and then divided by this number. The result does not appear until all "k" cycles have been completed.

Remote-control command:  
SENSE[1]:FUNCTION:FFT:AVERAge:MODE  
NORMAl



**Avg Count**

Used to enter the average count; only if averaging is activated.



With "normal averaging", the number entered here determines how many consecutive FFTs are used for averaging.

With "exponential averaging", the number "k" entered here determines the extent to which the previous measurements are taken into consideration in the result. The weighting of the previous measurements is  $(k-1)/k$ .

If, for example, 20 is entered as the average count (k), the current analysis result is weighted with 5 % and the previous measurements with 95 %.

Remote-control command:

```
SENSe[1]:FUNCTION:FFT:AVERAge <n>
```

## Zooming

Used to activate the Zoom FFT.

Zooming	<input checked="" type="checkbox"/>	
Zoom Fact	32	
Center	10000.0	Hz
Span	1.37 kHz	
Start	9314.45	Hz
Stop	10685.4	Hz
Resolution	183.105	mHz
Meas Time	170.667	ms

Unlike graphical zooming of the broadband FFT (Zooming OFF), the Zoom FFT analyzes a selectable frequency range with the *full* FFT size. The zoom factor can be varied in powers of 2. As a result, if the FFT size remains constant, the frequency resolution will double with every zoom step. The measurement time will, however, also double at the same time. In order to keep measurement times short, an unnecessarily high zoom factor (as well as an unnecessarily high FFT size) should be avoided.

A specific frequency resolution can be obtained in 2 ways:

- Broadband FFT with large FFT size
- Zoom FFT over a limited frequency band ("span") with smaller FFT size

The time required to record the measurement values is the same in both cases. The total measurement time is, however, less for the Zoom FFT since the time for the FFT calculation and graphical display is shorter owing to the lower number of points.

If the desired frequency resolution is too high to be obtained using the maximum FFT size, the Zoom FFT is the only option to achieve the desired frequency resolution.



Zooming deactivated; broadband FFT analysis is performed.

```
Remote-control command:
SENSE[1]:FUNCTION:FFT:ZOOM 1
```

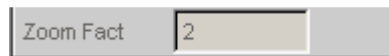


Zooming activated; FFT analysis is performed in a limited frequency band as a Zoom FFT. The parameter fields shown above appear.

```
Remote-control command:
SENSE[1]:FUNCTION:FFT:ZOOM <n>
<n> = 2..128
```

**Zoom Fact**

Displays the zoom factor; only if the Zoom FFT is activated.



The zoom factor can only be specified via remote control; it is varied in integer powers of 2 (2, 4, 8, ...).

The number specified here determines the factor by which the overall band (sampling frequency / 2) is reduced. The resulting frequency band corresponds to the "span".

In manual operation, the zoom factor can only be set indirectly by entering the desired span.

Remote-control command:

SENSe[1]:FUNction:FFT:ZOOM <n>

**Center**

Used to enter the FFT center frequency; only if the Zoom FFT is activated.



With the Zoom FFT, the entry for center frequency together with the selected "span" determines which frequency band is analyzed by the FFT. The start and end value of this band are displayed under "Start" and "Stop".

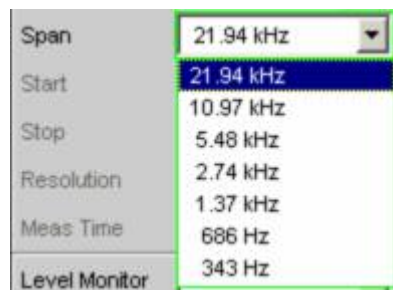
To be able to fully utilize the entire "span", the center frequency must be selected such that the "Start" value is greater than or equal to 0.0 and the "Stop" value is less than or equal to sampling rate / 2 (digital analyzer) or the bandwidth (analog analyzer).

Remote-control command:

SENSe[1]:FUNction:FFT:CENTer <nu>

**Span**

Used to select the FFT bandwidth; only if the Zoom FFT is activated.



The parameter list shown above is generated dynamically according to the current sampling rate. The selection corresponds to the zoom factor, whereby halving the span doubles the zoom factor.

With the Zoom FFT, the selected "Span" together with the set center frequency ("Center") determines which frequency band is analyzed by the FFT. The start and end value of this band are displayed under "Start" and "Stop".

The frequency range actually displayed may be smaller than the selected "Span" if the selected center frequency causes the "Start" value to be less than 0.0 or the "Stop" value to be greater than sampling rate / 2 (digital analyzer) or the bandwidth (analog analyzer).

Remote-control command: -

**Start**

Start value of the FFT frequency band (display only).

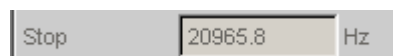


If the Zoom FFT is activated, the *minimum* Start value is limited to 0.0, i.e. no negative frequencies are displayed.

Remote-control command: (query only)  
SENSe[1]:FUNCTION:FFT:START?

**Stop**

End value of the FFT frequency band (display only).



If the Zoom FFT is activated, the *maximum* Stop value is limited to sampling rate / 2 (digital analyzer) or the bandwidth (analog analyzer).

Remote-control command: (query only)  
SENSe[1]:FUNCTION:FFT:STOP?

# Analysis in the Time Domain

In addition to analysis in the frequency domain, the R&S UPV can also be used to analyze input signals in the time domain. Time and frequency-domain analyses can be performed simultaneously and irrespective of the selected measurement function.

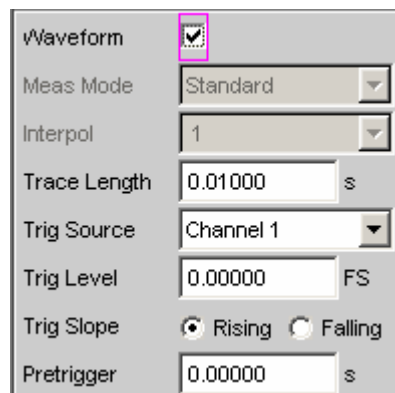
## Waveform Monitor

The waveform monitor is used for signal analysis in the time domain. Both channels of the active analyzer can be measured and displayed simultaneously and synchronously.

- The "Analyzer Function" panel is used to activate the waveform monitor and to configure its trigger condition and memory depth.
- The "Waveform Config" panel is used to select the scaling (incl. limit check and reference).
- The measurement results are displayed graphically in the "Waveform" graphical window.

### Waveform

Used to activate the waveform monitor; the *graphic* is configured and displayed in the configuration and graphical window "Waveform (Config)".



Waveform monitor deactivated.  
Recommended for increasing the measurement speed (e.g. for sweeps or remote-control mode).

Remote-control command:  
SENSe7:FUNCTION OFF

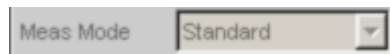


Waveform monitor activated; the parameter fields shown above appear.

Remote-control command:  
SENSe7:FUNCTION ON

**Meas Mode**

Used to select the operating mode.



Not available at present since only the standard operating mode is implemented.

**Standard**

Uncompressed recording of all samples. A maximum of 512 k samples (524288) can be stored. The possible recording length depends only on the bandwidth (analog) or sampling rate (digital).

An interpolation filter can be activated to smooth the trace in the case of periodic signals.

Recommended for short recordings (maximum of a few seconds) and for periodic signals.

Remote-control command: -

**Interpol**

Used to activate an interpolation filter for smoothing the trace. The interpolation factor has to be selected; interpolation is deactivated if "1" is selected.

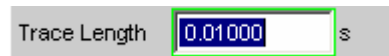


Interpolation is particularly recommended for high-frequency periodic signals. This is because with increasing signal frequency (at a constant sampling rate) fewer samples are available per period and the resolution of the signal over time decreases.

Remote-control command: -

## Trace Length

Used to enter the recording length (memory depth), including an optional pretrigger, in seconds.



A maximum of 512 k samples (524288) can be stored. Apart from the bandwidth (analog) and sampling rate (digital), the possible recording length also depends on the selected operating mode:

- The higher the bandwidth or sampling rate is, the shorter the maximum possible recording length will be.
- The recording length can be multiplied by using one of the compression modes.

The recording length does not depend on the length of the time axis (selected in the "Waveform Config" panel).

The *lower* the selected recording length is, the higher the update rate for the graphic will be.

If a *long* recording duration is set, any section of the recorded samples can be analyzed by reducing the graphical time axis (also possible at a later stage).

---

**Note:**

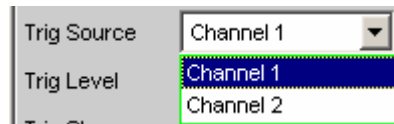
*The selected "Trace Length" (and not the length of the displayed trace section) determines the recording duration for each measurement and therefore the total measurement time. If a high measurement speed is required (e.g. for sweeps or remote-control mode), the memory depth should not be longer than the measurement time of the measurement function.*

---

Remote-control command: -

**Trigger Source**

Used to activate the trigger and to select the trigger source.



Selects the source (usually one of the measurement channels) which is to trigger measurement recording if the trigger threshold is overranged or underranged.

**Channel 1** Measurement channel 1 triggers recording. Only available if measurement channel 1 (or both channels) is activated.

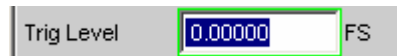
Remote-control command: -

**Channel 2** Measurement channel 2 triggers recording. Only available if measurement channel 2 (or both channels) is activated.

Remote-control command: -

**Trigger Level**

Used to enter the trigger threshold.



Recording is triggered according to the "Trigger Slope" when this level is overranged or underranged.

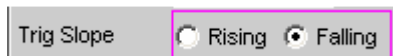
When measurement has been started or recording has been triggered (in the case of continuous measurement), a new recording cycle is not armed again until the trigger threshold is violated in the opposite direction.

Remote-control command: -



Trigger Slope

Used to select the signal edge on which measurement is to be triggered (trigger slope).



Rising

**Triggering** occurs when the level on the measurement channel selected as the "Trigger Source" *exceeds* the trigger threshold for the first time.  
(Re-)arming occurs as soon as a level *below* the trigger threshold exists.

Remote-control command: -

Falling

**Triggering** occurs when the level on the measurement channel selected as the "Trigger Source" *drops below* the trigger threshold for the first time.  
(Re-)arming occurs as soon as a level *above* the trigger threshold exists.

Remote-control command: -

**Pretrigger**

Used to activate the pretrigger and to enter the pretrigger interval in seconds:



The pretrigger is *deactivated* by entering a pretrigger time of 0.0 s.

The pretrigger memory is filled when measurement is started or after recording has been completed; before triggering, it always contains the most recent samples from the time frame selected as the pretrigger.

Similar to a shift register, the pretrigger memory is filled from behind – the older samples move one step forward each time a new sample enters the memory:

- If the time between (re-)starting of the measurement and triggering is *shorter* than the desired pretrigger interval, the front part of the pretrigger memory does not contain any valid data.
- If the desired pretrigger interval has expired, the older samples in the front part are replaced by newer samples.

The *trigger time* is always  $t = 0.0$  s; the pretrigger time is given as a negative time.

---

**Note:**

*The total length of the waveform trace is 512 k samples and is entered under "Trace Length". If the pretrigger is used, the recording duration for the triggered section of the signal is reduced.*

---

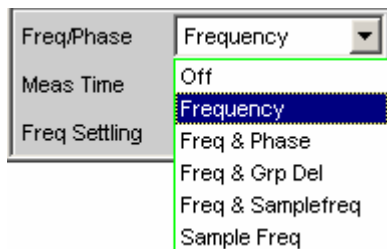
Remote-control command: -

# Frequency, Phase and Group Delay Measurement

The frequency measurement and combined frequency/phase/group delay measurement are performed *upstream* of the digital filters. In the analog analyzer, the frequency is measured *downstream* of the notch filter (if the analog notch filter is activated). If the fundamental is rejected with the notch filter, the frequency meter determines the frequency of the residual signal.

## Freq/Phase

Used to activate the frequency measurement and to select the 2<sup>nd</sup> frequency measurement value.



With 1-channel measurements, it is also possible to select the frequency measurement here; measurement of the sampling frequency can be selected here in the digital analyzer.

With 2-channel measurements, the frequency on the 2<sup>nd</sup> channel is often the same as the frequency on the 1<sup>st</sup> channel. In such cases, it is advisable to display a frequency-related measurement value instead of the frequency in the measurement window of the 2<sup>nd</sup> channel.

**Off** Frequency measurement is deactivated.

Remote-control command:  
SENSe3:FUNction OFF

**Frequency** Frequency measurement is performed on channel 1 and/or channel 2.

Remote-control command:  
SENSe3:FUNction FREquency

**Freq & Phase** Only available for two-channel measuring mode. Frequency measurement is performed on channel 1; the measurement window of channel 2 contains the phase of channel 2 referenced to channel 1.

**Note:**

**The signal from channel 1 is used as the reference signal. This measuring mode should only be selected if the frequency is identical on both channels.**

Remote-control command:  
SENSe3:FUNction FQPhase

**Freq & Grp  
Del**

Only available for two-channel measuring mode. Frequency measurement is performed on channel 1; the measurement window of channel 2 contains the group delay of channel 2 referenced to channel 1.

**Note:**

**The signal from channel 1 is used as the reference signal. This measuring mode should only be selected if the frequency is identical on both channels. The group delay measurement should only be used in the case of frequency changes (e.g. with frequency sweeps); a group delay is not defined in the case of constant frequency.**

The group delay is measured by differentiation of phase with respect to frequency, i.e. by evaluating the difference quotient.

$$t_2 [s] = \frac{\Delta\varphi}{2\pi \cdot \Delta f} \quad \text{where} \quad \Delta\varphi = \varphi_{2mes} - \varphi_{1mes}$$

The following points must be taken into consideration when selecting a frequency sweep for measuring the group delay:

- The frequency step size and the number of sweep points must be selected such that no phase shifts of more than 180° occur between two consecutive sweep points.
- The spacing should be linear; with logarithmic spacing the frequency increments at the bottom could become too small and the phase shifts at the top could become too large.
- In the case of group delay measurement over frequency (e.g. by means of a generator frequency sweep), the first sweep point is undefined because a reference point for calculating the delta values of frequency and phase is only available as of the 2<sup>nd</sup> frequency value.

Remote-control command:  
SENSe3:FUNCTION FQGRoupdelay

**Freq & Sampl  
freq** Only available for two-channel measuring mode.  
A frequency measurement is performed on  
channel 1; the measurement window of channel 2  
contains the sampling frequency.

---

**Note:**

*In this measuring mode, the audio frequency of the  
2<sup>nd</sup> channel is not measured.*

---

Remote-control command:  
SENSe3:FUNction FQSamplefrequency

**Sample Freq** Only available in the digital analyzer.  
The measurement windows contain the sampling  
frequency.

---

**Note:**

*In this measuring mode, the audio frequency is not  
measured.*

---

Remote-control command:  
SENSe3:FUNction SFrequency

## Meas Time

Used to select the measurement speed.

**Fast**

The frequency and (if applicable) phase measurement is optimized with respect to *speed*. A 4 k FFT is used as the measurement basis for high frequencies and the phase; low frequencies are determined by means of an evaluation of period (with interpolation). This measuring mode does not require any additional processing performance, i.e. the total measurement time of all activated measurement functions does not increase.

Recommended for pure frequency measurements on single-tone signals or for phase measurements on signals whose frequency is not too low (higher than 2 % of the bandwidth and 1 % of the sampling frequency).

Remote-control command:  
SENSe3:FREQuency:APERTure:MODE FAST

**Prec**

The frequency and (if applicable) phase measurement is optimized with respect to *precision*. A precision FFT with up to 256 k points is used as the measurement basis. The FFT length is automatically adapted to the measured signal frequency so that measurement can always be performed with the smallest possible FFT (and, therefore, in the shortest possible time). Depending on the activated measurement function, the total measurement time can increase in this measuring mode since it may be necessary to calculate an (additional) FFT.

**Note:**

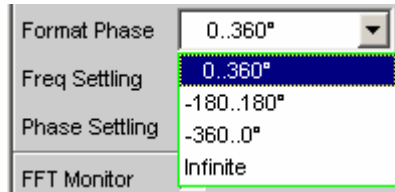
*Digital or analog filters which are active in the activated function measurement are also used in the frequency measurement. If only the unfiltered frequency or phase measurement result is required, the function measurement should be deactivated.*

Recommended for signals with a high noise component, multi-tone signals and for measuring the phase of low frequencies.

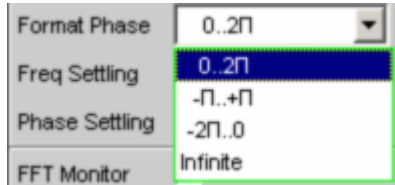
Remote-control command:  
SENSe3:FREQuency:APERTure:MODE  
PRECision

**Format Phase**

Used to select the phase display format; only available if phase measurement is activated.



or



depending on whether degrees or RAD has been selected for the phase unit.

**0..360°** The phase is displayed in the range 0° to 360°; only available if "°" has been selected for the phase unit.

Remote-control command:  
SENSe3:PHASe:FORMat POSitive

**-180..180°** The phase is displayed in the range +/- 180°; only available if "°" has been selected for the phase unit.

Remote-control command:  
SENSe3:PHASe:FORMat POSNegative

**-360..0°** The phase is displayed in the range -360° to 0°; only available if "°" has been selected for the phase unit.

Remote-control command:  
SENSe3:PHASe:FORMat NEGative

**0..2π** The phase is displayed as a radian from 0 to 2π; only available if "RAD" has been selected for the phase unit.

Remote-control command:  
SENSe3:PHASe:FORMat RAD

**-π..+π** The phase is displayed as a radian from -π to +π; only available if "RAD" has been selected for the phase unit.

Remote-control command:  
SENSe3:PHASe:FORMat RADBipolar

**-2 $\pi$ ..0** The phase is displayed as a radian from  $-2\pi$  to 0; only available if "RAD" has been selected for the phase unit.

Remote-control command:  
SENSe3:PHASe:FORMat RADNegative

**Infinite** The phase is displayed continuously ( $-\infty$  to  $+\infty$ ).

---

**Note:**

*The continuous phase display is mainly used for frequency sweeps to allow the phase characteristic to be displayed even in the case of phase displacement above 360°. This measuring mode is usually unsuitable for measurements without frequency variation since such measurements do not have a valid previous value.*

---

The continuous phase is measured by adding the phase difference between two consecutive phase measurement results to the phase measurement value of the first measurement result:

$$\varphi_2 = \varphi_1 + \Delta\varphi \quad \text{where} \quad \Delta\varphi = \varphi_{2mes} - \varphi_{1mes}$$

When configuring a frequency sweep for measuring the continuous phase, the frequency step size and the number of sweep points must be selected such that no phase shifts of more than 180° occur between two consecutive sweep points.

Remote-control command:  
SENSe3:PHASe:FORMat INFinite

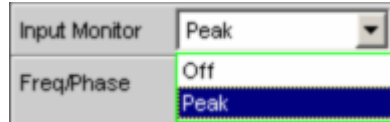


# Input Monitor

The input monitor is a level meter which determines the input level upstream of *all* digital filters (i.e. also *upstream* of the prefilter). In the analog analyzer, only the analog notch filter (if activated) is located upstream of the measurement point of the input monitor.

## Input Monitor

Used to activate the input level meter and to select the measurement method.



**Off** The input monitor is deactivated.

Remote-control command:  
SENSe2:FUNction OFF

**Peak** The peak input value is measured. The numerically highest input sample is determined within a preset interval.

---

**Note:**

*Unlike the peak measurement, which (like all measurement functions) is performed downstream of the filters, no interpolation filter (oversampling filter) is used.*

---

Remote-control command:  
SENSe2:FUNction IPEAK

**Phase To Ref** Measurement of the phase between the selected digital input and the reference input. Selectable only in the digital analyzer when the jitter/phase measurement mode is activated.

The jitter measurement data (function, level and frequency) is simultaneously displayed in the other measurement windows.

Remote-control command:  
SENSe2:FUNction PHASetorefDIGinpampl

**Dig Inp Amp** Measurement of the digital input amplitude at the selected digital input ("Bal" or "Unbal"). Selectable only in the digital analyzer when the common/input measurement mode is activated.

The common-mode voltage data (function, level and frequency) is simultaneously displayed in the other measurement windows.

---

**Note:** *The common-mode voltage can be measured only at the balanced input connector ("Bal"). If the unbalanced ("Unbal") input has been selected as "Input", only the digital input amplitude can be displayed. The measurement values for the common measurement (function, level and frequency values) are not displayed.*

---

Remote-control command:  
SENSe2:FUNction DIGInpampl

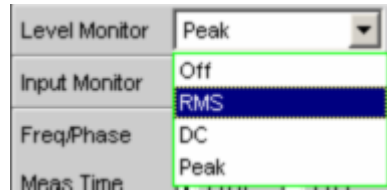
See section "[Level Measurements](#)" on page 4.150 and section "[Level Monitor](#)" on page 4.238 for further level measurement options.

## Level Monitor

The level monitor is a level meter which is used to determine the level *downstream* of the prefilter but *upstream* of the function-specific digital filters. In the analog analyzer, the analog notch filter (if activated) is also located upstream of the measurement point of the level monitor.

### Level Monitor

Used to activate the level monitor and to select the measurement method.



**Off** The level monitor is deactivated.

Remote-control command:  
SENSe6:FUNction OFF

**RMS** A broadband RMS measurement with automatic period detection is performed. The measurement method corresponds to the RMS measurement function in the "Meas Time Auto" mode. With weak signals, measurement is performed over a fixed period of 100 ms. Any superimposed DC components are also measured but (in the analog analyzer) are suppressed by the system hardware if the AC coupling is activated.

---

**Note:**

*In the case of multi-tone signals without dominant components, period detection cannot deliver reliable results; in this case, the RMS result will exhibit slightly larger fluctuations.*

---

Remote-control command:  
SENSe6:FUNction LRMS

**DC** A DC voltage measurement with automatic AC suppression is performed. The measurement method corresponds to the DC measurement function in the "Meas Time Auto" mode. With weak signals, measurement is performed over a fixed period of 100 ms. Only available in the analog analyzer if DC coupling is activated.

---

**Note:**

*In the case of multi-tone signals without dominant components, AC period detection cannot deliver reliable results; in this case, the DC result will exhibit slightly larger fluctuations.*

---

Remote-control command:  
SENSe6:FUNction DC

**Peak**

A measurement of the input peak value is performed. The input sample with the highest magnitude is determined within a predefined time interval. This time interval is obtained from the period length of the measurement signal. A fixed time of 100 ms is required in order to measure weak signals.

---

**Note:** *In contrast to the peak measurement, which, like all measurement functions, is performed after the filters, no interpolation filter (oversampling filter) is required.*

---

Remote-control command:  
SENSe6:FUNction PEAK

See section "[Level Measurements](#)" on page 4.150 and section "[Input Monitor](#)" on page 4.236 for further level measurement options.

## Filters

This section describes the setting options for *User-Definable Filters* and the available *Weighting Filters*.

The user-definable filters are configured in the Filter panel. They can then be used in the analyzer as prefilters and function filters and also in the generator.

The weighting filters are not selected in the Filter panel. They are selected together with the freely configurable filters in the selection fields of the analyzer and generator.

The section "Filter Table" provides an overview of the filters which can be set up in the analyzer and generator, together with the remote-control parameters.

## Analyzer Prefilter

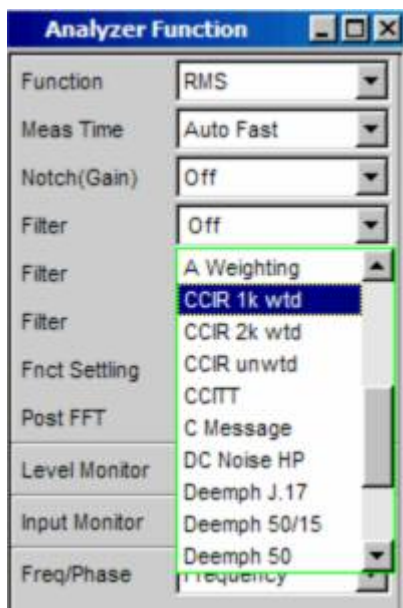
A filter which influences all measurement functions can be selected in the Analyzer Config panel. One of the user-definable filters in the Filter panel or a weighting filter can be selected. This means that prefiltering is possible without having to select the required filter for every single measurement function.



Remote-control command:  
INPut:FiLTeR OFF

## Analyzer Function Filters

In the Analyzer Function panel, up to 3 of the user-definable filters in the Filter panel or weighting filters can be looped into the measurement path regardless of which level measurement method is selected.



```
Remote-control command:  
SENSe[1]:FILTer CCIR  
SENSe[1]:FILTer2 UFIL5  
SENSe[1]:FILTer3 OFF
```

## Generator Filters

Most of the generator signals can be filtered in the time domain. One of the user-definable filters in the Filter panel or a weighting filter can be selected in the Analyzer Function panel.



```
Remote-control command:  
SOURce:FILTer AWE
```

## Filter Table

Overview of the filters which can be set up in the analyzer and generator, together with the remote-control parameters.

Filter deactivated	Display in selection field <b>Off</b>	Remote-control parameter <b>OFF</b>
User-definable filters	Defined in Filter panel as <b>Filter 01</b> <b>Filter 02</b> <b>Filter 03</b> <b>Filter 04</b> <b>Filter 05</b> <b>Filter 06</b> <b>Filter 07</b> <b>Filter 08</b> <b>Filter 09</b>	Remote-control parameter <b>UFIL1</b> <b>UFIL2</b> <b>UFIL3</b> <b>UFIL4</b> <b>UFIL5</b> <b>UFIL6</b> <b>UFIL7</b> <b>UFIL8</b> <b>UFIL9</b>
Weighting filter	Display in selection field <b>A Weighting</b> <b>CCIR 1k wtd</b> <b>CCIR 2k wtd</b> <b>CCIR unwtd</b> <b>CCITT</b> <b>C Message</b> <b>DC Noise HP</b> <b>Deemph J.17</b> <b>Deemph 50/15</b> <b>Deemph 50</b> <b>Deemph 75</b> <b>IEC Tuner</b> <b>Jitter wtd</b> <b>Rumble unwtd</b> <b>Rumble wtd</b>	Remote-control parameter <b>AWE</b> <b>CCIR</b> <b>CCIA</b> <b>CCIU</b> <b>CCIT</b> <b>CMES</b> <b>DCN</b> <b>DEMP17</b> <b>DEMP5015</b> <b>DEMP50</b> <b>DEMP75</b> <b>IECT</b> <b>JITT</b> <b>URUM</b> <b>WRUM</b>

## User-Definable Filters

In the Filter panel, 9 filters (defined as Filter 01 to Filter 09) can be defined individually as low-pass filters, high-pass filters, bandpass filters, band-stop filters, notch filters, third-octave filters or octave filters.

These filters are implemented as recursive, elliptical eighth-order digital filters (exception: fourth order is also possible for low-pass and high-pass filters). All filters are calculated by means of frequency transformation from a database with standardized reference low-pass filters. The ripple in the passband is 0.1 dB; stopband attenuation is available in steps of approx. 10 dB.

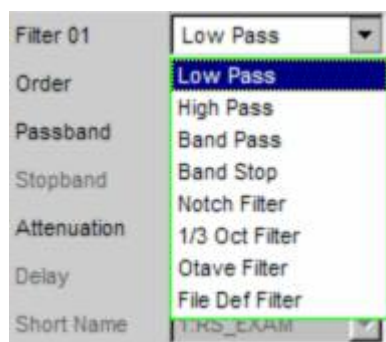
The user only has to enter the passband and the minimum stopband attenuation. The frequencies of the stopband are calculated and displayed taking the required stopband attenuation into consideration. The implemented stopband attenuation is always equal to or greater than the specified value.

Apart from the parameters entered in the Filter panel, the sampling rate must also be known to allow calculation of the filter. The other parameters (stop frequency, delay and the attenuation actually implemented) can therefore only be calculated and displayed after the filter has been activated in the analyzer or generator.

### Filter 0i

Filter 0i

Used to select the filter type for Filter i, where i = 1 to 9.



Remote-control command:

```
SENSe[1]:UFILter<i>
LPASS
HPASS
BPASS
BSTOP
NOTCh
TOCTave
OCTave
FILE
```



## Low-Pass Filter and High-Pass Filter

### Order

Used to specify the filter order. Only available for low-pass and high-pass filters. Low-order filters have edges with a lower rate of rise, but settle more quickly.

**4** 4<sup>th</sup> order filter.

Remote-control command:  
SENSE:UFILter<i>:ORDER N4

**8** 8<sup>th</sup> order filter.

Remote-control command:  
SENSE:UFILter<i>:ORDER N8

### Passband

Used to specify the cutoff frequency (-0.1 dB) of the passband in the case of low-pass and high-pass filters.

Remote-control command:  
SENSE[1]:UFILter<i>:PASSb <nu>

### Stopband

Displays the cutoff frequency of the stopband in the case of low-pass and high-pass filters; the cutoff frequency is derived from the selected passband and the stopband attenuation. This value is only updated after the filter is activated.

Remote-control command:  
SENSE[1]:UFILter<i>:STOPb?

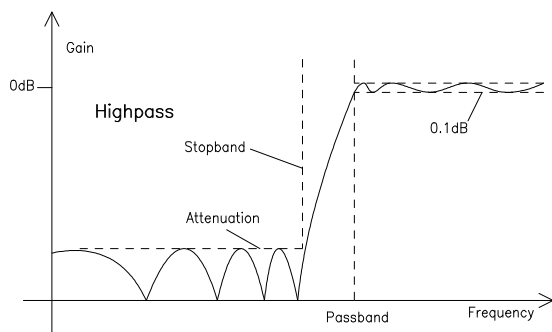
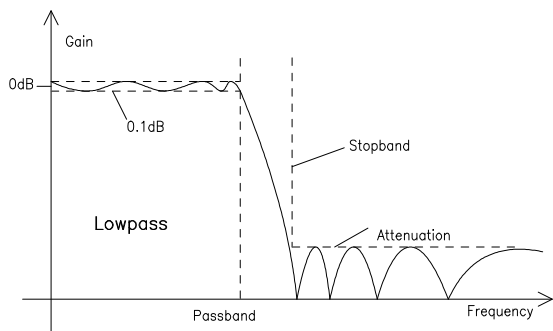


Figure 4-22 Low-pass and high-pass frequency response with filter parameters

## Band-Pass Filters and Band-Stop Filters

### Passb Low

Used to specify the lower cutoff frequency (-0.1 dB) of the passband in the case of bandpass and band-stop filters.

Remote-control command:  
`SENSe[1]:UFILter<i>:PASSb:LOWer <nu>`

### Passb Upp

Used to specify the upper cutoff frequency (-0.1 dB) of the passband in the case of bandpass and band-stop filters.

Remote-control command:  
`SENSe[1]:UFILter<i>:PASSb:UPPer <nu>`

### Stopb Low

Displays the lower cutoff frequency of the stopband in the case of bandpass and band-stop filters; the cutoff frequency is derived from the selected passband and the stopband attenuation. This value is only updated after the filter is activated.

Remote-control command:  
`SENSe[1]:UFILter<i>:STOPb:LOWer?`

**Stopb Upp**

Displays the upper cutoff frequency of the stopband in the case of bandpass and band-stop filters; the cutoff frequency is derived from the selected passband and the stopband attenuation. This value is only updated after the filter is activated.

Remote-control command:  
`SENSe[1]:UFILter<i>:STOPb:UPPer?`

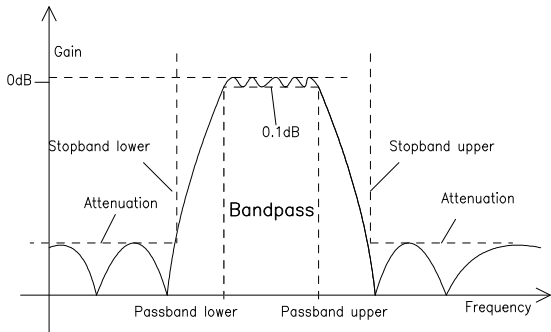


Figure 4-23 Band-pass frequency response with filter parameters

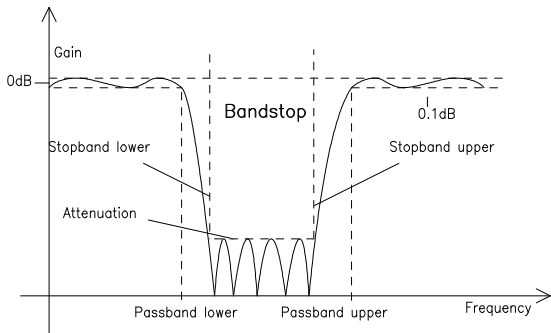


Figure 4-24 Band-stop frequency response with filter parameters

## Notch Filter, Third-Octave Filter and Octave Filter

### Center Freq

Used to specify the center frequency. The notch filter has a transmission zero at the center frequency; the attenuation at this frequency is considerably greater than the specified stopband attenuation.

Remote-control command:  
SENSe[1]:UFILter<i>:CENTer <nu>

### Width

For notch filter: used to *specify* the difference between the upper and lower cutoff frequency (-0.1 dB) of the passband.

Remote-control command:  
SENSe[1]:UFILter<i>:WIDTh <nu>

For third-octave and octave filter: *displays* the width of the passband.

Remote-control command:  
SENSe[1]:UFILter<i>:WIDTh?

### Stopb Low

Displays the lower cutoff frequency of the stopband; the cutoff frequency is derived from the selected passband and the stopband attenuation (only for the notch filter). This value is only updated after the filter is activated.

Remote-control command:  
SENSe[1]:UFILter<i>:STOPb:LOWer?

### Stopb Up

Displays the upper cutoff frequency of the stopband; the cutoff frequency is derived from the selected passband and the stopband attenuation (only for the notch filter). This value is only updated after the filter is activated.

Remote-control command:  
SENSe[1]:UFILter<i>:STOPb:UPPer?

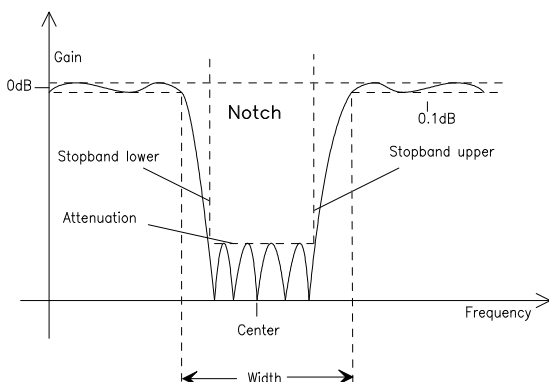


Figure 4-25 Notch-filter frequency response with filter parameters

Third-octave and octave filters are bandpass filters whose passband is geometrically symmetrical to the center frequency, whereby the passband frequencies are derived from the center frequency as follows:

**Third-  
octave  
filter:**

$$\text{Passband low} = \text{CenterFreq} / \sqrt[6]{2}$$

$$\text{Passband upp} = \text{CenterFreq} \cdot \sqrt[6]{2}$$

$$\text{Bandwidth} = \sqrt[6]{2} - \frac{1}{\sqrt[6]{2}} = 0.2315 = 23.15\%$$

**Oktave  
filter:**

$$\text{Passband low} = \text{CenterFreq} / \sqrt{2}$$

$$\text{Passband upp} = \text{CenterFreq} \cdot \sqrt{2}$$

$$\text{Bandwidth} = \sqrt{2} - \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}} = 0.7071 = 70.71\%$$

---

**Note:**

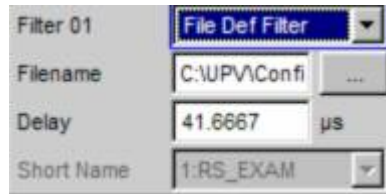
*With the third-octave and octave filters, the 0.1 dB bandwidth is reduced until an attenuation of approx. 3 dB is obtained for the cutoff frequencies. The displayed numeric value for "Width" is therefore less than the 3 dB bandwidth of the third-octave and octave filter.*

---


## File-Defined Filter

If the filters installed on the instrument do not satisfy the requirements of the application concerned, it is possible to read in a filter from a file. Two file formats are supported in which the filter is described either by means of the coefficients of the transmission function (\*.coe) or using the poles and zeros (\*.zpz or \*.npz) on the Z level.

### File Def Filter



A file can be loaded in which the filter is described either by means of the coefficients of the transmission function (\*.coe) or using the poles and zeros (\*.zpz or \*.npz) on the Z level.

The  button opens a browser which can be used to select the filter file.

Remote-control command:  
SENSe[1]:UFILter<i>:FNAME 'filename'

### Coefficients of the transmission function

The filter in the file must be an IIR filter with four pairs of poles and zeros in the form of four consecutive biquads.

The transmission function  $S(z)$  is then derived as follows:

$$S(z) = \text{gain} \cdot \frac{\prod_{i=0}^3 (z^2 + z \cdot b1i + b2i)}{\prod_{i=0}^3 (z^2 - z \cdot a1i - a2i)}$$

**Example:** See the file RS\_EXAM.COE in the directory D:\UPV\USER

---

#### Note:

*The coefficient file \*.COE is only valid for the sampling rate determined during the design stage, i.e. the frequency response of the filter is standardized to this sampling rate. If a different sampling rate is set in the R&S UPV, the frequency response changes accordingly.*

---

### Poles and zeros of the transmission function

The filter is defined by specifying the poles and zeros on the Z level. Four pairs of poles and zeros are permitted. Unused poles and zeros must be placed at the origin of the Z level.

The transmission function  $S(z)$  is then derived as follows:

$$S(z) = \text{gain} * \frac{\prod_{i=0}^3 (z - z_{0i})(z - z_{0i}^*)}{\prod_{i=0}^3 (z - z_{pi})(z - z_{pi}^*)}$$

where:  $z_0$  = zeros,  $z_p$  = poles,  $z^*$  = conjugate complex number.

#### File format \*.zpz

**Example:** See the file RS\_EXAM.ZPZ in the directory D:\UPV\USER

#### Note:

The pole/zero file \*.ZPZ is only valid for the sampling rate determined during the design stage, i.e. the frequency response of the filter is standardized to this sampling rate. If a different sampling rate is set in the R&S UPV, the frequency response changes accordingly.

#### File format \*.npz

**Example:** See the file HP\_100HZ.NPZ in the directory D:\UPV\USER

#### Note:

Poles and zeros in the \*.NPZ file are standardized to the sampling frequency specified there. If a different sampling rate is set in the R&S UPV, poles and zeros are converted to this rate so that the frequency response of the filter remains unchanged. A reference point for the frequency response (defined by the reference frequency and reference gain at this frequency) must be specified in the file.

## Parameters Common to All Filters

### Attenuation

Used to specify the desired filter attenuation of the stopband in dB. When the filter is activated, the attenuation actually implemented must be entered here (this attenuation is normally greater than the entered value). Filter attenuation in steps of approx. 10 dB is possible.

Remote-control command:  
SENSe[1]:UFILter<i>:ATTenuation <nu>

### Delay

Displays the estimated settling time of the filter. This value is only updated after the filter is activated.

Remote-control command:  
SENSe[1]:UFILter<i>:DELAy?

Exception: With file-defined filters, a settling time is calculated and displayed after the coefficients are read in. This settling time can then be changed manually.

Remote-control command:  
SENSe[1]:UFILter<i>:DELAy <nu>

### Short Name

Displays a short name under which the filter can be called up in the analyzer or generator. The short name consists of the filter type code (2 letters) and the frequency. (LP = low-pass filter, HP = high-pass filter, BP = bandpass filter, BS = band-stop filter, TZ = third-octave filter, OC = octave filter, NO = notch filter).

The name of the file is shown here in the case of file-defined filters.

## Filter Settling Time

The settling time of the filter can be estimated from the filter parameters. Certain filters (e.g. filters with steep edges and narrowband bandpass filters) have longer settling times.

When measurement is started (e.g. by making new settings, pressing the start key or in the case of a sweep), the R&S UPV waits until this settling time expires for every filter before performing the actual signal integration. If (in exceptional cases) the calculated time is too short, the filters cannot settle properly before the measurement is started. This can result in unstable measurement values.

The following trick can be used to remedy this problem:

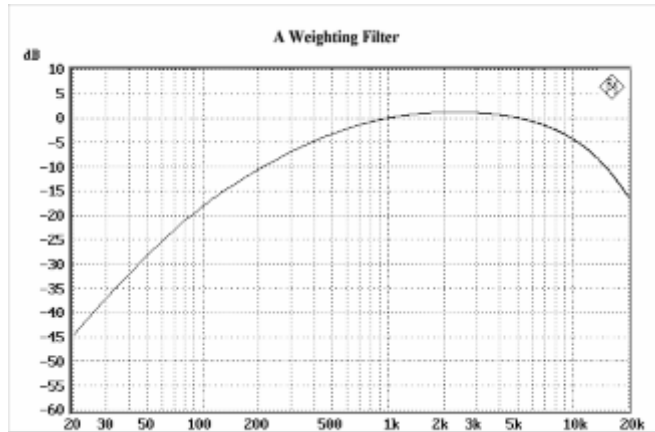
If the file-defined filter "DELAY.COE" (in the directory D:\UPV\USER) is selected, a settling time can be entered there which is then added to the settling time of the other filters when measurement is performed. The DELAY.COE filter has no other function.



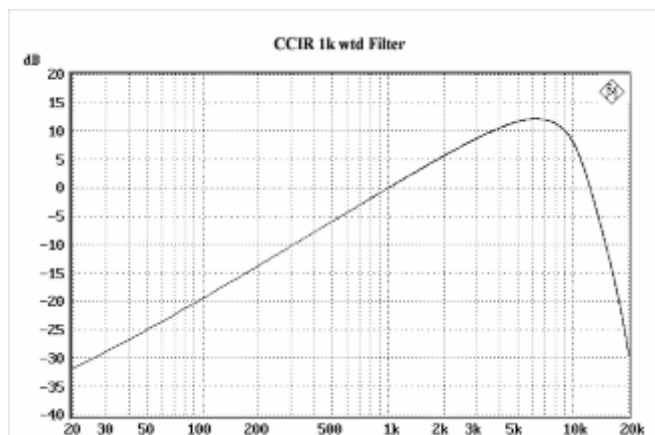
# Weighting Filters

In addition to the user-definable filters, the R&S UPV also offers a large number of weighting filters which conform to the relevant standards.

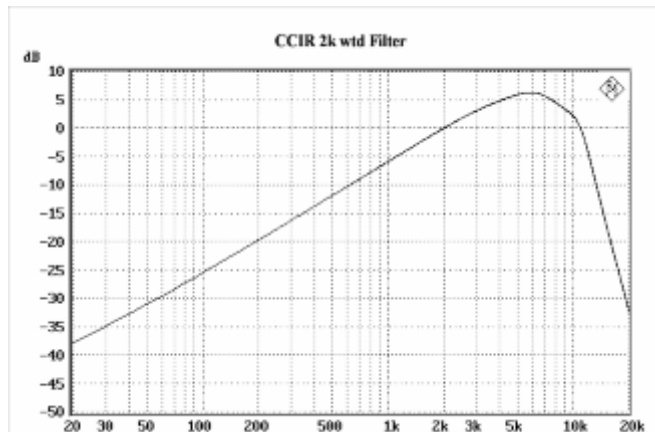
Filter: A Weighting  
 Standards: DIN 45412, DIN 45633  
 IEC 179, IEC 651  
 ANSI S1.4  
 Application: Weighted  
 noise measurement



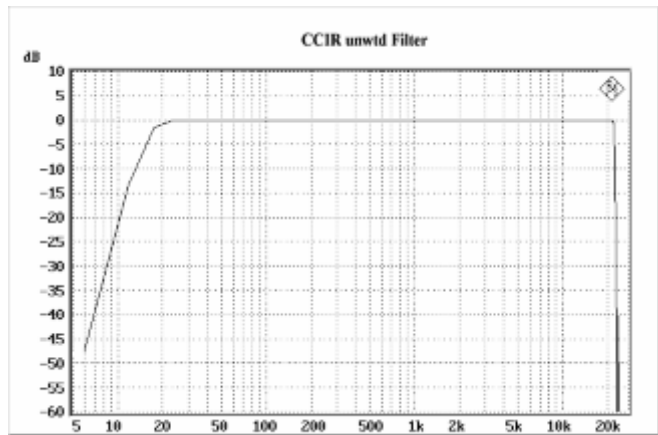
Filter: CCIR 1k wtd  
 Standards: CCIR Rec. 468-4  
 DIN 45405  
 CCITT Rec. N21  
 CISPR 6-76  
 ITU-T J.16  
 Application: Weighted  
 noise measurement



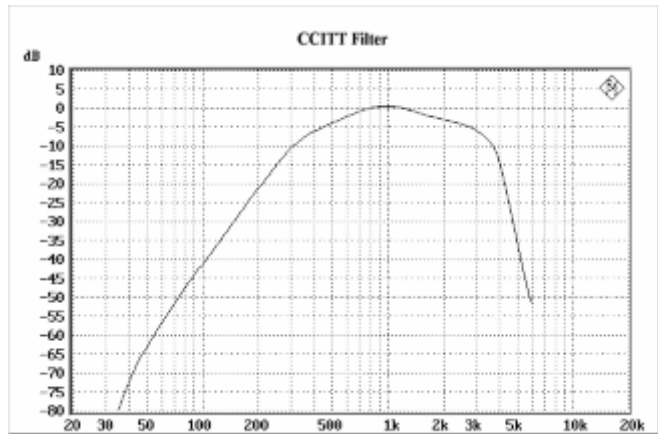
Filter: CCIR 2k wtd  
 Standard: Dolby  
 Application: NAB Standard



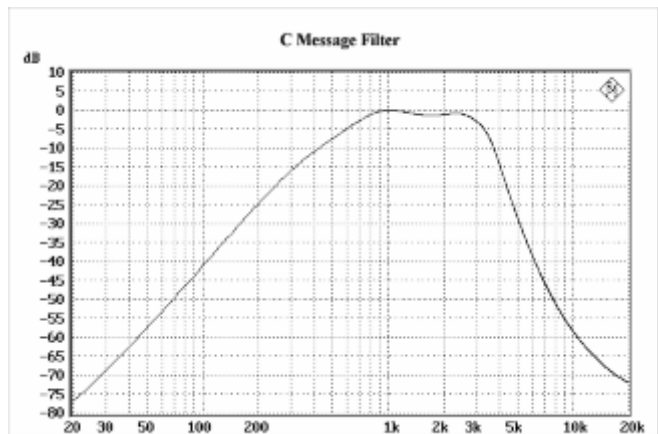
Filter: CCIR unwt'd  
 Standards: CCIR Rec. 468-4  
 ITU-T J.16  
 Application: Band-pass filter from 20 Hz to 20 kHz for band-limited unweighted measurement to CCIR



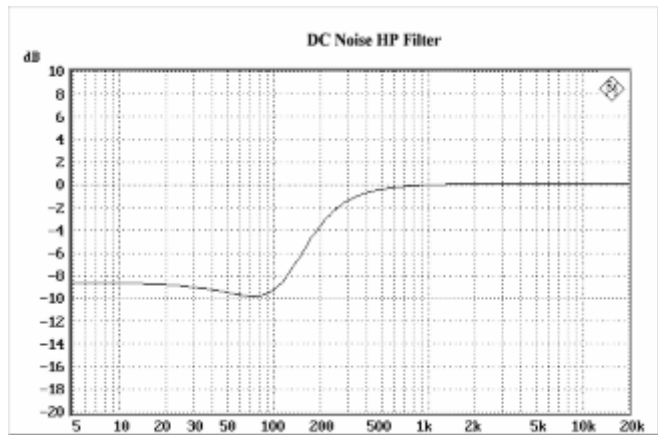
Filter: CCITT  
 Standards: ITU-T Rec. O.41  
 CISPR 6-76  
 ITU-T Rec. P.53  
 Application: Psophometric weighting



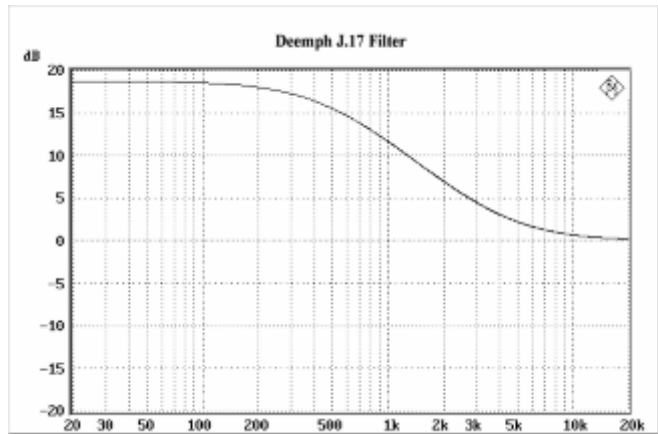
Filter: C Message  
 Standard: IEEE 743-1995  
 Application: Weighted noise measurement



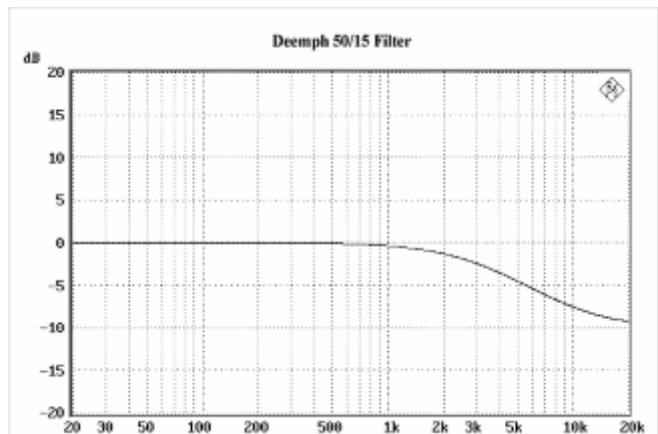
Filter: DC Noise HP  
 Standard: ARD Spec. 3/4  
 ARD Spec. 12/2  
 Application: High-pass filter for  
 measurement  
 of DC noise  
 (tape recorders)



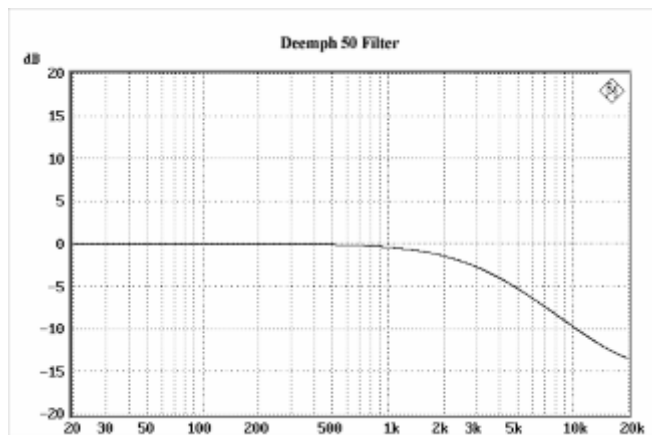
Filter: Deemph J.17  
 Standard: ITU-T J.17  
 Application: Weighted noise measurement



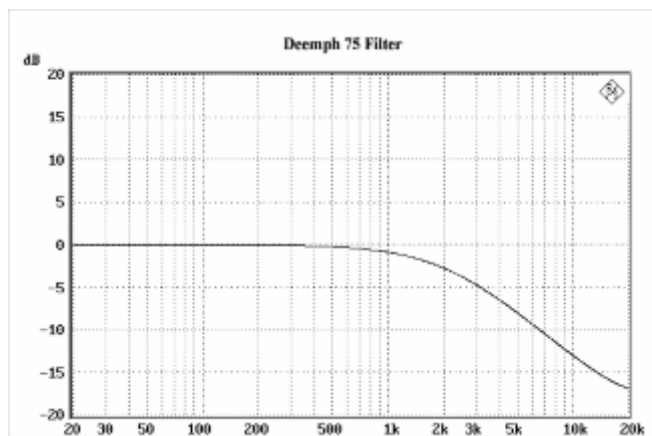
Filter: Deemph 50/15  
 Standard: CCIR Rec. 651  
 Application: Compact disc



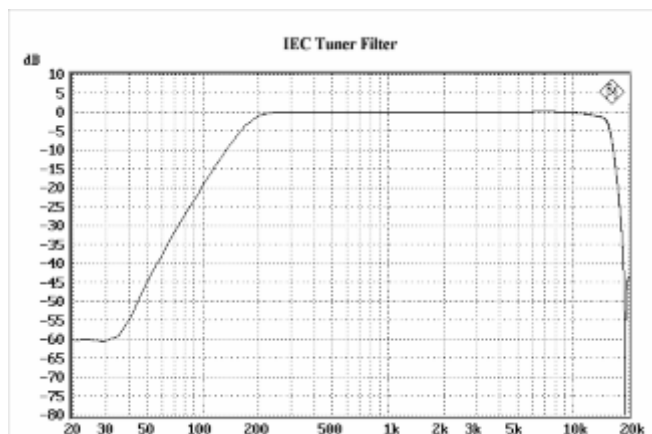
Filter: Deemph 50  
 Standard: ARD Spec. 5/3.1  
 Application: Weighted noise measurement



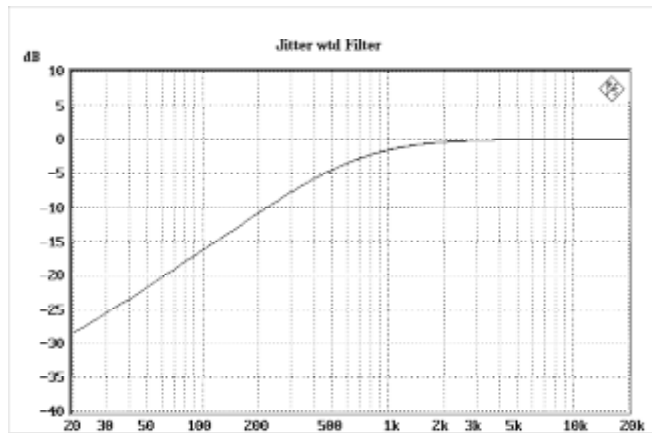
Filter: Deemph 75  
 Standard: ARD Spec. 5/3.1  
 Application: Weighted noise measurement



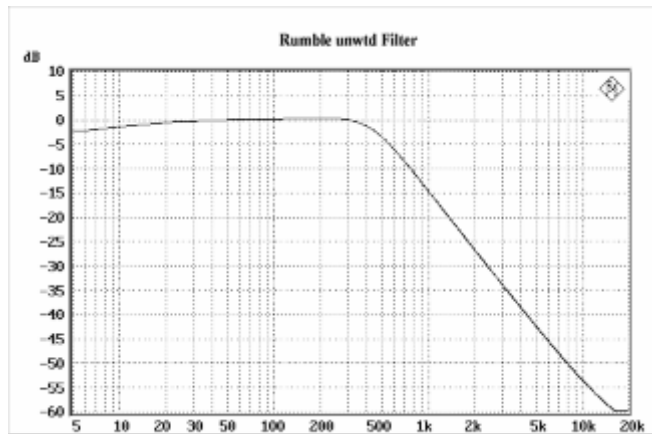
Filter: IEC Tuner  
 Standard: DIN/IEC 60315-4  
 Application: Measurements on FM tuners



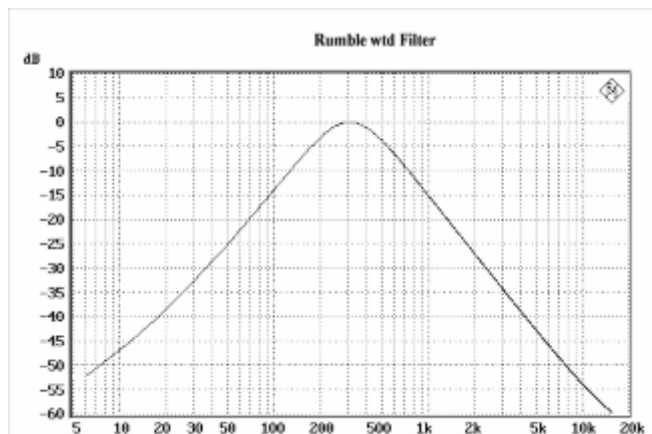
Filter: Jitter wtd  
 Standard: AES 3  
 Application: Weighting of jitter transmission function  
 1st order HP  
 -3 dB at 700 Hz  
 -20 dB at 70 Hz



Filter: Rumble unwtd  
 Standards: DIN 368.3  
 DIN 45539  
 Application: Testing of record players  
 Unweighted noise measurement

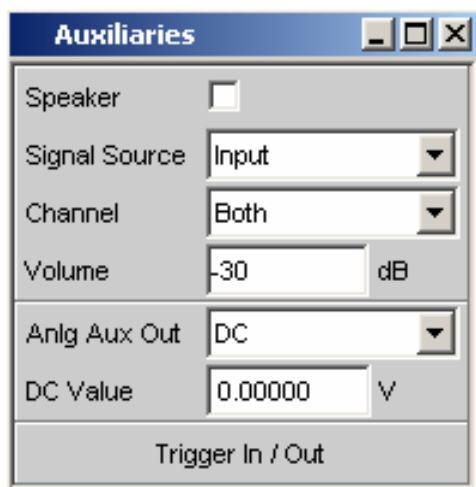


Filter: Rumble wtd  
 Standard: DIN 45539  
 Application: Testing of record players  
 Weighted noise measurement



# Audio Monitoring

## Auxiliaries Panel



The Auxiliaries panel allows audio monitoring of many different sources inside the R&S UPV. Applied and measured analog signals, external digital signals and also analog input signals which have been converted into digital signals and processed can all be monitored by ear.

Figure 4-26 Auxiliaries panel

The Auxiliaries panel allows the user to monitor the signal aurally at many different points along the signal path. The signal to be monitored can be an analog or digital signal, or an externally applied or internally generated signal.

To allow audio monitoring of digital signals, the loudspeaker output has an audio-monitoring D/A converter which converts the digital signals into analog signals.

The audio monitoring signal is output from a loudspeaker integrated in the R&S UPV, at a 6.3 mm jack socket at the bottom right-hand side of the R&S UPV front panel, or at the BNC socket labelled "Anlg Aux Out" at the rear of the R&S UPV. The maximum output voltage can be up to 5 V, depending on the selected configuration.

Speaker

Activates/deactivates the audio monitoring function.



If the tick box is empty, the audio monitoring function is deactivated. If the audio monitoring function is activated, a tick is shown in the tick box. The audio monitoring signal is then output at the volume/voltage set under "Volume".

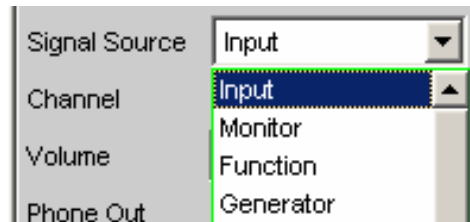


The illustration above shows a section of the R&S UPV front-panel keypad. The internal loudspeaker can be operated directly via these keys. The left-hand key has a toggle function, i.e. the internal loudspeaker is activated/deactivated alternately each time the key is pressed. Pressing the right-hand key opens the window used for setting the volume.

Remote-control command:  
AUXiliaries:SPEaker ON | OFF

Signal Source

Used to select the audio monitoring point along the signal path.



**Input** Audio monitoring of a signal applied at the analyzer inputs. The input signal of the activated analyzer is automatically switched to the audio monitoring output.

Remote-control command:  
AUXiliaries:SPEaker:SOURce INPut

**Monitor** Audio monitoring downstream of the digital prefilter.

Remote-control command:  
AUXiliaries:SPEaker:SOURce MONitor

**Function** The input signal can undergo digital post-processing (processing type depends on the set measurement function) before it is listened to by the user.

Remote-control command:  
AUXiliaries:SPEaker:SOURce FUNction

**Generator**

The digital data signal from the DSP for the currently activated generator is fed to the audio monitoring output via the audio monitoring D/A converter. If the analog generator is being monitored, the audio monitoring D/A converter is actuated using the same digital signals as those fed to the main D/A converter of the analog generator. Audio monitoring is **not** possible with the generator functions "DIM" or "Sine" with activated Low Dist. After one of these functions has been switched on, the following message will appear: "Speaker not available for generator function DIM or Low Dist activated!"

Remote-control command:  
 AUXiliaries:SPEaker:SOURce GENERator

The block diagram below shows the points along the signal processing path at which the signal is tapped and fed to the audio monitoring output:

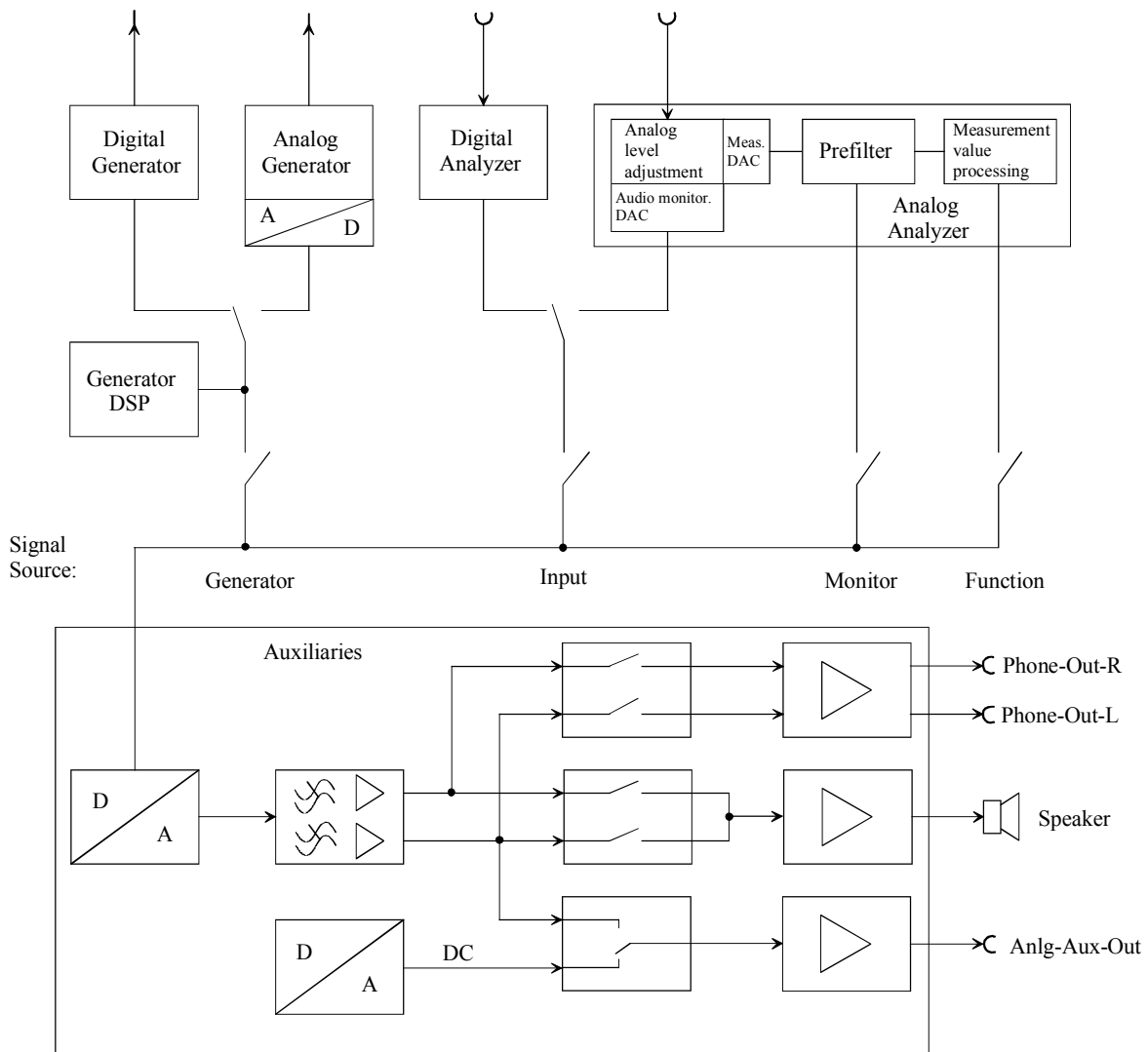
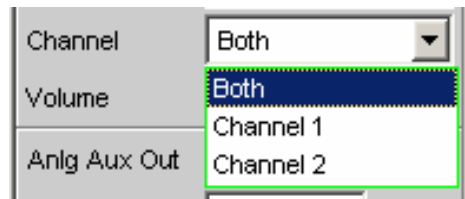


Figure 4-27 Connection to audio monitoring output



**Channel**

Used to select the audio monitoring channel.



This menu item is used to decide whether both channels (Stereo) or just one channel (either Channel 1 or 2) are to be monitored.

**Both** The audio monitoring signal is output on both channels at the audio monitoring output. The internal loudspeaker outputs the signal from both channels.

Remote-control command:  
AUXiliaries:SPEaker:CHANnel STEReo

**Channel 1** Only the signal applied and analyzed via Channel 1 or generated internally is output at the audio monitoring output.

Remote-control command:  
AUXiliaries:SPEaker:CHANnel CH1

**Channel 2** Only the signal applied and analyzed via Channel 2 or generated internally is output at the audio monitoring output.

Remote-control command:  
AUXiliaries:SPEaker:CHANnel CH2

## Volume

Used to set the volume.

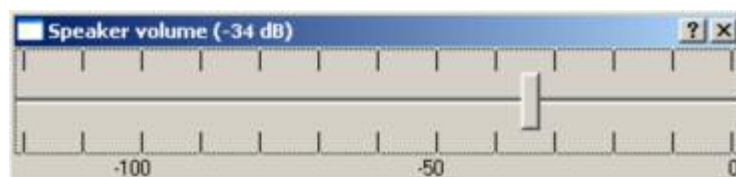


Setting range from 0 dB (highest volume or output voltage) to -120 dB (lowest volume or output voltage). This setting affects all three internal signal paths: the internal loudspeaker, the jack socket on the front panel of the instrument, and the BNC socket (Anlg Aux Out) at the rear of the instrument.

The output voltage can be adjusted by entering values directly in the panel. If Direct mode is active (the entry field has a magenta frame when the field is selected and the selection is confirmed with "Enter"), the output voltage can be adjusted almost steplessly using the cursor keys or the rotary knob.



If the loudspeaker volume symbol (right-hand key) on the R&S UPV keypad is pressed, the following panel appears on the screen:



In this panel, the volume can be adjusted in steps of 1 dB using the rotary knob or cursor keys  $\Rightarrow$  /  $\Leftarrow$  or in steps of 10 dB using the keys "Page  $\Uparrow$ " and "Page  $\Downarrow$ ".

If a mouse is connected to the R&S UPV, the horizontal slider can be operated directly.

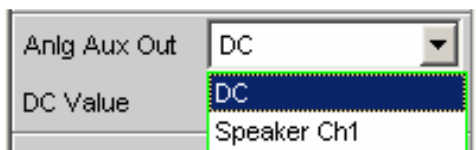
On an external keyboard, this panel can be called up by pressing "Ctrl F9". The output voltage can then be adjusted using the same keys as on the R&S UPV front-panel keypad. The keys "Tab" and "Shift Tab" are used to adjust the output voltage in steps of 1 dB.

The entry window is closed again by pressing the ENTER  $\Leftarrow$  key, the Escape key or by pressing the loudspeaker volume symbol again. If a mouse is used, the window is closed by simply clicking the cross in the top right-hand corner.

Remote-control command:  
 AUXiliaries:SPEaker:VOLume <n>

Anlg Aux Out

Auxiliary BNC output at the rear of the R&S UPV.



**DC** The auxiliary output supplies DC voltage to the BNC socket at the rear of the instrument. This voltage can be used to power an external DUT (Device Under Test, e.g. a hearing aid).

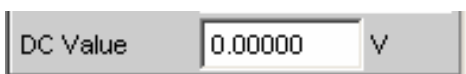
Remote-control command:  
AUXiliaries:AAUXout DC

**Speaker Ch1** The left-hand channel of the audio monitoring signal is output at the rear BNC socket.

Remote-control command:  
AUXiliaries:AAUXout CH1Speaker

DC Value

Magnitude of the DC voltage level at the rear BNC socket.



The DC output voltage can be adjusted between -2.5 V and +2.5 V.

Remote-control command:  
AUXiliaries:DCValue <nu>

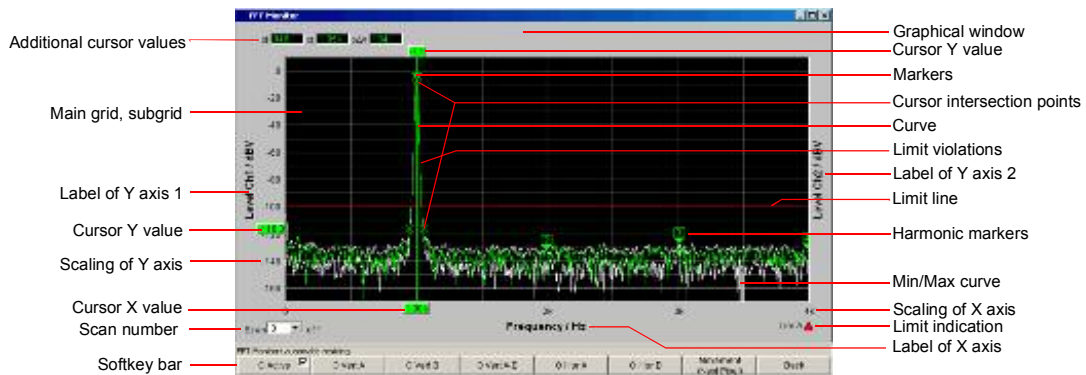
# Traces, Spectrum Displays and Bargraphs

The most informative method of displaying measurement results is usually a two-dimensional graphic. Measurement values as a function of frequency, measurements over a time axis and so on are just a few examples of the many possible applications. The Audio Analyzer R&S UPV makes a distinction between the following graphical windows: Sweep Graph, FFT Monitor, FFT Graph, Waveform and Bargraph. These windows are set up and modified using the associated configuration panel and displayed as traces or bargraphs.

## Graphical Display, Explanation of the Elements

Whether a graphical display is shown as a trace or a bargraph depends on the selected display configuration panel. The sweep graphs, FFT monitor, FFT graphs and waveform graphical windows are displayed as traces, whereas the graphical displays showing the THD measurement results take the form of bargraphs. See the section *"Calling Up"* on page 4.268 for information on how to set up the various display configurations.

The individual elements used in the traces and bargraphs are identical with a few exceptions. For example, some elements are not available for bargraphs (e.g. markers or gridlines for the X axis).



Cursor intersection points The points **O** or **X** at which the cursor line intersects the trace / lines identify the cursor so that a reference to the labels in the softkey bar (e.g. **O Vert A** or **X Hor A**) is provided.

Cursor X value X value for vertical cursors.

Cursor Y value Vertical cursors:  
Y value, or if **O Vert A-B / X Vert A-B** is set, the difference between the Y values for the A and B trace / A and B line.

Horizontal cursors:  
Y value on the Y1 and/or Y2 axis.

Additional cursor values  $\Delta X$ ,  $\Delta Y$ , ol, or, o $\Delta X$ , xl, xr, x $\Delta X$

$\Delta X$ : Difference between the X values if the o and x cursor are both activated as the vertical cursor at the same time.

$\Delta Y$ : Difference between the Y values if the o and x cursor are both activated as the vertical cursor at the same time.

Only for traces (not for bargraphs):

ol: The point to the left of the marker at which the o cursor intersects the trace.

or: The point to the right of the marker at which the o cursor intersects the trace.

o $\Delta X$ : Difference between ol and or.

xl: The point to the left of the marker at which the x cursor intersects the trace.

xr: The point to the right of the marker at which the x cursor intersects the trace.

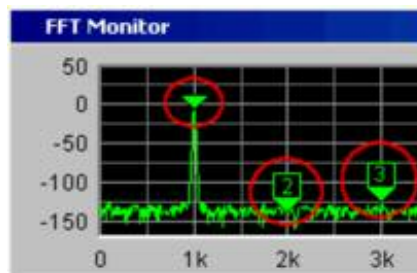
x $\Delta X$ : Difference between xl and xr.

Graphical window The graphical window for the respective graphic subsystem, opened with



Harmonic markers Only for traces (not for bargraphs):

The harmonics (2 kHz and 3 kHz) are marked starting from the X position of the marker (1 kHz).



The harmonic markers are activated using the softkeys:



Main grid, subgrid

Set in the associated panel using the parameter fields



in the sections Trace A, Trace B and X Axis.

Gridlines for the X axis are not available for bargraphs as the X axis in bargraphs is not to scale.

Limit line







Fixed limit or limit curve from a file; set in the associated panel using the parameter fields



in the sections Trace A and Trace B.

Limit indication



-  Limit Upper is activated and there is no limit violation.
-  Limit Lower is activated and there is no limit violation.
-  The Limit Upper value has been violated in the past but there is currently no limit violation. The violation is indicated until the **START** key is pressed again.
-  The Limit Lower value has been violated in the past but there is currently no limit violation. The violation is indicated until the **START** key is pressed again.
-  The Limit Upper value is currently being violated.
-  The Limit Lower value is currently being violated.

Limit violations

Limit violations are indicated by red dots on traces or by red bars in bargraphs:

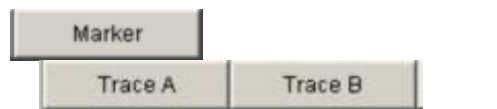


Markers

Only for traces (not for bargraphs):

The X axis value of the marker is used as the basis for calculating the harmonics, and the left and right-hand intersection points of a horizontal cursor with the trace.

The marker is set using the softkeys:

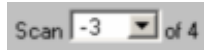


Min/Max curve

The Min curve represents the lowest value of a measurement sequence and the Max curve the highest value. Set in the upper section of the associated panel using the parameter field

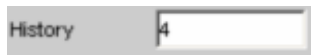


Scan number



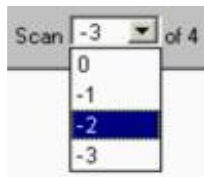
The number of the current scan is displayed here by scrolling through the scans using the **Next Scan** rocker key. The number 0 indicates the most recent scan; the more negative the number, the older the scan.

"of 4" shown in the example indicates the currently set history and informs the user how many scans are stored in the memory or saved in the file. This value is set in the associated panel using



See section ["History"](#) on page 4.271.

Right-clicking the arrow opens a box



in which the desired scan can be selected by clicking the appropriate number. The cursors, markers, limits and so on are then referenced to this scan.

Softkey bar

The softkey menu for the graphical window allows quick configuration of all the important and frequently used settings, especially cursor, marker and zoom functions. See section ["Softkey Menu"](#) on page 4.305 for a detailed description of functionality. The softkeys can also be operated by clicking with the mouse.

Label of X axis

Consists of the label and unit; set with

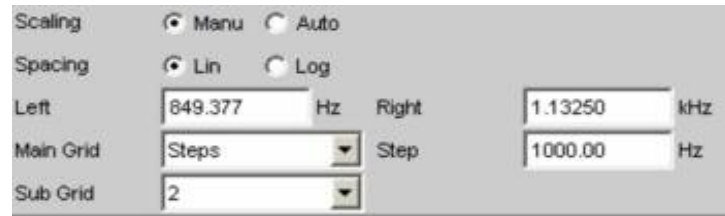


See section ["Parameter Fields of the Panel"](#) on page 4.269.

Scaling of X axis

Only for traces (not for bargraphs):

Automatic or manually set scaling of the X axis; set with



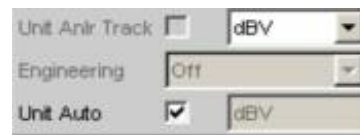
See section ["Parameter Fields of the Panel"](#) on page 4.269.

Label of Y axis 1  
Label of Y axis 2

Consists of the label and unit; set with



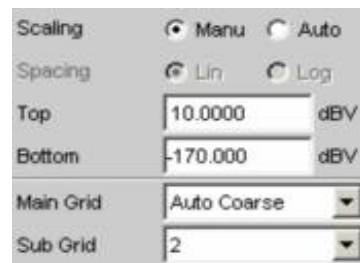
and



See section ["Parameter Fields of the Panel"](#) on page 4.269.

Scaling of Y axis

Automatic or manually set scaling of the Y axis; set with



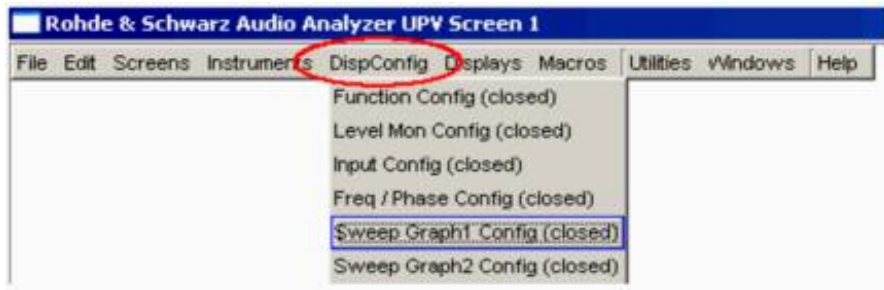
See section ["Parameter Fields of the Panel"](#) on page 4.269.



## Calling Up

The way in which measurement results are to be **displayed** graphically is set up in the display configuration panels. **What** is measured and **how** measurement is performed is configured in the analyzer panel, or in the generator panel in the case of sweeps. The way in which the measurement is displayed can also be changed at a later stage. It is also possible to load and replot traces from files.

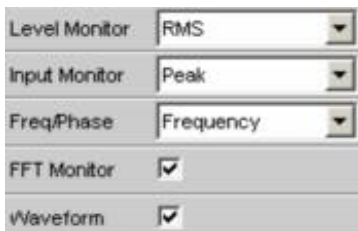
The display configuration panels are opened via the menu bar of the R&S UPV. The menu bar is opened by pressing the [MENU] key on the front panel or, with mouse operation, by moving the pointer to the left-hand edge of the R&S UPV application window; the menu bar then appears at the top left-hand edge of the R&S UPV application.



Six different display configuration panels are available, some with two or four windows; i.e. the measurement data sets for the analyzer measurement function



and the measurement data sets for the additional measurement functions



can be displayed at the same time.

- **Sweep** in 4 windows  
Listed in the menu as **Sweep Graph1 Config** to **Sweep Graph4 Config**.  
The panel is used to configure the display of measurement results from a measurement sequence (sweep) as a diagram in the Cartesian co-ordinate system. Two dependent values can be displayed as TRACE A and TRACE B over an independent X axis.
- **FFT Monitor**  
Listed in the menu as **FFT Monitor Config**.  
The panel is used to configure the display of a frequency spectrum if FFT Monitor is set as the additional measurement function in the analyzer panel.

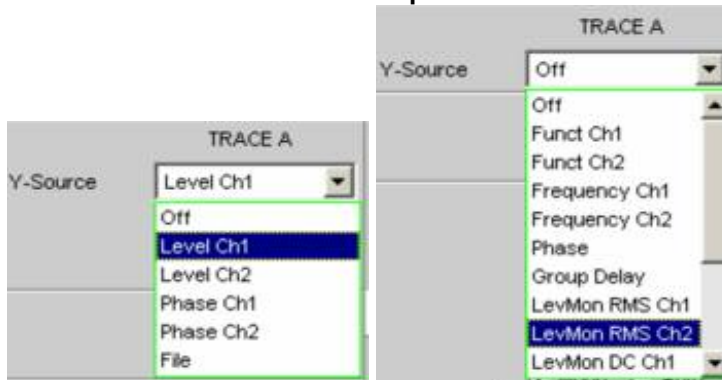
- 
- **FFT Graph** in two windows  
Listed in the menu as **FFT Graph1 Config** and **FFT Graph2 Config**.  
The panel is used to configure the display of a frequency spectrum if the FFT measurement function or a Post FFT is selected in the analyzer panel.
- **Waveform**  
Listed in the menu as **Waveform Config**  
The panel is used to configure the display of a waveform (level over time) if Waveform is selected as the additional measurement function in the analyzer panel.
- **Bargraph** in two windows  
Listed in the menu as **Bargraph1 Config** and **Bargraph2 Config**.  
The panel is used to configure the display of a bargraph with symbolic (i.e. not to scale) X axis if the THD measurement function is selected in the analyzer panel.

## Parameter Fields of the Panel

The layout of the display configuration panels is almost identical for all of the graphic systems. Depending on the graphic system, parameter fields may be omitted or different parameter lists may appear in the selection fields.

For example, in the display configuration panels for

**FFT Monitor**      or      **Sweep**



there are different selection options for the sources of the measurement results. The differences are explained in the respective parameter field description.

### Display



Clicking the **Show** button in the Display parameter field activates the graphical display of traces or bargraphs.

The display is deactivated by pressing the **CLOSE** key or by clicking the X button in the title bar using the mouse, provided that the display window has the focus (see section ["Traces, Spectrum Displays and Bargraphs"](#) on page 4.263).

**Data List**

Clicking the button opens a separate window in which the measurement results for Trace A, Trace B and the values for the X axis are displayed numerically. The display is deactivated by pressing the **CLOSE** key or by clicking the X button in the title bar using the mouse, provided that the display window has the focus (see section ["Result List"](#) on page 4.314).

**Scan**

For:

- FFT Monitor
- Sweep Graph1 to 4

Used to specify whether **one** (Single) or **several** (Multi) measurement sequences are recorded or loaded from a file.

**Single**

Only one trace (measurement sequence) or one trace pair (TRACE A and B) is to be recorded or loaded (see section ["Trace Files"](#) on page 4.344).

The display can be in the form of a trace or a bargraph.  
Each new trace overwrites the previous trace.

The following parameter fields are hidden:

- History
- New Scan
- Import From

**Multi**

With this setting, **not just one** measurement sequence or pair of measurement sequences (Trace A and Trace B) is recorded/loaded and displayed but any number of sequences and sequence pairs (see section ["Trace Files"](#) on page 4.344).

However, only the number selected in the **History** parameter field (max. 20) is stored internally and written to a file (see Saving) or read from a file (see Loading). The scans that are not stored are only available in the graphic and are lost if the graphical window is moved or resized, if rescaling is performed, if trace files are stored/loaded, or if setups are stored/loaded.

The following parameter fields become available:

- History
- New Scan
- Import From

History



Only available if "Scan" is set to "Multi" and therefore only for the graphic systems FFT Monitor or Sweep Graph1 to 4. History determines how many scans are stored in the memory or saved in the file. It is not possible to select "1" as this number represents single-scan mode.

Show MIN/MAX



If the tick box is activated, the Min/Max curves will be displayed. The Min curve represents the lowest value of a measurement sequence and the Max curve the highest value. The Min/Max function is reset each time the [START] key is pressed.

A MIN/MAX display is also possible for graphic systems which do not have any scans (e.g. FFT Graph), i.e. a MIN scan and a MAX scan are recorded. The Show MIN/MAX function is available for the following graphic systems:

- FFT Monitor
- Sweep Graph1 to 4
- FFT Graph 1 and 2
- Bargraph1 and 2

Y-Source

Sweep Graph graphic system



Used to select which sweep measurement results (obtained from one of the sweep functions listed below) are to be collected as TRACE A or TRACE B and displayed graphically on the left-hand or right-hand Y axis.

Example:

The frequency response of a DUT is determined by means of a generator frequency sweep and the analyzer measurement function "RMS" and displayed in the Sweep Graph graphic system as TRACE A.



For more information on Y Source see section "Trace Files" on page 4.344.

- Off No trace is displayed or an available trace is deleted.
- Funct Ch1**  
**Funct Ch2** The **function** measurement result obtained by means of a generator sweep for channel 1 or channel 2 with the set analyzer measurement function



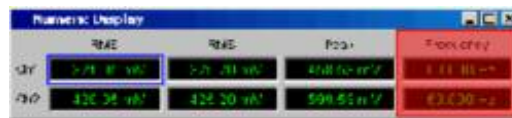
is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87.  
The measurement result is displayed in the numeric display:



- Frequency Ch1**  
**Frequency Ch2** The **frequency** measurement result obtained by means of a generator sweep for channel 1 or channel 2 with the additional measurement function Freq/Phase



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87.  
The measurement result is displayed in the numeric display:



**LevMon RMS Ch1  
LevMon RMS Ch2**

The **RMS** measurement result obtained by means of a generator sweep for channel 1 or channel 2 with the additional measurement function Level Monitor RMS



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87. The measurement result is displayed in the numeric display:

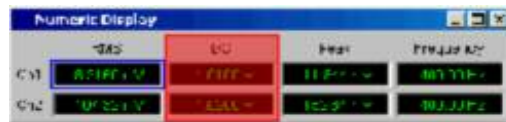


**LevMon DC Ch1  
LevMon DC Ch2**

The **DC** measurement result obtained by means of a generator sweep for channel 1 or channel 2 with the additional measurement function Level Monitor DC



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87. The measurement result is displayed in the numeric display:



**LevMon Max Ch1  
LevMon Max Ch2**

The **spectral maximum** obtained by means of a generator sweep for channel 1 or channel 2 with the additional measurement function Level Monitor Spectral Max



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87. The measurement result is displayed in the numeric display:



**Inp Peak Ch1  
Inp Peak Ch2**

The **peak** measurement result obtained by means of a generator sweep for channel 1 or channel 2 with the additional measurement function Input Peak



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87. The measurement result is displayed in the numeric display:

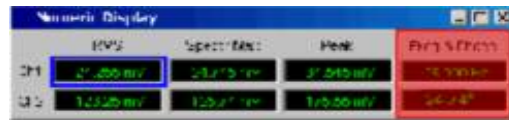


**Phase**

The **phase** measurement result obtained by means of a generator sweep with the additional measurement function Freq/Phase



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87. The measurement result is displayed in the numeric display:



**Group Delay**

The **group delay** measurement result obtained by means of a generator sweep with the additional measurement function Freq & Grp Del



is displayed as Trace A or Trace B over a basic physical quantity selected under "X Axis" on page 4.87. The measurement result is displayed in the numeric display:



**File: Trace A**

Trace A is loaded from a file, see section "Trace Files" on page 4.344.

**File: Trace B**

Trace B is loaded from a file, see section ["Trace Files"](#) on page 4.344.

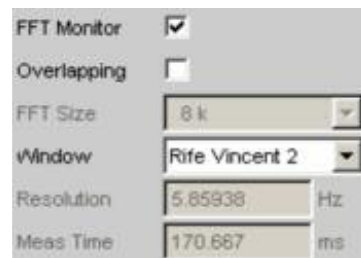
**Y-Source**

**FFT Monitor graphic system**



Used to select which measurement results obtained with the additional measurement function **FFT Monitor** are to be displayed graphically as TRACE A or TRACE B on the left-hand or right-hand Y axis.

Section of the Analyzer Function panel:



For more information on Y Source see section ["Trace Files"](#) on page 4.344.



<b>Off</b>	No trace is displayed or an available trace is deleted.
<b>Level Ch1 Level Ch2</b>	The level measurement result for channel 1 or channel 2 obtained with the FFT Monitor is displayed as Trace A or Trace B over a frequency X axis.
<b>Phase Ch1 Phase Ch2</b>	The phase measurement result for channel 1 or channel 2 obtained with the FFT Monitor is displayed as Trace A or Trace B over a frequency X axis.
<b>File: Trace A</b>	Trace A is loaded from a file, see section <a href="#">"Trace Files"</a> on page 4.344.
<b>File: Trace B</b>	Trace B is loaded from a file, see section <a href="#">"Trace Files"</a> on page 4.344.

**Y-Source**

**FFT Graph graphic system**



Used to select which measurement results obtained with the analyzer measurement function **FFT** are to be collected as TRACE A or TRACE B and displayed graphically on the left-hand or right-hand Y axis.

Section of the Analyzer Function panel:



For more information on Y Source see section ["Trace Files"](#) on page 4.344.

<b>Off</b>	No trace is displayed or an available trace is deleted.
<b>FFT Level Ch1 FFT Level Ch2</b>	The level measurement result for channel 1 or channel 2 obtained with the analyzer measurement function <b>FFT</b> is displayed as Trace A or Trace B over a frequency X axis.
<b>FFT Phase Ch1 FFT Phase Ch2</b>	The phase measurement result for channel 1 or channel 2 obtained with the analyzer measurement function <b>FFT</b> is displayed as Trace A or Trace B over a frequency X axis.
<b>File: Trace A</b>	Trace A is loaded from a file, see section <a href="#">"Trace Files"</a> on page 4.344.
<b>File: Trace B</b>	Trace B is loaded from a file, see section <a href="#">"Trace Files"</a> on page 4.344.

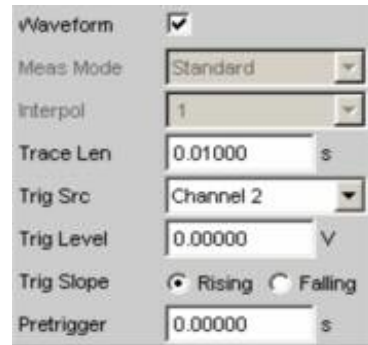
Y-Source

Waveform graphic system



Used to select which measurement results obtained with the additional measurement function **Waveform** are to be collected as TRACE A or TRACE B and displayed graphically on the left-hand or right-hand Y axis.

Section of the Analyzer Function panel:



For more information on Y Source see section ["Trace Files"](#) on page 4.344.

- Off** No trace is displayed or an available trace is deleted.
- Level Ch1** The level measurement result for channel 1 or
- Level Ch2** channel 2 obtained with the waveform measurement function is displayed as Trace A or Trace B over a time X axis.
- File: Trace A** Trace A is loaded from a file, see section ["Trace Files"](#) on page 4.344.
- File: Trace B** Trace B is loaded from a file, see section ["Trace Files"](#) on page 4.344.

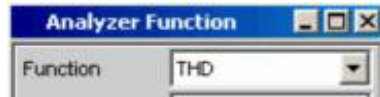
## Y-Source

## Bargraph graphic system



Used to select whether the measurement result for channel 1 or channel 2 obtained with the analyzer measurement function **THD** is to be collected as TRACE A or TRACE B and displayed graphically on the left-hand or right-hand Y axis.

Section of the Analyzer Function panel:



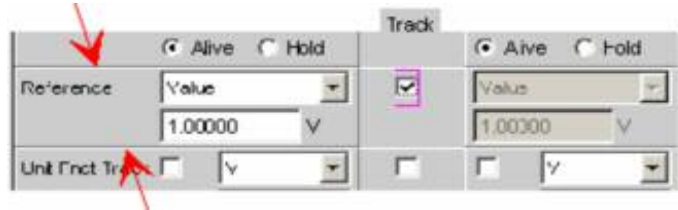
For more information on Y Source see section ["Trace Files"](#) on page 4.344.

<b>Off</b>	No trace is displayed or an available trace is deleted.
<b>Funct Ch1 Funct Ch2</b>	The function measurement result for channel 1 or channel 2 obtained with the analyzer measurement function <b>THD</b> is displayed as Trace A or Trace B over a not-to-scale frequency X axis.
<b>File: Trace A</b>	Trace A is loaded from a file, see section <a href="#">"Trace Files"</a> on page 4.344.
<b>File: Trace B</b>	Trace B is loaded from a file, see section <a href="#">"Trace Files"</a> on page 4.344.

Track

Track

If a tick box is available in the Track column, the settings for the parameters concerned can be transferred from TRACE A to TRACE B. The horizontal partition lines in the panel indicate the parameters for which tracking applies.



The content of the parameter fields for TRACE A are transferred to TRACE B. The parameter fields for TRACE B then appear grey and cannot be accessed.

**Changes** made to the settings in TRACE A are transferred immediately to TRACE B.  
Example:



The parameter fields for TRACE A and TRACE B can be accessed and changed separately.  
Example:



**Label Auto**

Used to label the left-hand (Trace A) or right-hand (Trace B) Y axis of the graphical display.



The label (which is selected under TRACE A or TRACE B), i.e. the name of the measurement result which is displayed as TRACE A or TRACE B, is displayed in grey (cannot be accessed) in the text field to the right of the tick box and also on the Y axis in the graphical display.



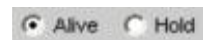
Here rotated by 90°.



A user-definable label appears on the Y axis of the graphical display.



Here rotated by 90°.



Used to enable or freeze the display of new measurement values for Trace A or Trace B.

**Alive** New measurement values are displayed, see section ["Trace Files"](#) on page 4.344.

**Hold** The last trace remains in the display, see section ["Trace Files"](#) on page 4.344.

## Reference



It can be a single numeric value or a data set (reference trace). It applies to all numeric values of the trace, i.e. measurement values, top/bottom/limit values and all the scans of a trace; the same reference value therefore applies for all scans. Used to select the reference for referenced units (e.g. dB<sub>r</sub>, V/V<sub>r</sub> or ΔHz) for Trace A or Trace B.

## Meas Panel

The reference value from the associated measurement function configuration panel is used.

Example:

The additional measurement function Input Monitor is activated in the analyzer panel:



In the Sweep Graph1 graphic system, the result of the Input Peak measurement for channel 1 is selected as the source for Trace A:

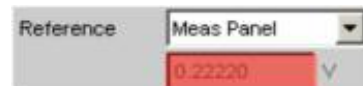


The measurement results of the additional measurement function Input Monitor are therefore plotted as Trace A on the Y1 axis.

In the Input Config panel, the reference value for the additional measurement function is set to 0.2222 V.



If Reference is now set to Meas Panel,



the reference value from the Input Config panel is entered here and used if referenced units are selected.

The advantage of adopting the reference value in this way is that a measurement display in **referenced units** in the numeric display or combi display can be compared with the measurement values in the graphical display.

<b>Value</b>	A numeric value with unit must be entered as the reference value in the parameter field below.
<b>Max</b>	The maximum Y value of the measurement sequence is used once only as the reference value. The setting then returns to Value and the reference value is displayed in the parameter field below.
<b>* Cursor</b>	The Y value at which the * cursor is positioned is used once only as the reference value. The setting then returns to Value and the reference value is displayed in the parameter field below. If the * cursor is an A-B cursor, the value of the trace for which the reference value is intended is used, i.e. the * cursor of Trace A if the * cursor was selected as the reference value for Trace A.
<b>o Cursor</b>	The Y value at which the o cursor is positioned is used once only as the reference value. The setting then returns to Value and the reference value is displayed in the parameter field below. If the o cursor is an A-B cursor, the value of the trace for which the reference value is intended is used, i.e. the o cursor of Trace A if the o cursor was selected as the reference value for Trace A.
<b>Ref 997 Hz</b>	The Y value at 997 Hz is used once only as the reference value. The setting then returns to Value and the reference value is displayed in the parameter field below. If the X axis is not a frequency axis (e.g. in the case of level sweeps or waveform displays), an error message is displayed and the reference value remains unchanged.
<b>Ref 1000 Hz</b>	As for Ref 997 but with 1000 Hz
<b>Other Trace</b>	The reference trace is loaded with the trace data of the other traces. Each new measurement value of the other trace is entered in this reference trace at the same time and is then immediately available for displaying the new measurement points. If the other trace is not available or unsuitable, an appropriate warning is issued.
<b>Meas Ch1</b>	The reference trace is deleted and then loaded with the measurement values from channel 1. This setting is only available if both channels are activated.
<b>Meas Ch2</b>	As for Meas Ch1 but with channel 2

<b>Generator</b>	The reference trace is deleted and the valid generator setup is then loaded for each measurement.
<b>File</b>	The reference trace is loaded from a file. The file name is entered in the parameter field below, see section " <a href="#">Trace Files</a> " on page 4.344.
<b>File Intern</b>	File Intern is only offered as the mandatory setting if Y-Source = File: Trace A or File: Trace B and if a trace file has been loaded that contains a reference value scan plus a data scan.
<b>Hold</b>	The reference trace is no longer changed. If HOLD is selected when no valid reference trace data is available, a warning is issued and the last valid parameter selected for Reference is set again.

**Reference Value**

Reference value with unit for the reference parameter VALUE.

**Reference File**

File name for the reference parameter FILE.

**Normalize**

If a referenced unit (e.g. dBr or V/Vr) and a moving reference value (i.e. Reference = OTHER TRACE, MEAS CH1, MEAS CH2, GENERATOR or a reference trace stored in a file) are used, the displayed trace is normalized by the entire trace being shifted, i.e. multiplied by the normalization value.

The normalization value is transferred to all scan data sets; the same normalization value therefore applies for all scans.

<b>OFF</b>	Normalization is deactivated.
<b>Value</b>	Fixed normalization value which is entered as a multiplication factor in the parameter field below.



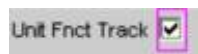
- o **Cursor** The trace is normalized once only at the o cursor to 0 dBr or V/Vr = 1. For this purpose, the referenced trace value is read out and the reciprocal value is entered in the parameter field below. The parameter then changes back to VALUE.
- \* **Cursor** As for the o cursor.

**Normalize Value**



Used to enter a fixed normalization value as a factor. The value can be entered separately for each scan. The normalization value set for the scan is entered here by scrolling through the scans using the **Next Scan** rocker key or by selecting the scan number in the graphical display.

**Unit Funct Track**



Used to determine whether the unit is the same as that set in the analyzer or whether it can be user-selected.



The unit selected in the analyzer is used for the measurement data displayed on the Y axis and for the displayed top, bottom and limit values. It is displayed in grey (cannot be accessed) next to the tick box and also on the Y axis of the graphical display. If a logarithmic unit (dBU, dBV, dBr, dBm or dBFS) appears here, the parameter field below (Spacing) cannot be accessed and its parameter is set to Lin (it would be pointless to display measurement values with a logarithmic unit on an axis with logarithmic spacing).



Here rotated by 90°.

The unit which appears here depends on the parameter selected under Trace A or Trace B (e.g. Level Ch1, Phase Ch1) and on the analyzer instrument (e.g. ANALOG, DIGITAL).



The unit can be user-selected from the list of available parameters.  
 If a logarithmic unit (dBu, dBV, dBr, dBm or dBFS) is selected here, the parameter field below (Spacing) cannot be accessed and its parameter is set to Lin (it would be pointless to display measurement values with a logarithmic unit on an axis with logarithmic spacing).

**Unit**



The list of units available here depends on many different settings, e.g. the graphic system, measurement function or whether the digital or analog analyzer is selected.  
 The unit can be user-selected from the list of parameters.  
 If a logarithmic unit (dBu, dBV, dBr, dBm or dBFS) is selected here, the parameter field below (Spacing) cannot be accessed and its parameter is set to Lin (it would be pointless to display measurement values with a logarithmic unit on an axis with logarithmic spacing).

**Unit Auto**



Used to determine whether the unit label displayed on the Y axis for Trace A or Trace B is the same as the unit set in the Unit Funct Track parameter field or whether it can be user-selected.



The unit label displayed on the Y axis for Trace A or Trace B is the same as the unit set in the Unit Funct Track parameter field and is therefore generated automatically by the R&S UPV.



A user-defined unit label can be entered.

**Practical example:**

The output level  $U_{0dBspl}$  which is output at a sound pressure of 0 dBspl (spl = sound pressure level) is specified for high-quality microphones.

If the measured microphone output level is displayed in the referenced unit dBr and entered for the reference value  $U_{0dBspl}$ , the level displayed on the R&S UPV will be in dBr but corresponds to the sound pressure in dBspl. In the graphical display, however, an axis label in dBspl is desirable. To allow this, the unit label can be changed from dBr to dBspl.



Here rotated by 90°.

**Engineering**



Conversion of the Trace A or Trace B-related cursor and scaling values in the graphical display by a factor of 1000.

This parameter field cannot be accessed if a dB or % unit is selected in the Unit Funct Track parameter field above since these units do not have an engineering function.

**Auto**

Automatic engineering assignment from p to M. The cursor and scaling values are displayed **with** the engineering symbol.

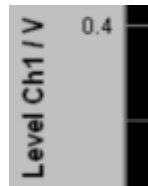
The Y axis is labelled with the unit **without** engineering.



**Off**

Engineering is deactivated.

Values are always displayed in 1.0 E<sup>0</sup> format.



μ  
m  
k

Engineering fixed to μ, m or k.

The cursor and scaling values are displayed **without** the engineering symbol.

The Y axis is labelled **with** engineering and unit.



**Auto Scale**



One-off automatic scaling of the Y axes for Trace A or Trace B.

**Exec**

Clicking this button triggers a **one-off** scaling process which uses the minimum and maximum values of the existing measurement sequence for TRACE A or TRACE B.

The end values of the new scaling are approx. 5% less or greater than the exact values. The determined values are entered in the Top and Bottom parameter fields below.

**Spacing**



Linear or logarithmic spacing of the Y axis for Trace A or Trace B.

**Lin**

Linear spacing of the Y axis.

If a logarithmic unit (dB unit) has been selected in the Unit Funct Track parameter field, this parameter field is shown in grey (cannot be accessed) and its parameter is set to Lin (it would be pointless to display measurement values with a logarithmic unit on an axis with logarithmic spacing).

**Log** Logarithmic spacing of the Y axis.

This parameter is only available if a linear unit (V, W,  $\Delta V$  and so on) has been selected in the Unit Funct Track parameter field and its value range cannot contain negative numbers.

Example:  
Although  $\Delta V$  is a linear unit, the measurement results can be negative which means that logarithmic display is not possible.

**Top**



Used to set the top value of the Y axis for Trace A or Trace B.

If Auto Scale has been triggered, the value is reset on the basis of the current trace data.  
Negative values or the value 0.00000 are not permitted if Spacing is set to Log.

**Bottom**



Used to set the bottom value of the Y axis for Trace A or Trace B.

If Auto Scale has been triggered, the value is reset on the basis of the current trace data.

This value must always be lower than the top value.  
Negative values or the value 0.0000 are not permitted if Spacing is set to Log.

**Main Grid**



Division of the graphical display with horizontal main gridlines.

**Off** No main gridlines are used in the graphical display.

**On** Decadic division of a Y axis (with Spacing = Log) with main gridlines.

**Auto Coarse** Coarse, medium or fine division of a Y axis (with Spacing = Lin) with main gridlines. One to two, 3 to 4 or 8 to 9 main gridlines are displayed depending on the scale end values.  
**Auto Medium**  
**Auto Fine** Main gridlines may be **hidden** if the graphical window is reduced in size.

- Divisions** Preset division of a Y axis (with Spacing = Lin) with main gridlines.  
The desired number of divisions is set in the parameter field below.  
These main gridlines are **not** hidden if the graphical window is reduced in size.
- Steps** Preset division of a Y axis (with Spacing = Lin) in a fixed step size.  
The step size is set in the parameter field below.  
These main gridlines are **not** hidden if the graphical window is reduced in size.

**Division**

The screenshot shows a control panel with a label 'Main Grid' on the left. To its right is a dropdown menu labeled 'Divisions' with a downward arrow. Below the dropdown is a text input field containing the number '20'.

Used to enter the number of main gridline divisions for a Y axis (with Spacing = Lin).  
If, for example, **2** is entered, the Y axis is divided into **two sections**, i.e. **one** main gridline is displayed.

**Steps**

The screenshot shows a control panel with a label 'Main Grid' on the left. To its right is a dropdown menu labeled 'Steps' with a downward arrow. Below the dropdown is a text input field containing the value '10.00000' followed by a unit field containing 'dBV'.

Used to enter the main gridline step size for a Y axis (with Spacing = Lin).  
The unit of the value is not linked to the unit selected in the Unit Funct Track parameter field; the value can be given in different units.

**Sub Grid**

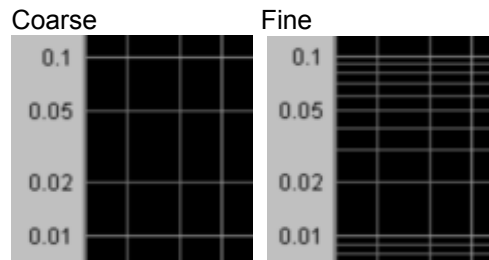
The screenshot shows a control panel with a label 'Sub Grid' on the left. To its right is a dropdown menu with a downward arrow. Below the dropdown is a text input field containing the number '2'.

Subdivision of the main gridlines in a graphical display using subgridlines.

- Off** Subgridlines are deactivated.
- 2** Subdivision of the main gridlines of a Y axis (with Spacing = Lin) into 2, 4 or 5 sections.
- 4**
- 5** If, for example, **2** is selected, the area between two main gridlines is divided into **2** sections, i.e. **one** subgridline appears between the main gridlines.  
These subgridlines are **not** hidden if the graphical window is reduced in size.

**Coarse**  
**Fine**

Coarse or fine subdivision of the main gridlines of a Y axis (with Spacing = Log) with subgridlines.



Only  
subgridlines  
2 and 5

All  
subgridlines

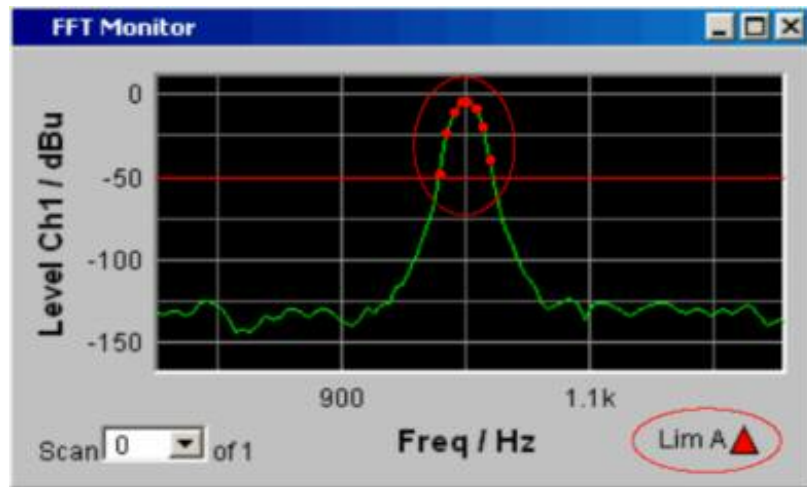
**Limit Upper**



An upper limit / limit curve can be defined for the measurement, whereby each measurement value of a sweep or FFT is compared with the limit / limit curve. The limit / limit curve is plotted in red in the co-ordinate system of the graphical display.

Limit overranging is indicated by red dots on the trace or on the bars of a bargraph.

The **upward**-pointing arrow in the bottom right-hand corner of the graphical display indicates **overranging** of the **upper** limit or the limit line.



See section ["Graphical Display, Explanation of the Elements"](#), page 4.314 for the meaning of the limit violation symbols.

Pressing the **START** key causes the existing limit overranging to be reset and new violations to be recorded.

Source



Used to determine how the upper limit is set.

Value

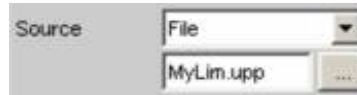


A fixed limit can be entered (Source must be set to Value).

In the parameter field below, an upper limit constant for all X values is entered in the unit which has been selected in the Unit Funct Track parameter field. If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.

The value can be entered separately for each scan. The current value for the respective scan is entered here by scrolling through the scans using the **Next Scan** rocker key or by selecting the scan number in the graphical display; this value can then be changed.

File



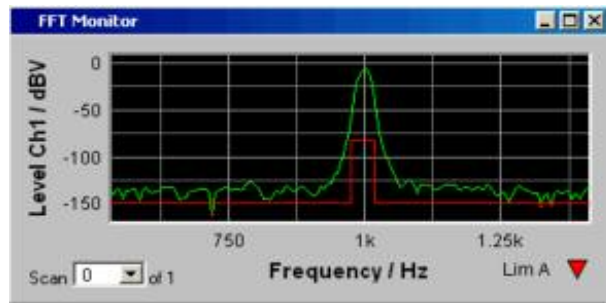
Limits are checked by using a limit file.

The name of the limit file is entered in the parameter field below.

This limit file contains reference values for a limit curve in a special format.

Each new scan interpolates the entries in the limit file to the X values of the scan.

All scans of a trace are compared to this limit curve, and the limit violations are marked.



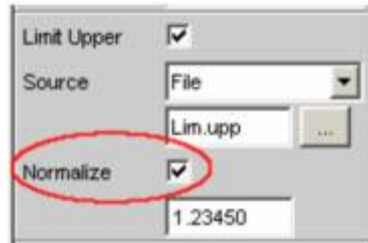


**File Intern**

File Intern is only offered as the mandatory setting if Y-Source = File: Trace A or File: Trace B and if a trace file has been loaded that contains a reference value scan plus a data scan.

Limit violations are displayed using the limit data set of the scan selected by means of the **Next Scan** rocker key.

**Normalize**



Used to shift (normalize) a limit trace stored as a file. This parameter field is only available if Source is set to File or File Intern.



The Upper Limit curve is shifted.

This parameter field is only available if "Normalize" is activated.



Normalization is activated.  
A numeric value (factor) must be entered as the normalization value in the parameter field below.

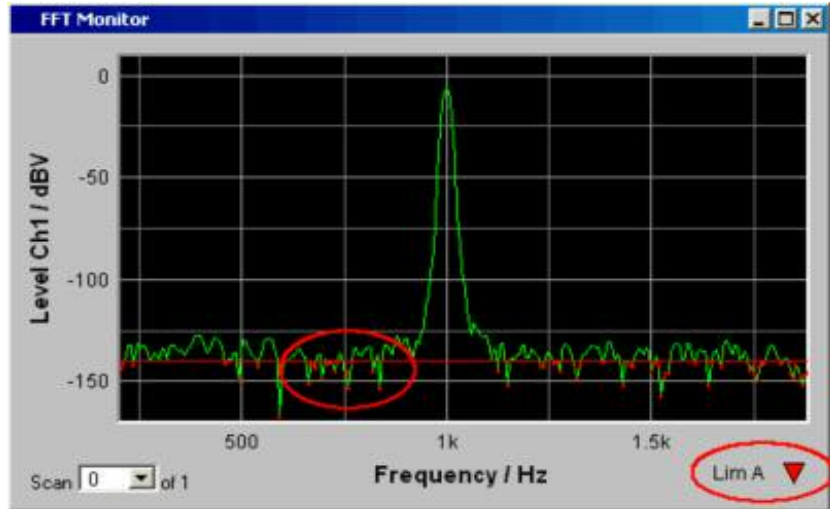


Normalization is deactivated.

Limit Lower



A lower limit / limit curve can be defined for the measurement, whereby each measurement value of a sweep or FFT is compared with the limit / limit curve. The limit / limit curve is plotted in red in the co-ordinate system of the graphical display. Limit underranging is indicated by red dots on the trace or on the bars of a bargraph. The **downward**-pointing arrow in the bottom right-hand corner of the graphical display indicates **underranging** of the lower limit or the limit line.



Pressing the **START** key causes the existing limit underranging to be reset and new violations to be recorded.

Source



Used to determine how the lower limit is set.

**Value**

A fixed limit can be entered (Source must be set to Value).

In the parameter field below, a lower limit constant for all X values is entered in the unit which has been selected in the Unit Funct Track parameter field. If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.

The value can be entered separately for each scan. The current value for the respective scan is entered here by scrolling through the scans using the **Next Scan** rocker key or by selecting the scan number in the graphical display; this value can then be changed.

**File**

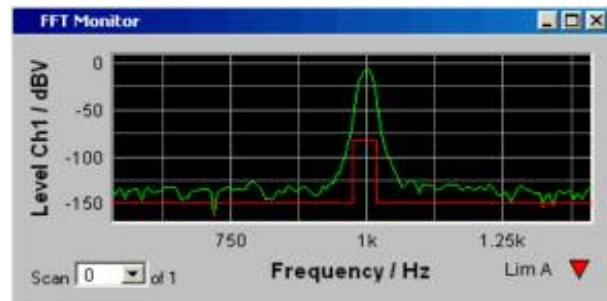
Limits are checked by using a limit file.

The name of the limit file is entered in the parameter field below.

This limit file contains reference values for a limit curve in a special format.

Each new scan interpolates the entries in the limit file to the X values of the scan.

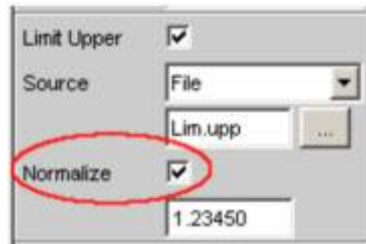
All scans of a trace are compared to this limit curve, and the limit violations are marked.

**File Intern**

File Intern is only offered as the mandatory setting if Y-Source = File: Trace A or File: Trace B and if a trace file has been loaded that contains a reference value scan plus a data scan.

Limit violations are displayed using the limit data set of the scan selected by means of the **Next Scan** rocker key.

## Normalize



Used to shift (normalize) a limit trace stored as a file. This parameter field is only available if Source is set to File or File Intern.



The Upper Limit curve is shifted.  
This parameter field is only available if "Normalize" is activated.

- Normalization is activated.  
A numeric value (factor) must be entered as the normalization value in the parameter field below.
- Normalization is deactivated.

## New scan



This parameter field only appears if Scan is set to Multi. It is therefore available for the following graphic systems:

- FFT Monitor
- Sweep Graph1 to 4

It is used to determine whether a scan in the current trace is replaced (Replace) or whether a scan is appended (Append) to the current trace.

Here it is irrelevant whether the scan originates from a **measurement** or is imported from a trace file specified in the **Import from** parameter field below.

Details see section "[Trace Files](#)" on page 4.344.

- Replace** The scan (selected using the Next Scan rocker key or by means of the scan number in the graphical display) is replaced by the scan from a **measurement** or from the trace file specified in the **Import from** parameter field below.  
See section "[Trace Files](#)" on page 4.344 for further details.
- Append** The scans from a **measurement** or from the trace file specified in the **Import from** parameter field below are appended to the current trace.  
See section "[Trace Files](#)" on page 4.344 for further details.

**Import from**



This parameter field only appears if Scan is set to Multi. It is therefore available for the following graphic systems:

- FFT Monitor
- Sweep Graph1 to 4

It is used to enter the name of a trace file whose scans are to replace a current scan or are to be appended to the current trace.

Whether scans are to be replaced or appended is determined in the **New scan** parameter field above:

Replace: "New scan" must be set to "Replace".

Append: "New scan" must be set to "Append".

See section *"Trace Files"* on page 4.344 for further details.

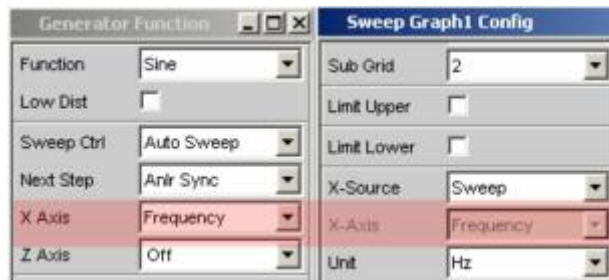
**X-Source**



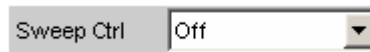
This parameter field is only available in the display configuration panel Sweep Graph1 to 4 and determines the response of the X axis parameter field.

**Sweep**

The X Axis parameter field is not available in a sweep that is switched on in the Generator Function panel; the X axis is thus automatically adapted to the X axis sweep setting in the generator.



If the sweep is switched off in the generator,



the X Axis parameter field is operable and the user can select the functionality.

**Hold**

The X Axis parameter field is not available. The X axis retains the current setting at the time of the switchover to Hold and helps prevent the X axis from being unintentionally destroyed.

**Manu**

The X Axis parameter field is operable and completely independent of a sweep setting in the generator. It is reserved for the special case of graphically displaying self-generated trace data sets.

Example:

The distortion of an amplifier versus its output voltage is to be graphically displayed by means of a generator sweep.

At first glance, this does not seem to be possible, for normally only the generator voltage supplied by the UPV (i.e. the amplifier's input voltage) can be swept and projected onto the X axis.

However, to be able to evaluate how the distortion changes when the amplifier clips, the user wants to display the distortion versus the output voltage on the amplifier.

To be able to display the output voltage on the X axis, this voltage must be measured in addition to the distortion. From these two series of measurements, it is possible to generate a trace data set and save it as a trace file using Visual Basic, for example, in order to graphically display the data set with the setting Manu and the X Axis = Voltage parameter field.

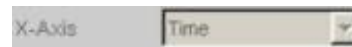
**X Axis**

The parameter displayed in the selection field depends on the graphic subsystem in which the parameter field is offered.

For the graphic subsystems FFT Monitor and FFT Graph, the parameter is always Frequency and cannot be changed.

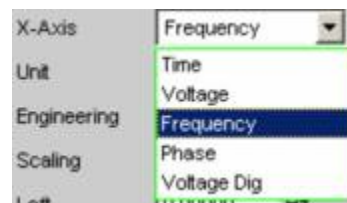


For the graphic subsystem Waveform, the parameter is always Time and can also not be changed.



Any other X axis functionality is impractical for these subsystems.

In contrast, for the graphic subsystem Sweep Graph1 ... 4, the functionality of this parameter field is determined by the X-Source parameter field above it, which is only offered in the display configuration panel Sweep Graph1 ... 4, and by the sweep setting of the generator.



See section "[X-Source](#)" on page 4.296.

Unit



Used to determine the unit of the measurement result values, cursor values and scaling values on the X axis and depends on the setting of the X axis parameter field, i.e. frequency units for frequency, voltage units for voltage, and so on.  
Recorded measurement sequences can be redisplayed with different units at any time.

Engineering



Displays the cursor and scaling values of the X axis in the graphical display.  
 This parameter field cannot be accessed if a dB or % unit is selected in the Unit Funct Track parameter field above since these units do not usually have an engineering function.

**Auto** Automatic engineering assignment from p to M. The cursor and scaling values are displayed **with** the engineering symbol.  
 The X axis is labelled with the unit **without** engineering.



**Off** Engineering is deactivated.  
 Values are always displayed in 1.0 E<sup>0</sup> format.



**μ**  
**m**  
**k** Engineering fixed to μ, m or k.  
 The values to be displayed are multiplied by the factor 1.0 E<sup>6</sup>, 1.0 E<sup>3</sup> or 1.0 E<sup>-3</sup>.

The cursor and scaling values are displayed **without** the engineering symbol.  
 The X axis is labelled **with** engineering and unit.



Label Auto

Used to determine whether the X axis label is the same as that set in the X Axis parameter field or whether the label can be user-selected.



The label in the X Axis parameter field is displayed in grey (cannot be accessed) in the text field to the right of the tick box and also on the X axis in the graphical display.







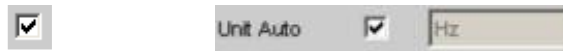
A user-definable label appears on the X axis of the graphical display.



**Unit Auto**



Used to determine whether the unit label displayed on the X axis is the same as the unit set in the Unit parameter field or whether it can be user-selected.



The unit label displayed on the X axis is the same as the unit set in the Unit parameter field and is therefore generated automatically by the R&S UPV.



A user-defined unit label can be entered.



**Auto Scale**



Manual or automatic scaling of the X axis.

**Manu**

The scaling of a graphical display is determined using the Left and Right parameter fields below.

Each time the Manu parameter is set, the graphical display is deleted and then replotted with the scale end values entered under Left and Right.

**Auto** The Auto Scale function is activated.

Auto Scale uses suitable default values for **one-off** scaling of the X axis. These values depend on the measurement task and the subsystem (e.g. the start/stop values of the sweep or FFT are used in the generator and analyzer panel). The entry fields for the Left and Right parameter fields below are displayed in grey (cannot be accessed) with the obtained values.

### Spacing



Linear or logarithmic spacing of the X axis.

**Lin** Linear spacing of the X axis.

**Log** Logarithmic spacing of the X axis.

### Left



Used to set the left-hand value on the X axis.

This parameter field can only be accessed if Scaling is set to Manu. Negative values or the value 0.00000 are not permitted if Spacing is set to Log.

### Right



Used to set the right-hand value on the X axis.

This parameter field can only be accessed if Scaling is set to Manu. This value must always be higher than the Left value. Negative values or the value 0.0000 are not permitted if Spacing is set to Log.

### Main Grid



Division of the graphical display with vertical main gridlines.

**Off** No main gridlines are used in the graphical display.

**On** Decadic division of an X axis (with Spacing = Log) with main gridlines.

<b>Auto Coarse</b> <b>Auto Medium</b> <b>Auto Fine</b>	Coarse, medium or fine division of an X axis (with Spacing = Lin) with main gridlines. One to two, 3 to 4 or 8 to 9 main gridlines are displayed depending on the scale end values. Main gridlines may be <b>hidden</b> if the graphical window is reduced in size.
<b>Divisions</b>	Preset division of an X axis (with Spacing = Lin) with main gridlines. The desired number of divisions is set in the parameter field below. These main gridlines are <b>not</b> hidden if the graphical window is reduced in size.
<b>Steps</b>	Preset division of an X axis (with Spacing = Lin) in a fixed step size. The step size is set in the parameter field below. These main gridlines are <b>not</b> hidden if the graphical window is reduced in size.

**Division**

Used to enter the number of main gridline divisions for an X axis (with Spacing = Lin).

If, for example, **2** is entered, the X axis is divided into **two sections**, i.e. **one** main gridline is displayed.

**Step**

Used to enter the main gridline step size for an X axis (with Spacing = Lin).

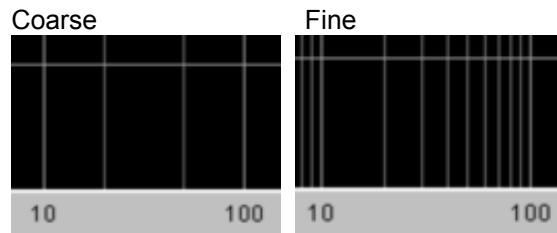
The unit of the value is not linked to the unit selected in the Unit Funct Track parameter field; the value can be given in different units.

Sub Grid



Subdivision of the main gridlines in a graphical display using subgridlines.

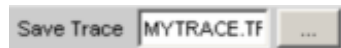
- Off** Subgridlines are deactivated.
  - 2** Subdivision of the main gridlines of an X axis (with Spacing = Lin) into 2, 4 or 5 sections.
  - 4**
  - 5** If, for example, **2** is selected, the area between two main gridlines is divided into **2** sections, i.e. **one** subgridline appears between the main gridlines. These subgridlines are **not** hidden if the graphical window is reduced in size.
- Coarse** Coarse or fine subdivision of the main gridlines of an X axis (with Spacing = Log) with subgridlines.
- Fine**



Only subgridlines 2 and 5

All subgridlines

Save Trace



Used to save the current trace together with all scans to the specified file.

**Resolution**



Used to set the number of digits used to display the cursor and scaling values in the graphical window.

If Engineering is set to Auto, the Resolution setting only applies to the cursor values and not to the scale values.

- 3 dig. / 0.1 dB**
- 4 dig. / 0.01 dB**
- 5 dig. / 0.001 dB**
- 6 dig. / 0.0001 dB**
- 7 dig. / 0.00001 dB**

The parameters are explained below using an example:

**5 dig. / 0.001 dB**

**5 dig.:** Values which are displayed with a linear unit (V, Hz, etc) are output with 5 digits.



**0.001 dB:** Values which are displayed with a logarithmic unit (dBV, dBu, etc) are output to three decimal places.



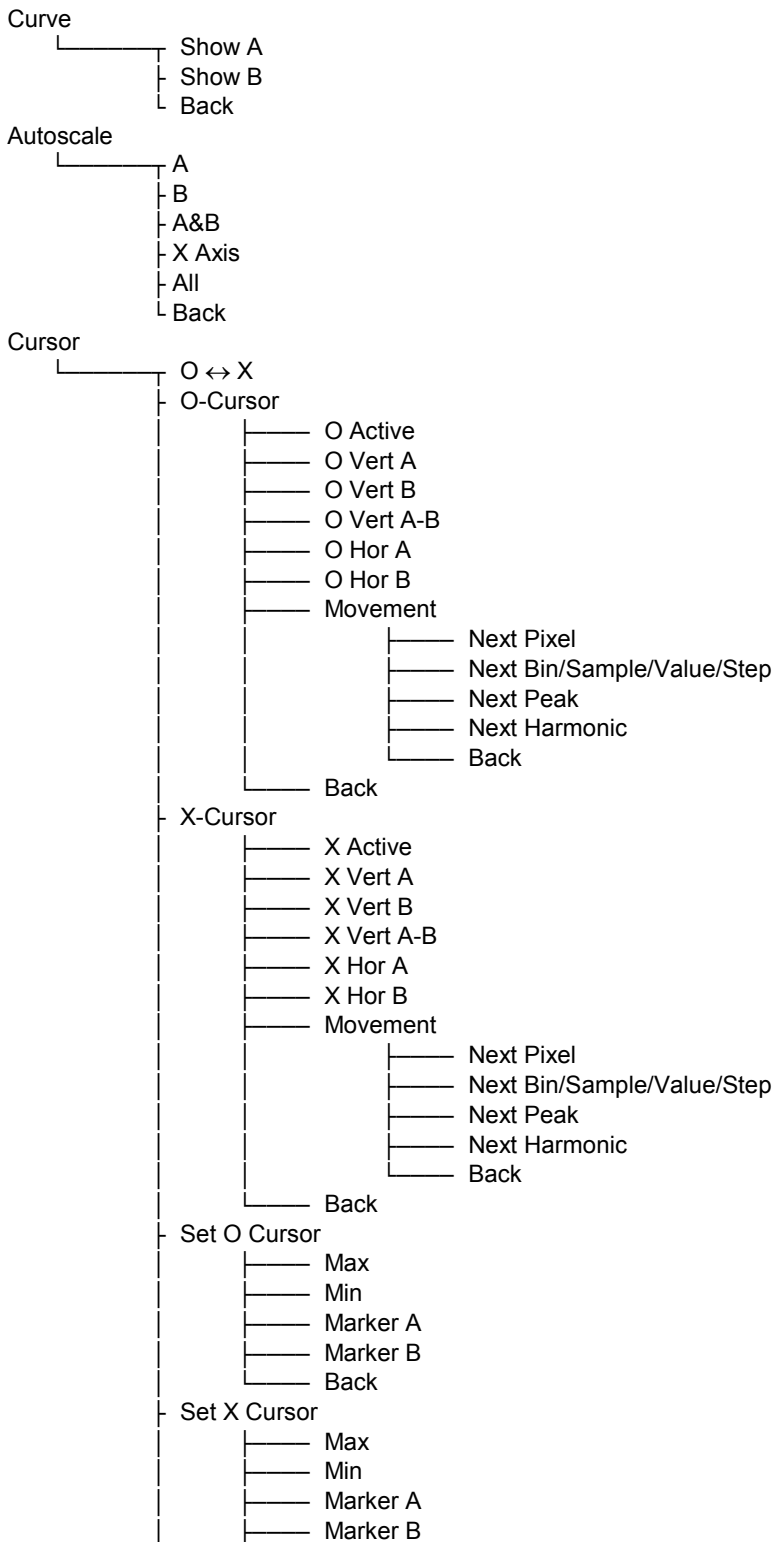
If the numeric values can no longer be displayed with the selected resolution, they are rounded off and shown as an exponent:

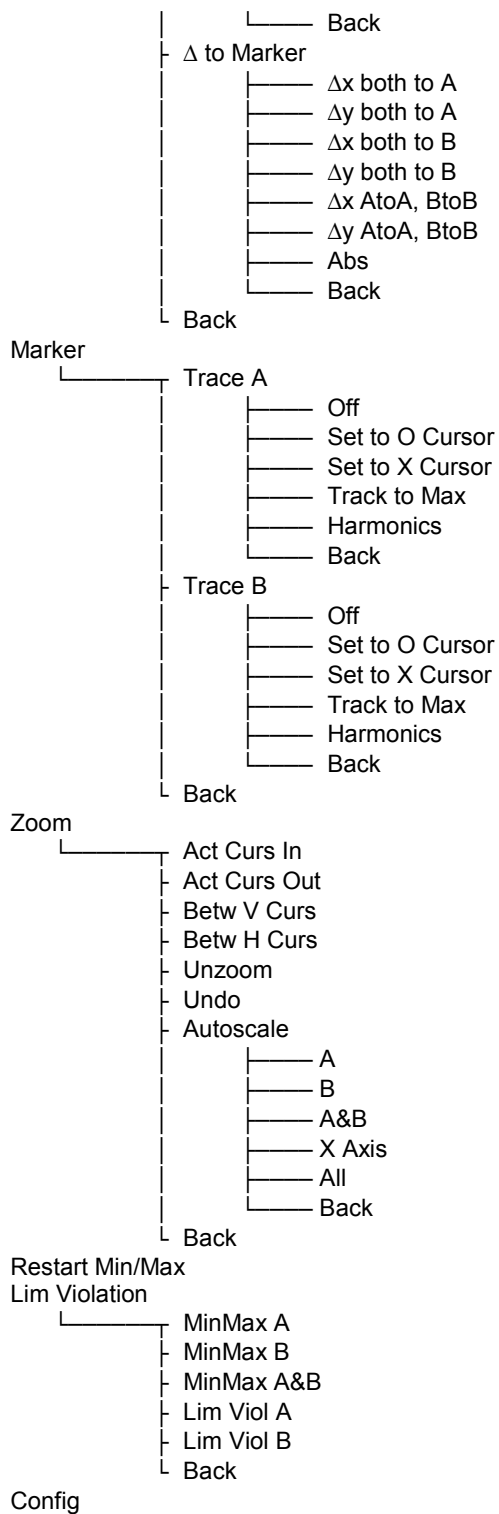


## Softkey Menu

Using the comprehensive command menu available via the softkeys, it is possible to, for example, scale and zoom the display and to measure the display using vertical and horizontal cursors.

### Overview of the softkey menu:





## Explanation of the individual menu items:




Level 1	Level 2	Level 3	Level 3	Brief description
Curve				
	Show A <input checked="" type="checkbox"/>			(Temporarily) show/hide graphical display of Trace A
	Show B <input checked="" type="checkbox"/>			Ditto for Trace B
	Back			Move back by one menu level
Autoscale				Single scaling of co-ordinate system using minimum and maximum values
	A			For Trace A
	B			Ditto for Trace B
	A&B			Ditto for Trace A and B
	X Axis			Ditto for X axis
	All			Ditto for Trace A, B and X axis
	Back			Move back by one menu level
Cursor				Cursor settings
	O ↔ X			Used to determine whether O or X cursor is moved with rotary knob
	O-Cursor			O cursor settings
		O Active <input checked="" type="checkbox"/>		Activate/deactivate O cursor
		O Vert A		O cursor becomes vertical cursor on Trace A
		O Vert B		Ditto on Trace B
		O Vert A-B		Ditto on Trace A and Trace B and shows difference between Y values.
		O Hor A		O cursor becomes horizontal cursor on Trace A
		O Hor B		Ditto on Trace B
		Movement (Next Pixel)		Movement behaviour of O cursor when it is moved using rotary knob
			Next Pixel	Pixel-by-pixel movement
			Next Bin	Between reference points With FFT
			Next Sample	With Waveform
			Next Value	With Bargraph



			Next Step	With Sweep
			Next Peak	Movement between partial curve peaks
			Next Harmonic	FFT display: movement between harmonics
		Back		Move back by one menu level
	X-Cursor			X cursor settings
		X Active <input checked="" type="checkbox"/>		Activate/deactivate X cursor
		X Vert A		X cursor becomes vertical cursor on Trace A
		X Vert B		Ditto on Trace B
		X Vert A-B		Ditto on Trace A and Trace B and shows difference between Y values.
		X Hor A		X cursor becomes horizontal cursor on Trace A
		X Hor B		Ditto on Trace B
		Movement (Next Pixel)		Movement behaviour of X cursor when it is moved using rotary knob
			Next Pixel	Pixel-by-pixel movement
			Next Bin	Between reference points
			Next Sample	With FFT
			Next Value	With Waveform
			Next Step	With Bargraph
			Next Peak	With Sweep
			Next Peak	Movement between partial curve peaks
			Next Harmonic	FFT display: movement between harmonics
		Back		Move back by one menu level
	Set O Cursor			Sets O cursor ...
		Max		... to trace maximum
		Min		... to trace minimum
		Marker A		... to position of Marker A
		Marker B		... to position of Marker B
		Back		Move back by one menu level
	Set X Cursor			Sets X cursor ...

		Max		... to trace maximum
		Min		... to trace minimum
		Marker A		... to position of Marker A
		Marker B		... to position of Marker B
		Back		Move back by one menu level
	$\Delta$ to Marker			
		Back		Move back by one menu level
	Back			Move back by one menu level
Marker				Marker settings
	Trace A			Marker settings for Trace A
		Off		Marker deactivated
		Set to O Cursor		Set marker to position of O cursor
		Set to X Cursor		Set marker to position of X cursor
		Track to <input checked="" type="checkbox"/> Max		Set marker to maximum of Trace A; marker changes with maximum
		Harmonics <input checked="" type="checkbox"/>		Harmonics are calculated and displayed based on X position of marker
		Back		Move back by one menu level
	Trace B			Marker settings for Trace B
		Off		Marker deactivated
		Set to O Cursor		Set marker to position of O cursor
		Set to X Cursor		Set marker to position of X cursor
		Track to <input checked="" type="checkbox"/> Max		Set marker to maximum of Trace A; marker changes with maximum

		Harmonics <input checked="" type="checkbox"/>		Harmonics are calculated and displayed based on X position of marker
		Back		Move back by one menu level
Zoom				Increase / reduce size of graphical display
	Act Curs In			Size of graphical display is increased around active cursor (solid line). If active cursor is a vertical cursor, a section of X axis is displayed; if it is a horizontal cursor, a section of Y axis is displayed. In both cases, displayed section is adjusted so that cursor appears at center of display.
	Act Curs Out			Ditto for reducing size of graphical display
	Betw V Curs			Zooming between two vertical cursors
	Betw H Curs			Zooming between two horizontal cursors
	Unzoom			Undoes all zoom operations
	Undo			Undoes zoom operation last performed. Several zoom operations can be undone. Entering new axis limits (Top, Bottom, Left, Right) resets undo memory.
	Autoscale			Automatic scaling of coordinate system using minimum and maximum values
		A		For Trace A
		B		Ditto for Trace B
		A&B		Ditto for Trace A and B
		X Axis		Ditto for X axis
		All		Ditto for Trace A, B and X axis
		Back		Move back by one menu level
Restart Min/Max Lim Violation				Deletes Min/Max curves and limit violation symbols for graphical display and restarts collection of Min/Max data and checking

				of limit violations.
	MinMax A			Min/Max curves of Trace A
	MinMax B			Ditto for Trace B
	MinMax A+B			Ditto for Trace A and Trace B
	Lim Viol A			Limit violation symbols for Trace A, i.e. red dots which indicate limit violations on trace, and red triangular symbols for limit violations are deleted and only a grey triangle is displayed.  or  ? 
	Lim Viol B			Ditto for Trace B
	Lim Viol A+B			Ditto for Trace A and Trace B
	Back			Move back by one menu level
Config				Opens associated Config panel

## Single Sweep

Of the eight simultaneously recorded measurement values, the user can use two for the two independent y axes (trace A and B). For example, this may be the distortion of the left and right channels, or also physically different values such as voltage and phase. The parameter to be measured is set in the analyzer; the parameter to be recorded as a trace is selected in the Gfx Configuration panel under Y-Source.

Measurement values relative to other values must often be displayed in relative units. If the reference value is constant, it can be included immediately. However, if it is also dependent on the X axis, it yields a reference trace. It may also be a series of measurement values or the generator voltage or frequency or be loaded from a file (as a reference trace, for example).

## Trace Group

With the R&S UPV, the number of measurement sequences is not restricted to x number of scans. Instead, between 2 and 20 can be set for the FFT Monitor and the Sweep Graphs 1 to 4 using the Scan and History parameter field (see sections ["FFT Monitor"](#) on page 4.210 and ["Graphical Display, Explanation of the Elements"](#) on page 4.263).



in the appropriate configuration panels. Additionally, two other scans (the Min and Max curves) can be generated using the setting



A trace group is shown as the graphical display.

All of the recorded measurement sequences are saved (both internally and, if the user requires, as a file) and can be displayed, rescaled and reloaded as a single unit.

With the generator, a second sweep (the Z sweep) is possible in addition to the X sweep. It is called the Z sweep because it is usually displayed on the Z axis of a 3D co-ordinate system.

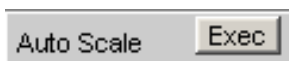
Generally, in a graphical window which allows scans to be recorded, a trace group or a trace pair consisting of Trace A and Trace B each with one trace group will be displayed in the respective graphical window if History is set to  $\geq 2$ .

If History is set to the maximum value of 20 and Show Min Max is activated: a maximum of 44 scans are displayed.,

Trace A,	20 scans
Trace A	1 Min curve
Trace A	1 Max curve
Trace B,	20 scans
Trace B	1 Min curve
Trace B	1 Max curve

As long as a measurement is running and scans are performed, they are displayed in grey. When the measurement is completed or the scan was stopped by means of Hold, the scans are displayed in automatically assigned colours.

In the case of automatic scaling of the Y axis



all available traces are taken into account in order to determine the maxima and minima.

All other actions, e.g. setting the cursor to the Min or Max value, always relate to the current scan. With limit overranging, set with

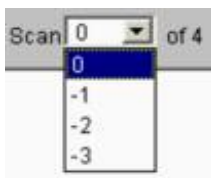


all traces are checked against the two identical limit curves; the symbol for limit overranging



always relates to the current trace pair.

The current scan (one trace if only Trace A or Trace B is activated, two traces if both traces are activated) is changed in the graphical window or result list using the **Next Scan** rocker key or the "Scan" selection field.



The number in the "Scan" selection field



indicates the current value (the scan index).

O or X indicates the point at which the cursor intersects the current trace or trace pair.

If the result list is activated, the lists are regenerated when the scan index is changed because only one scan can be displayed in the result list.

## Interpolation on the Common X Axis

If traces are to be used as reference or are simply to be displayed simultaneously for purposes of comparison and measured using the cursors, they would all have to have the same X values. The R&S UPV can, however, use any number of X divisions by interpolating the sequences of measurement and reference values on a configured X axis.

## Result List

All measurement values from all graphic subsystems can also be displayed in lists instead of or in combination with the graphical windows.

## Graphical Display, Explanation of the Elements

	X A (Hz)	Y A (dBV)	X B (Hz)	Y B ( )
167	972.66	-71.580	972.66	
168	978.52	-49.804	978.52	
169	984.38	-24.968	984.38	
170	990.23	-12.766	990.23	
171	996.09	-7.001	996.09	
172	1.0020 k	-6.402	1.0020 k	
173	1.0078 k	-10.863	1.0078 k	
174	1.0137 k	-21.284	1.0137 k	
175	1.0195 k	-41.523	1.0195 k	
176	1.0254 k	-67.302	1.0254 k	
177	1.0313 k	-82.990	1.0313 k	
178	1.0371 k	-95.093	1.0371 k	

Display filter

If the result list has the focus, a softkey menu appears. Pressing the "Selection" button opens the next softkey level where it is possible to select the measurement values according to the following criteria, i.e. to list only those rows which satisfy the selection criteria:

- All
- Lim upper
- Lim lower
- Lim upp&low
- Harmonics
- Peaks

Selection frame

Used to scroll through the result list using the rotary knob. When the selection frame reaches the top or bottom of the result list, the list is scrolled below the window.

Symbols indicating limit violations



- Limit Upper is activated and there is no limit violation.
- Limit Lower is activated and there is no limit violation.
- The Limit Upper value has been violated in the past but there is currently no limit violation. The violation is indicated until the **START** key is pressed again.
- The Limit Lower value has been violated in the past but there is currently no limit violation. The violation is indicated until the **START** key is pressed again.
- The Limit Upper value is currently being violated.
- The Limit Lower value is currently being violated.

Columns with measurement values

Trace A, Trace B and the associated X axes are displayed as numeric values in a maximum of four columns.

Cursor markers

A coloured rectangular marking indicates the row containing the value at which the cursor is located (also applies to traces and bargraphs). "o" or "x" to the left of the measurement number indicates the O or X cursor.

168	978.52
<b>o</b> 169	984.38
170	990.23
<b>x</b> 171	996.09
172	1.0020 k

Pressing the **Find Cursor** softkey adjusts the display window so that the active cursor appears at the center of the display.

Arrow

Coloured arrow symbols indicate the direction in which a cursor left the display window.

Measurement value with limit violation

A limit violation, which is identified by red dots on the traces and bargraphs, is indicated by red measurement values in the result list.

Numbering of measurement values

The individual measurement values are numbered consecutively from 1 to n.

Scan number

If a trace consists of several scans, the desired scan can be selected here by pressing the **Next Scan** rocker key or using the mouse. In the result list, only the values of the selected scans are shown in the list. The scan number shown in this display field indicates which scan is listed.



## Calling Up

A button which can be used to open a result list (containing measurement values from an FFT, sweep or bargraph) on its own or together with the graphical display is available in the first parameter field of each display configuration panel.



Trace A, Trace B and the associated X axes are displayed as numeric values in a maximum of four columns.

The column on the left-hand side contains the number of the measurement value, a coloured marking indicating the row containing the value at which the cursor is located (also applies to traces and bargraphs) and may also contain coloured arrow symbols indicating the direction in which a cursor left the display window. Pressing the **Find Cursor** softkey adjusts the display window so that the cursor appears at the center of the display.

In the columns for the Y values of Trace A and Trace B, digits highlighted in colour by pressing the **Selection** softkey indicate whether the measurement result is violating the Limit Upper and/or Limit Lower parameters or whether the value is a harmonic.

Hidden sections of the data set can be shown in the display window using the scroll bar on the right-hand side of the panel or using the blue selection frame.

## Parameter Fields of the Panel

The result list does not have its own panel; it is configured according to the settings in the display configuration panel from which it was opened.

The following parameter fields and softkey functions affect the result list (and, at the same time, the traces and bargraphs):

### Unit Funct Track

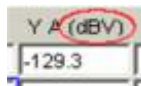


Used to determine whether the unit is the same as that set in the analyzer or whether it can be user-selected.

### Unit



The unit set here is displayed above the measurement result column for Trace A / Trace B or above the values on the X axis:



Engineering



The measurement values for Trace A or Trace B and the values on the X axis are displayed with the engineering selected in this parameter field:

Y A (V)
0.641 μ
0.338 μ

Unit Auto



Used to determine whether the unit label displayed above the measurement result column for Trace A / Trace B or above the values on the X axis is the same as the unit set in the Unit Funct Track or Unit parameter field, or whether it can be user-selected.

	X A (MyFra)	Y A (dBspl)
1	0.000	-143.4
2	5.859	-143.5

Limit Upper



If a Limit Upper value or scan is set here, the measurement values which violate the limit are displayed in red if Limit Upper or LimUp&Low is set under the Selection softkey.



Limit Lower

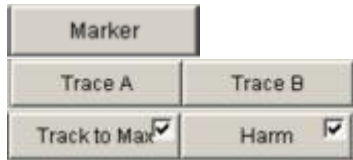


If a Limit Lower value or scan is set here, the measurement values which violate the limit are displayed in red if Limit Lower or LimUp&Low is set under the Selection softkey.

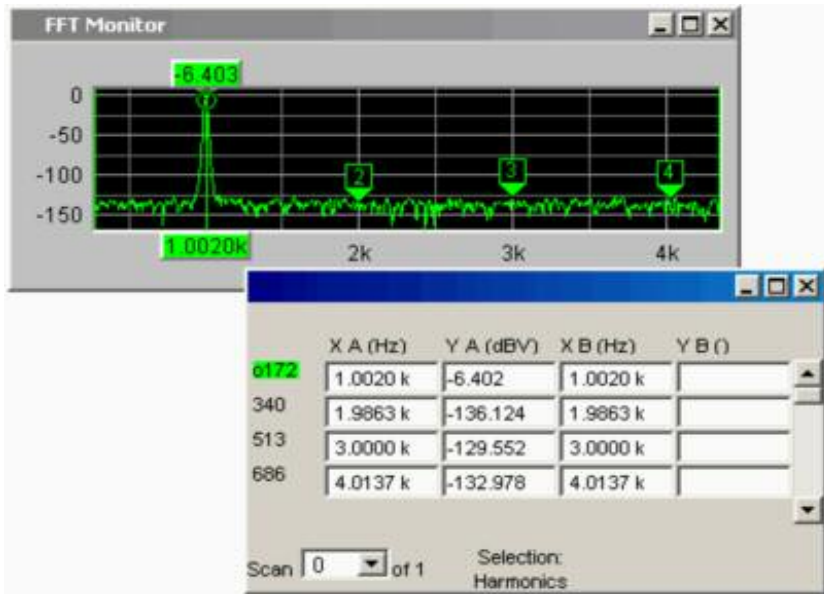
Resolution



Used to set the number of digits used to display the measurement results for Trace A and Trace B and the values on the X axis.



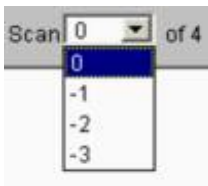
If harmonics are shown in the graphical display (activated using the softkey menu), a display filter which only shows the values of the harmonics can be applied to the list display by setting Harmonics under the Selection softkey.



in graphical display

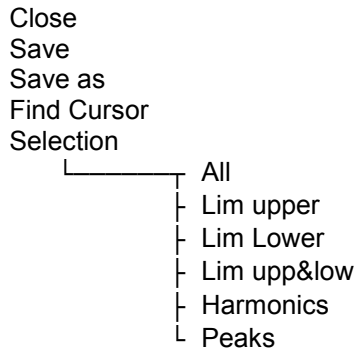
This field and selection option in the graphical display also appears in the result list. It indicates the selected scan for graphic subsystems which have multi-scan recording (FFT Monitor and Sweep Graph1 to 4).

The current value for the respective scan is entered here by scrolling through the scans using the **Next Scan** rocker key; this value can then be changed.



# Softkey Menu

## Overview of the softkey menu:



## Explanation of the individual menu items:

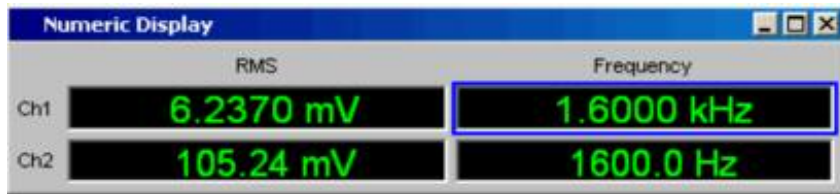
Level 1	Level 2	Brief description
Close		Used to close the result list.
Save		Used to save the result list.
Save as		Used to save the result list as a trace file, equalization file, limit file or sweep list.
Find Cursor		Used to adjust the display window containing the result list so that the cursor appears at the center of the display. If both cursors are activated, this button is used to toggle between the two cursors.
Selection		The following values are listed in the result list:
	All	All
	Lim upper	Only those values which overrange the upper limit
	Lim lower	Only those values which underrange the lower limit
	Lim upp&low	Only those values which overrange the upper limit and underrange the lower limit
	Harmonics	Only harmonics

# Numeric Display

The numeric display provides a clear overview of max. 8 measurement results from max. four analyzer measurement functions from the Analyzer Function panel. If all of the analyzer measurement functions are activated, the individual columns are assigned the measurement functions in the following sequence (from left to right):

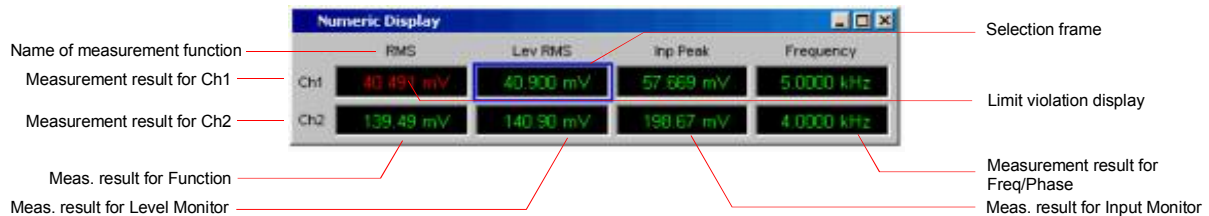
Measurement results for Analyzer Function, Level Monitor, Input Monitor, Freq/Phase.

If certain analyzer measurement functions are deactivated, the associated measurement results are hidden. The name of the measurement function, however, clearly indicates which column refers to which measurement function.



For more detailed information on the assignment of the individual measurement results to the analyzer measurement functions see *"Combi Display"* on page 4.323.

## Graphical Display, Explanation of the Elements



Name of measurement function

Name of the current measurement function from left to right: Function, Level Monitor, Input Monitor, Freq/Phase  
If the measurement function is changed in the analyzer panel, the labels here also change.

Measurement result for Channel 1

In the sequence specified above.

Measurement result for Channel 2

In the sequence specified above.

Measurement result for Function

**Column 1:** Measurement results for the function which is set in the **Function** field of the **Analyzer Function** panel.



Measurement result for Level Monitor

**Column 2:** Measurement results for the set **Level Monitor** function.



Measurement result for Freq/Phase

**Column 4:** Measurement result for the Freq/Phase measurement function. Display of the frequency measurement result in the first row for **Frequency** or **Freq & Phase / Freq & GrpDel**, and display of the phase or group delay measurement in the second row.



Measurement result for Input Monitor

**Column 3:** Measurement results for the **Input Monitor** function.



Selection frame

If the numeric display has the focus, measurement results can be selected by moving the blue selection frame with the rotary knob or by clicking with the mouse. Clicking with the rotary knob or double-clicking with the mouse opens the associated combi display (see ["Combi Display"](#) on page 4.323).

Limit violation display



Measurement result displayed in green: Limit monitoring is deactivated or the measurement result is within the preset limits.



Measurement result displayed in red: A limit has been violated. See ["Combi Display"](#) on page 4.323 for information on how to set the limits.



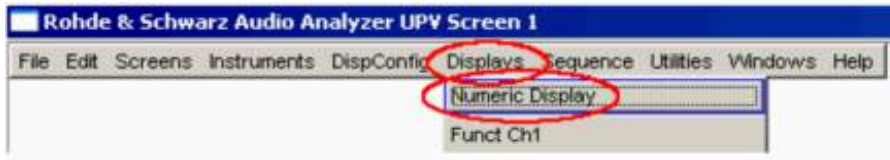
The measurement is deactivated in the analyzer panel.



No measurement result is available (yet).

## Calling Up

The numeric display is opened via the menu bar by pressing the **MENU** key on the front panel or, with mouse operation, by moving the pointer to the top left-hand edge of the R&S UPV application window.



## Parameter Fields of the Panel

The numeric display does not have its own panel; however, a number of settings made in the measurement result configuration panels in the combi displays affect the way in which the measurement results are displayed:

- Unit
- Unit Auto
- Resolution
- Engineering
- Reference
- Limit Lower
- Limit Upper

See ["Combi Display"](#) on page 4.323 for more detailed information.

## Softkey Menu

The numeric display does not have its own softkey menu; however, the softkey functions of the combi displays affect the way in which the measurement results are displayed.

See ["Combi Display"](#) on page 4.323 for more detailed information.

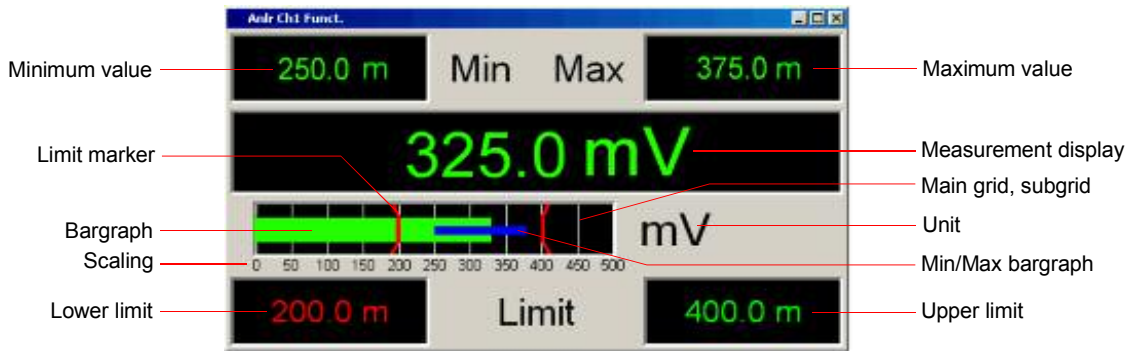
# Combi Display

It is often the case that the measurement results in the numeric display do not contain adequate information. Additional features such as analog bargraphs, limit monitoring or the storage of maximum and minimum values are frequently required.

The combi display is used for this purpose. Additional information can be displayed for every measurement shown in the numeric display.

The free selection and free scalability mean that especially important or critical results can be monitored and tracked even when viewing the R&S UPV screen from a relatively long distance.

## Graphical Display, Explanation of the Elements



**Bargraph** Displays the measurement result as a bar on a scale. If the bar changes to red, there is a limit violation.

**Unit** Unit of the bargraph; set with

The screenshot shows a configuration menu with three items:

- Unit: v
- Unit Auto:  v
- Engineering: m

**Limit marker** Displays the lower and upper limit specified under

The screenshot shows a configuration menu with two items:

- Limit Lower:  200.000 mV
- Limit Upper:  400.000 mV



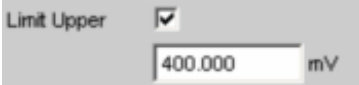
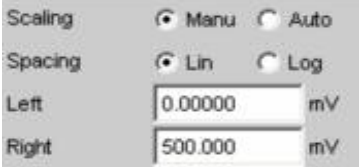

in the bargraph.

**Main grid, subgrid** Division of the scaling; set with

The screenshot shows a configuration menu with two items:

- Main Grid: Auto Fine
- Sub Grid: Off

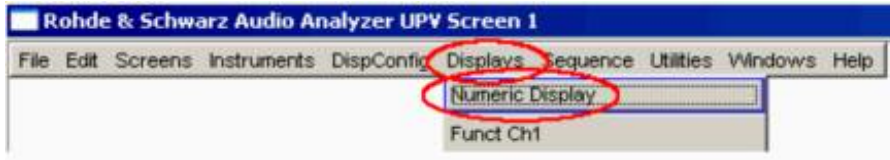


- Maximum value Maximum value measured since the **[START]** key was pressed; set with 
- Measurement display Current measurement value.  
If the measurement value changes to red, there is a limit violation.
- Min/Max bargraph The ends of the blue bar indicate the lowest and highest measurement value since the **[START]** key was pressed.
- Minimum value Minimum value measured since the **[START]** key was pressed; set with 
- Upper limit Displays the upper limit specified under  as a numeric value.  
If the value changes to red, this means that a violation of the upper limit occurred after the **[START]** key was pressed. This limit violation is indicated until the hold function is reset by pressing the **[START]** key again or by entering a new upper limit.
- Scaling Measurement range of the bargraph; set with 
- Lower limit Displays the lower limit specified under  as a numeric value.  
If the value changes to red, this means that a violation of the lower limit occurred after the **[START]** key was pressed. This limit violation is indicated until the hold function is reset by pressing the **[START]** key again or by entering a new lower limit.

## Calling Up

There are several ways to open the combi display:

- Open the Display menu.



Select the Numeric Display menu item.



Move the blue selection frame to the desired measurement result using the rotary knob and then click with the rotary knob or, with mouse operation, double-click the desired measurement result in the numeric display.



- Open the DispConfig menu and select a measurement result configuration panel.



Click the Show button in the Display field of the configuration panel



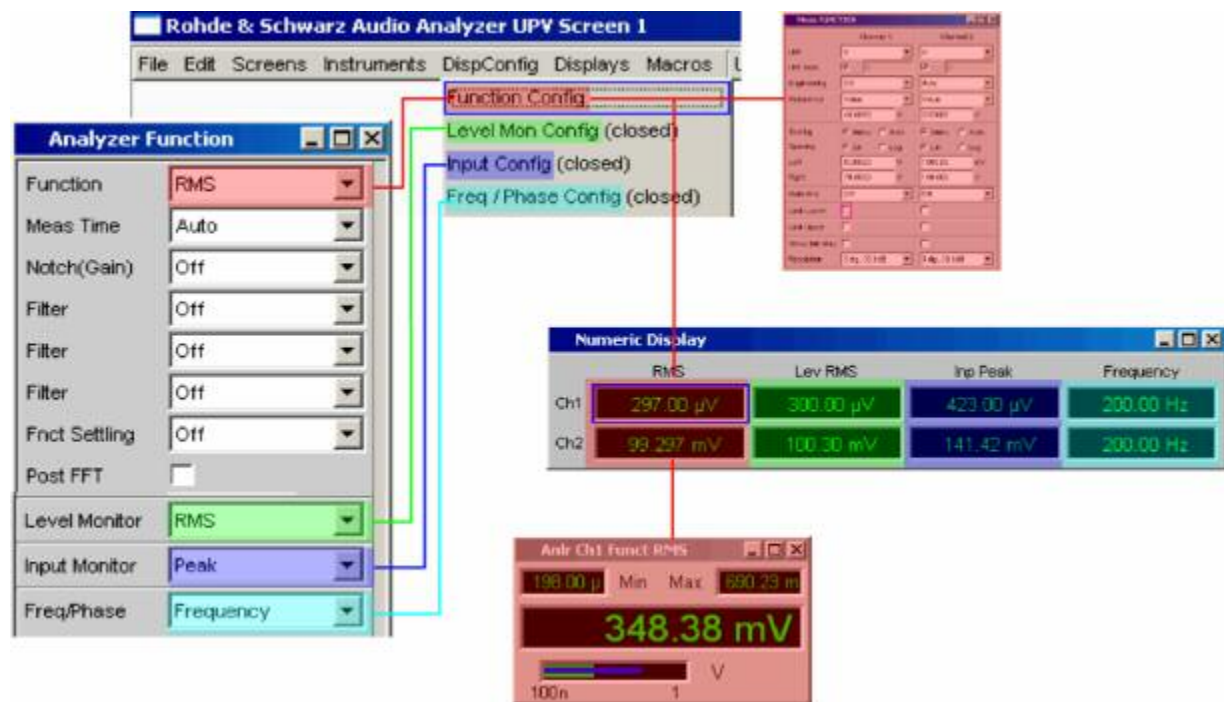
The measurement result configuration panels are used to determine how measurement results are **displayed** in the numeric display and the combi display. **What** is measured and **how** measurement is performed is configured in the analyzer panel.

The measurement result configuration panels are opened by pressing the **MENU** key on the front panel or, with mouse operation, by moving the pointer to the top left-hand edge of the R&S UPV application window.

4 different measurement result configuration panels are available.

- **Function Config**  
The panel is used to configure how the measurement results for the analyzer measurement function "Function" are displayed.
- **Level Mon Config**  
The panel is used to configure how the measurement results for the additional measurement function "Level Monitor" are displayed.
- **Input Config**  
The panel is used to configure how the measurement results for the additional measurement function "Input Peak" are displayed.
- **Freq / Phase Config**  
The panel is used to configure how the measurement results for the additional measurement function "Freq/Phase" are displayed.

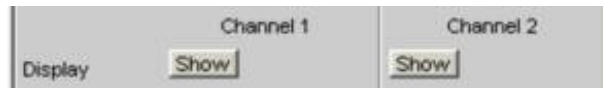
The illustration below shows the assignment of the analyzer measurement functions to the measurement result configuration panels and the measurement result displays.



## Parameter Fields of the Panel

The layout of the measurement result configuration panels is almost identical for all of the displays. The differences are explained in the respective setting function description.

### Display



Clicking the **Show** button activates the combi display for a measurement value.

The display is deactivated by pressing the **CLOSE** key or by clicking the X button in the title bar using the mouse, provided that the display window has the focus.

### Unit



This parameter field is used to determine the unit in which the measurement results are to be displayed.

The parameter list available in this parameter field depends on whether the analog or digital analyzer instrument has been selected and under which of the 4 analyzer measurement functions

- Function
- Level Monitor
- Input measurement
- Frequency/phase measurement

the panel was opened.

Approx. 30 different units are available to allow all measurement functions of the analyzer to be displayed.

## Unit Auto

Used to determine whether the unit label displayed in the numeric display and in the combi display is the same as that set in the Unit parameter field above or whether it can be user-selected.



The unit label displayed in the numeric display and in the combi display is the same as the unit set in the Unit parameter field and is therefore generated automatically by the R&S UPV.



A user-defined unit label can be entered.

**Practical example:**

The output level  $U_{0\text{dBspl}}$  which is output at a sound pressure of 0 dBspl (spl = sound pressure level) is specified for high-quality microphones.

If the measured microphone output level is displayed in the referenced unit dBr and entered for the reference value  $U_{0\text{dBspl}}$ , the level displayed on the R&S UPV will be in dBr but corresponds to the sound pressure in dBspl. For the measurement result display, however, a numeric value in dBspl is desirable. To allow this, the unit label can be changed from dBr to dBspl.



Engineering



Factor applied to the measurement results in the numeric display and in the combi display.  
 This parameter field cannot be accessed if a dB or % unit is selected in the Unit parameter field above since these units do not usually have an engineering function.

**Auto**                      **Automatic** engineering assignment from p to M, for the measurement result, limits and Min/Max values; depends on the magnitude of the respective value.



**Off**                              Engineering is **deactivated**. Measurement result, limits and Min/Max values are always displayed in 1.0 E<sup>0</sup> format.



**μ**  
**m**  
**k**                              Engineering **fixed** to μ, m or k. The values to be displayed are multiplied by the factor 1.0 E<sup>6</sup>, 1.0 E<sup>3</sup> or 1.0 E<sup>-3</sup>.

Measurement results, limits and Min/Max values are displayed with the selected engineering.



Resolution



Used to set the number of digits used to display the measurement result, limits and Min/Max values.

## Reference

 A screenshot of a control panel showing a parameter field labeled 'Ref'. To its right is a dropdown menu with 'Value:' selected.

Used to select the reference for referenced units for the measurement result.

**Value**

A numeric value with unit must be entered as the reference value in the parameter field below.

 A screenshot of a control panel showing a parameter field labeled 'Ref'. To its right is a dropdown menu with 'Value:' selected. Below the dropdown is a text input field containing the value '1.234500' followed by a unit 'V'.

A reference value with unit can only be set if "Value" is selected in the "Reference" parameter field.

**Store**

The current measurement result of a single-channel measurement is stored under Value when the ENTER key is pressed or the rotary knob/mouse key is clicked; this measurement result is then displayed as the new reference value. The reference value does not change while measurements are being performed. This selection option is only available for 1-channel measurement.

**Store Ch1  
Store Ch2**

The current measurement result for Channel 1 and Channel 2 is stored under Value when the ENTER key is pressed or the rotary knob/mouse key is clicked; this measurement result is then displayed as the new reference value. The reference value does not change while measurements are being performed. This selection option is only available for 2-channel measurement.

**Meas Ch1  
Meas Ch2**

Every level measurement result for Channel 1 and Channel 2 is stored as the reference value. If a referenced unit has been selected in the Unit parameter field, the measurement result is referenced to this moving reference value and displayed.

This selection option is only available for 2-channel measurement.

**Gen Track**

The currently valid and every newly set generator voltage is stored as the reference value and can then be used for referenced display (by both channels). If a referenced unit has been selected in the Unit parameter field, the measurement result is referenced to this reference value and displayed.

## Auto Scale



One-off automatic scaling of the bargraph.

**Exec** Clicking this button triggers **one-off** scaling of the bargraph; the current minimum and maximum values are used for the scaling process. The determined values are entered in the Left and Right parameter fields below.

## Spacing



Linear or logarithmic spacing of the bargraph.

**Lin** Linear spacing of the bargraph.

If a logarithmic unit (dB unit) has been selected in the **Unit** parameter field, this parameter field is shown in grey (cannot be accessed) and its parameter is set to Lin (it would be pointless to display measurement values with a logarithmic unit on a bargraph with logarithmic spacing).

**Log** Logarithmic spacing of the bargraph.

This parameter is only available if a linear unit (V, W,  $\Delta V$ , etc) has been selected in the Unit parameter field and its value range cannot contain negative numbers.

Example:

Although  $\Delta V$  is a linear unit, the measurement results can be negative which means that logarithmic display is not possible.

## Left



Used to set the left-hand value on the bargraph.

This parameter field can only be accessed if Scaling is set to Manu. Negative values or the value 0.00000 are not permitted if Spacing is set to Log.



## Right



Used to set the right-hand value on the bargraph.

This parameter field can only be accessed if Scaling is set to Manu.

This value must always be higher than the Left value.

Negative values or the value 0.0000 are not permitted if Spacing is set to Log.

## Main Grid



Division of the bargraph with vertical main gridlines.



- |  |  |
|--|--|
| <b>Off</b>   | No main gridlines are used in the bargraph.  |
| <b>On</b>  | Decadic division of a bargraph (with Spacing = Log) with main gridlines.   |
| <b>Auto Coarse</b><br><b>Auto Medium</b><br><b>Auto Fine</b> | Coarse, medium or fine division of a bargraph (with Spacing = Lin) with main gridlines. One to two, 3 to 4 or 8 to 9 main gridlines are displayed depending on the scale end values.<br>Main gridlines may be <b>hidden</b> if the combi display is reduced in size. |
| <b>Divisions</b>   | Preset division of a bargraph (with Spacing = Lin) with main gridlines.<br>The desired number of divisions is set in the parameter field below.<br>These main gridlines are <b>not</b> hidden if the combi display is reduced in size.                               |
| <b>Steps</b>   | Preset division of a bargraph (with Spacing = Lin) in a fixed step size.<br>The step size is set in the parameter field below.<br>These main gridlines are <b>not</b> hidden if the combi display is reduced in size.  |

## Division

A screenshot of a control panel for 'Main Grid'. It features a dropdown menu labeled 'Divisions' with a downward arrow, and a text input field below it containing the number '3'.

Used to enter the number of main gridline divisions for a bargraph (with Spacing = Lin).

If, for example, **2** is entered, the bargraph is divided into **two sections**, i.e. **one** main gridline is displayed.

## Step

A screenshot of a control panel for 'Main Grid'. It features a dropdown menu labeled 'Steps' with a downward arrow, and a text input field below it containing the value '10.0000'.

Used to enter the main gridline step size for a bargraph (with Spacing = Lin).

The unit of the value is not linked to the unit selected in the Unit parameter field; the value can be given in different units.

Sub Grid

Sub Grid

Subdivision of the main gridlines in a bargraph using subgridlines.

- Off** Subgridlines are deactivated.
- 2** Subdivision of the main gridlines of a bargraph (with Spacing = Lin) into 2, 4 or 5 sections.
- 4**
- 5** If, for example, **2** is selected, the area between two main gridlines is divided into **2** sections, i.e. **one** subgridline appears between the main gridlines. These subgridlines are **not** hidden if the combi display is reduced in size.

**Coarse** Coarse or fine subdivision of the main gridlines of a bargraph (with Spacing = Log) with subgridlines.  
**Fine**

Coarse:



Subgridlines 2 and 5 only

Fine:



All subgridlines

Limit Lower

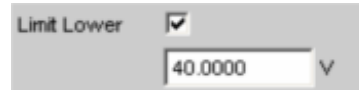


Used to activate/deactivate the lower limit check.



The lower limit check is activated.

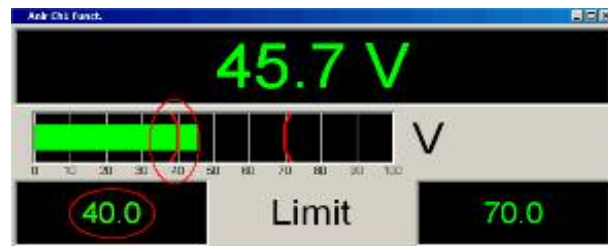
The parameter field below is used to enter a lower limit in the units selected in the Unit parameter field.



A lower limit can be defined for the measurement result; every measurement value is then compared with this limit.

If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.

The lower limit is displayed as a value (bottom left) and as a red limit marker in the bargraph.



As soon as a limit is underranged, the measurement result and bargraph change from green to red; if the limit violation no longer exists, the measurement result and bargraph are displayed in green again.

A red measurement value in the numeric display also indicates a limit violation:

In order to monitor limit violations over a long period of time without having to watch the measurement result display continuously, the lower limit is displayed permanently in red as soon as the limit is underranged after the **START** key has been pressed.



Pressing the **START** key or re-entering the limit resets the hold function.

This hold function is not visible in the numeric display.



The lower limit check is deactivated.

Limit Upper

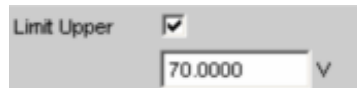


Used to activate/deactivate the upper limit check.



The upper limit check is activated.

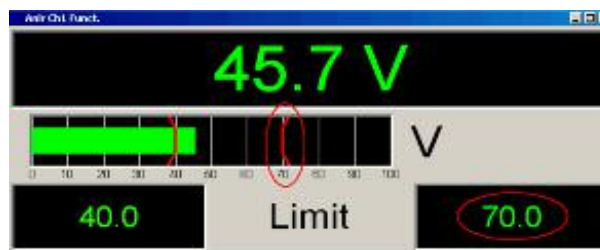
The parameter field below is used to enter an upper limit in the units selected in the Unit parameter field.



An upper limit can be defined for the measurement result; every measurement value is then compared with this limit.

If a relative unit is selected, the associated reference value (a few parameter fields higher up) is used.

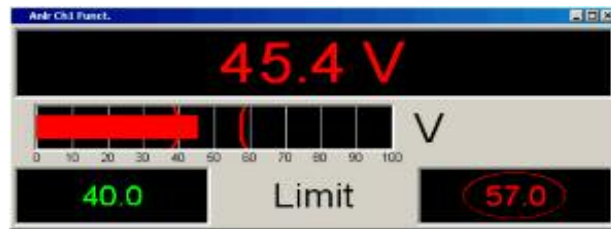
The upper limit is displayed as a value (bottom right) and as a red limit marker in the bargraph.



As soon as a limit is overranged, the measurement result and bargraph change from green to red; if the limit violation no longer exists, the measurement result and bargraph are displayed in green again.

A red measurement value in the numeric display also indicates a limit violation:

In order to monitor limit violations over a long period of time without having to watch the measurement result display continuously, the upper limit is displayed permanently in red as soon as the limit is overranged after the **[START]** key has been pressed.



Pressing the **START** key or re-entering the limit resets the hold function.

This hold function is not visible in the numeric display.



The upper limit check is deactivated.

Show Min/Max



Used to activate/deactivate the Min/Max display. Two numeric values and the ends of the blue bar inside the green bar indicate the lowest and highest values measured.



The lowest and highest value measured since the **START** key was pressed are displayed. The Min/Max values are shown in the top left and right-hand corners of the combi display.



The ends of the blue Min/Max bar indicate the lowest and highest values measured since the **START** key was pressed.

Pressing the **START** key resets Min/Max value recording and the collection of measurement values begins again.



The Min/Max display is deactivated.

3 dig. / 0.1 dB  
4 dig. / 0.01 dB  
5 dig. / 0.001 dB  
6 dig. / 0.0001 dB  
7 dig. / 0.00001 dB

The parameters are explained below using an example:

**5 dig. / 0.001 dB**

**5 dig.:** Values which are displayed with a linear unit (V, Hz, etc) are output with 5 digits:



**0.001 dB:** Values which are displayed with a logarithmic unit (dBV, dBu, etc) are output to three decimal places:



If the numeric values can no longer be displayed with the selected resolution (e.g. because there are too many decimal places with the selected engineering setting), the values are rounded off and shown as an exponent:









## Softkey Menu

Every combi display has its own softkey menu. The settings selected in the menu apply exclusively to the associated combi display and affect no other combi display.



Store Reference	The current measurement value is stored as a reference value. If, for example, the reference unit dBr is selected as the unit, the next measurement value is 0.0 dBr.
Autoscale	One-time scaling of the bargraph on the basis of the minimum and maximum values. Corresponds to  in the associated configuration panel.
Show Min/Max	If the tick is set, the min/max values are displayed. Corresponds to  in the associated configuration panel.
Show Lim Low	If the tick is set, the lower limit value is displayed. Corresponds to  in the associated configuration panel.
Show Lim Upp	If the tick is set, the upper limit value is displayed. Corresponds to  in the associated configuration panel.
Restart Min/Max	Resets min/max value recording in order to restart measurement.
Restart Lim Violation	Resets the red colour marking (measurement value, bar and limit value) for indicating a limit violation and restarts a test for a limit violation.
Config	Opens the configuration panel.

# Limit Monitoring

Both traces/bargraphs and measurement results can be monitored to determine whether limits or limit curves have been overranged or underranged.

## Traces and Bargraphs

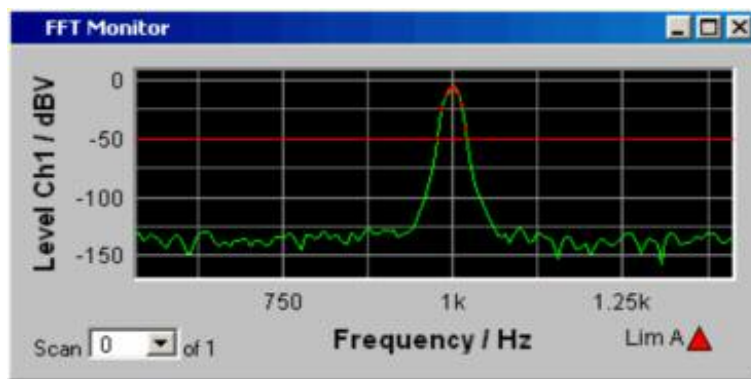
A lower and upper limit or a limit curve can be entered separately for Trace A and Trace B in any display configuration panel of the following graphic subsystems:

- Sweep (in 4 windows)
- FFT Monitor
- FFT measurement function (in two windows)
- Waveform
- Bargraph (in two windows)

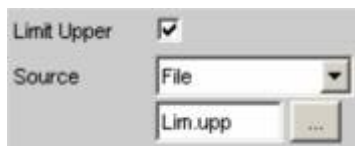
### Limit entered as a value:



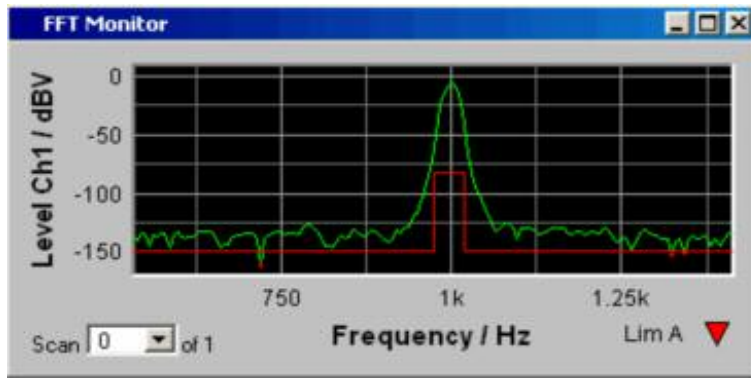
The limit in a graphical display is shown as a straight line.



### Limit entered as a curve:



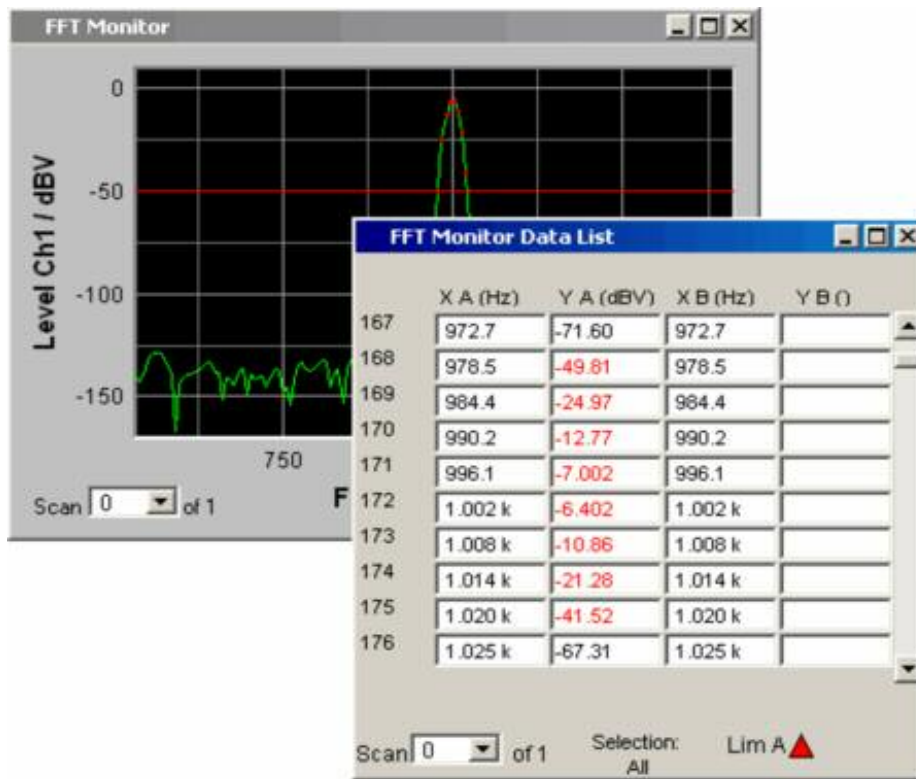
The limit in a graphical display is shown as a user-defined curve.







Every measurement value is compared with the limit and limit curve, and any limit violations are plotted as red dots on the trace or bargraph.





If multi-scan recording is performed in the graphic subsystems FFT Monitor and Sweep, all of the scans of a trace are checked against the associated limit or limit curve.

In the result list (see section "Result List" on page 4.314), rows containing measurement values which violate the specified limits are displayed in red.



In addition to the red dots which indicate a limit violation on the trace or bar of the bargraph, there is also a limit violation indicator in the bottom right-hand corner of the graphical display and result list. This provides the user with a clear indication as to whether a limit has been violated. The symbols have the following meaning:

- Lim A  Lim B  Symbols indicating limit violations
-  Limit Upper is activated and there is no limit violation.
  -  Limit Lower is activated and there is no limit violation.

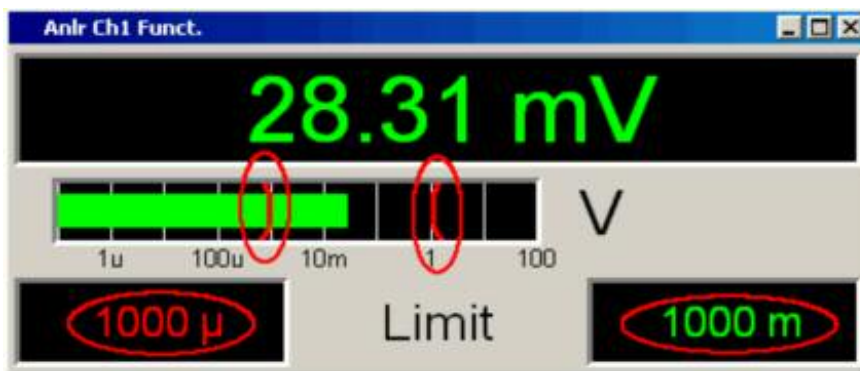
-  The Limit Upper value has been violated in the past but there is currently no limit violation. The violation is indicated until the **START** key is pressed again.
-  The Limit Lower value has been violated in the past but there is currently no limit violation. The violation is indicated until the **START** key is pressed again.
-  The Limit Upper value is currently being violated.
-  The Limit Lower value is currently being violated.

## Measurement Results

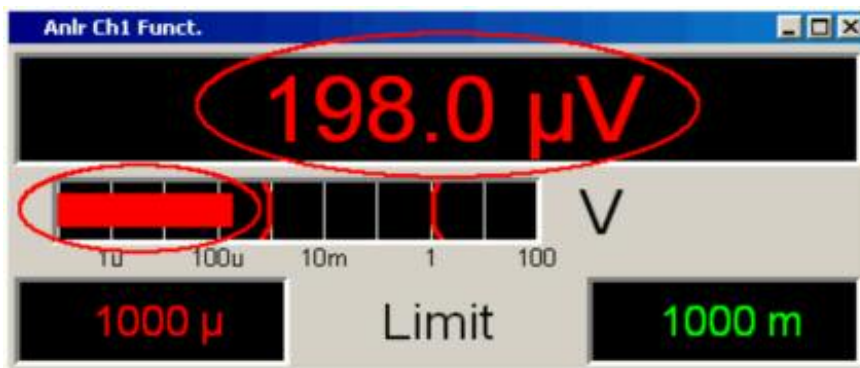
A lower and upper limit can be specified in any measurement result configuration panel:



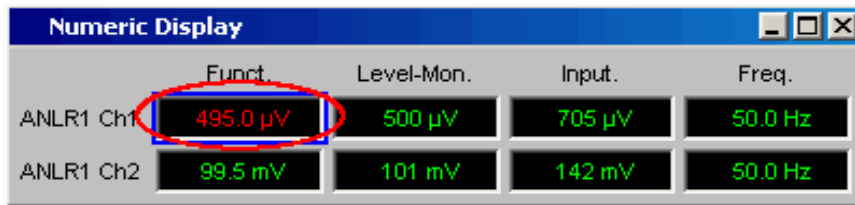
In the combi display, the limits are displayed as red limit markers (brackets) in the bargraph and as numeric values:



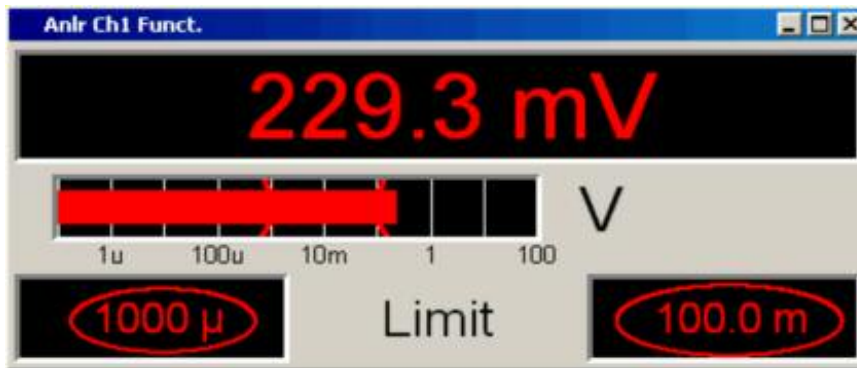
A red measurement value and bar indicate that there is a limit violation:



A red measurement value in the numeric display also indicates a **current** limit violation:



In order to indicate that the lower or upper limit was violated in the past, the lower or upper limit is displayed in red until the **[START]** key is pressed, which resets the hold function and restarts monitoring of the measurement values:



This hold function is not visible in the numeric display.

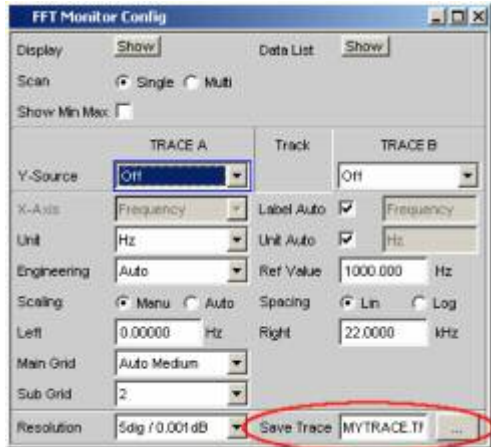
## Trace Files

Series of measurement values from recorded function measurement results, sweeps, FFT or waveform data can be saved to a file for various reasons:

- To load the measurement values again as a report, to permit comparison or to allow processing at a later stage. When loaded using commands in the display panel, the series of measurement values are initially displayed exactly as they were when saved. They can, however, be rescaled or, for example, converted into different units.
- The files are stored in ASCII format so that they can be easily imported into other programs where the data can be processed further. See section *"Format"* on page 4.349 for information on the ASCII format and how data can be imported into other programs.
- In the R&S UPV, the series of measurement values can be used in a different form:
  - As reference curves referenced to other traces if the measurement values are displayed in relative units. To allow this, the measurement values are loaded in the graphic subsystem as a reference file. The measurement values can also be used as equalization data for the generator.

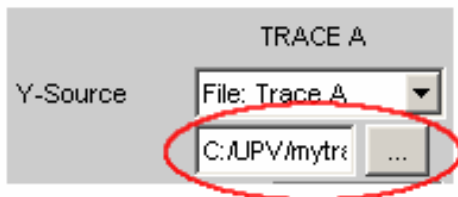
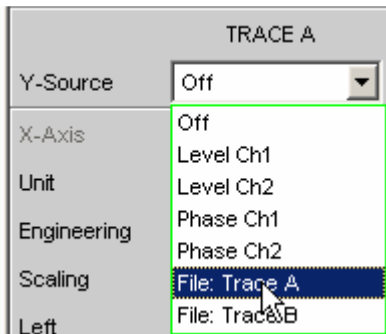
## Saving

When traces are **saved** via Save Trace, no distinction is made between trace A or trace B. The file always contains both traces, provided both traces are switched on. The data save format is the same for all subsystems.



## Loading

In contrast to **saving** traces via Save Trace, where no distinction is made between trace A or trace B (the file always contains both traces, provided both traces are switched on), a distinction is made between trace A or trace B when traces are **loaded** via Y-Source = "File: Trace A" or "File: Trace B". By selecting "File: Trace A" or "File: Trace B", the user can decide whether to load trace A or trace B.



All trace files have the default file name extension \*.TRC – i.e. if only the file name without extension is specified, this extension is automatically added. Other extensions are permitted. Clicking the ... button opens the Windows file box with all the known characteristics.

During loading, the UPV tests whether the trace file can be loaded. It does not matter from which graphic subsystem the trace file was saved.

A trace file can be loaded if the base unit of the X axis corresponds to the X axis unit currently set and if the base unit of the Y axis occurs in the current subsystem.

### What is a base unit?

The base unit of dBV, dBu, dBr, W, V/Vr, etc, is volt.

The base unit of Hz, Toct, f/fr is hertz.

The base unit of Rad is degree.

### An example to illustrate this:

In the graphic subsystem **Sweep Graph 1**, the measurement result of the level monitor with the RMS measurement function of Ch1 (Y-Source = LevMon RMS Ch1) was displayed versus the frequency on the Y axis of trace A (X Axis = Frequency). The base unit for the Y axis is therefore volt and the base unit of the X axis is Hz.

This data set can now be loaded in the graphic subsystem **FFT Graph 1**, since this subsystem includes Y-Source = FFT Level Ch1 or FFT Level Ch2 with the base unit volt and the X axis is permanently set to Frequency with the base unit Hz.

Loading a data set obtained in the graphic subsystem Sweep as FFT is unusual, of course, but no restrictions are imposed on the user, provided the base units of the Y axis correspond to the current subsystem and base unit of the X axis matches the X axis unit.

**The situation is different** when the data set of the graphic subsystem **Sweep Graph 1** is to be loaded into the graphic subsystem **Waveform**. The base units of the Y axes would match the subsystem, since volt values correspond to Y-Source = Level Ch1; but the X values in Hz from the data set do not correspond to the fixed waveform time axis in seconds. This file would be rejected with a message "X Axis incompatible! File not loaded".

If a trace file cannot be loaded, or if Y-Source = File: Trace A or File: Trace B is used to address a trace that is not available in the trace file, the warning "The requested Trace A is not available in trace file" is output. However, the preceding trace in the graphic display is retained.

Displaying and deleting traces depends mainly on the switchover of the Y-Source (the source of the traces).

The Y-Source parameter field offers two sources for recording and displaying traces:

- **Traces from measurements** are all settings other than File: Trace A or File: Trace B, e.g. Funct Ch1, Level Ch1, Phase Ch1 etc
- **Traces** can be loaded **from a file** with File: Trace A or File: Trace B
- The setting **Off** deletes the trace

### Switchover of the Y-Source:

The following description refers to the most frequent setting, New Scan = Append; with this setting, scans are always appended to the most recently recorded scan.

The special mode, New Scan = Replace, is designed as a repair mode and makes it possible to replace a single scan with the scan of a measurement or from a file.

If the switchover is **from one measurement to another measurement**, the current scan is retained, provided the base unit is appropriate (e.g. Y-Source from FFT Level Ch1 to FFT Level Ch2). The new scan is recorded after the Start or Single button is pressed. If the base unit is not appropriate, the current scans are deleted (e.g. Y-Source from FFT Level Ch1 to FFT Phase Ch1). The new scan is recorded after the Start or Single button is pressed.

If the switchover is from a **measurement to the loading of a trace from a file** (e.g. Y-Source from FFT Level Ch1 to File: Trace A), the traces from the file are deleted and displayed immediately, provided the

base unit in the subsystem is acceptable and the base unit of the X axis is appropriate. If not, a warning is output and the current scans are retained.

If the switchover is from **file-loaded trace to measurement** (e.g. Y-Source from File: Trace A to FFT Level Ch1), the current scan is retained, provided the base unit is appropriate. The new scan is recorded after the Start or Single button is pressed. This behaviour is especially important, since it allows new measurement scans to be appended to scans loaded from a file! If the base unit is not appropriate, the current scans are deleted.

There is only a slight change in appearance when loading or recording scans, depending on whether Scan is set to Single or to Multi.

If **Scan** is set to **Multi**, new scans are appended to the existing scans after the Start or Single button is pressed, provided the base units are appropriate. If a trace is loaded from a file and the file contains a multiscan, as many scans as are available (up to the maximum number of 20 scans) are taken from the file. If there is only a single scan in the file, this scan is interpreted as a multiscan with only one scan.

If **Scan** is set to **Single**, the current scan is replaced by the new scan after the Start or Single button is pressed. If a scan is loaded from a file and the file contains a multiscan, the first scan from the multiscan is taken.

When Y-Source is switched to File, the Alive/Hold parameter field disappears (but retains its setting for a subsequent switchover to measurement), since there is no sense in an Alive/Hold option for a trace loaded from a file.

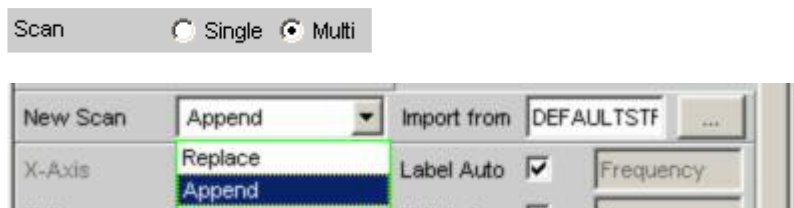
When Y-Source is switched to measurement, the Alive/Hold parameter field appears again with its previous setting.

When Scan is switched from Single to Multi, trace A and trace B are deleted and New Scan is switched to the Append mode (the special function Replace is switched to Append).

When Scan is switched from Multi to Single, the last scan of the current multiscan is retained.

### Appending and replacing multiscans

The "New Scan" and "Import from" parameter fields are not available unless Scan is set to Multi, since new scans can be appended or replaced only in the case of multiscan recording.



The scans to be appended or replaced can come from a measurement or a file. The by far most frequently used setting is New Scan = Append.

If scans are loaded from a file using "Import from", existing scans are retained and the scans from the file are appended to the most recent scan, provided the Alive/Hold parameter field is set to **"Hold"**. If the Alive/Hold parameter field is on **"Alive"** and a measurement is in process (single measurement not yet finished or continuous measurement), the attempt to import a file is rejected with a message. If the Alive/Hold parameter field is on **"Alive"** and a single measurement is finished, scans can be appended from an import file.

"Import from" can be used to append one or more scans from a file to a trace with a multiscan that is on hold, regardless of whether the held trace was generated from measurements or by loading a trace file. A file is not imported unless the base units from the file correspond to the Y-Source setting and the unit is permitted in the graphic subsystem. If, for example, Y-Source = Funct Ch1 and the set analyzer



measurement function = RMS, a trace file with the base unit "volt" is appropriate. A trace file with the base unit "%" would be rejected with an error message.

If measurement scans are to be appended to available scans, the Alive/Hold parameter field must be switched to Alive and a measurement is triggered and a scan appended every time the  button is pressed.

When loading a trace file, you must specify exactly which trace you want to load from the file ("File: Trace A" or "File: Trace B").

When importing, you do not have this selection option. If the base units match, the file content determines what is imported:

If only trace A or only trace B is switched on in Y-Source and the file to be imported contains only one trace (either A or B), then this trace is imported.

If trace A and trace B are simultaneously switched on and the file to be imported contains only one trace (either A or B), then this trace is imported to trace A and trace B.

If only trace A or only trace B is switched on and the file to be imported contains a stereo trace (i.e. A and B), then the matching trace is imported, i.e. A to A and B to B.

If trace A and trace B are simultaneously switched on and the file to be imported contains a stereo trace, then both traces are imported, i.e. A to A and B to B.

If New Scan is set to **Append**:

Alive + measurement: Every newly measured scan, triggered by the  button, is appended.

Hold + Import from File: All appropriate scans from the file are appended. Beginning with the first scan, one scan after another is appended from the file until the maximum number of 20 scans is reached.

If New Scan is set to **Replace**:

Alive + measurement: The scan selected with the  button is replaced by each newly measured scan, triggered by the  button.

Hold + Import from File: If the file contains more than one scan, a warning is output and the first scan from the file is taken.

# Format

All trace data is stored in plain text in ASCII format. The choice of format allows the data to be easily processed in EXCEL.

## Format of the trace file:

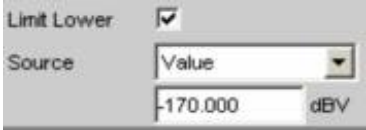
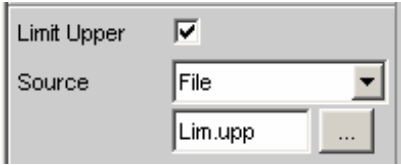

Subsystem: TSG								
Title: Titletext								
Comment: Commenttext								
<b>X Axis;</b>	<b>Trace A;</b>				<b>Trace B;</b>			
X-Axis-Label: Frequency	Y1-Axis-Label: Input RMS analog Ch1				Y2-Axis-Label: THD+N digital CH2			
X-Unit: Hz	A-Unit: dBV				B-Unit: dB			
X-Spacing: LOG	A-Spacing: LIN				B-Spacing: LIN			
X-Left: Value	A-Bottom: Value				B-Bottom: Value			
X-Right: Value	A-Top: Value				B-Top: Value			
Void	A-LimLow: Value or Void				B-LimLow: Value or Void			
Void	A-LimUpp: Value or Void				B-LimUpp: Value or Void			
Scan #1	A-Comment: Scan Labeltext				B-Comment: Scan Labeltext			
X-Ref: Value	A-Ref: Value or Void				B-Ref: Value or Void			
X/datacount	A-Y	A-LimLow	A-LimUpp	A-RefY in V	B-Y	B-LimLow	B-LimUpp	B-RefY in V
20.0000	0.201	0.2	0.3	1.01	-98.82	-98.5	-90	Void
..	..	..	..	..	..	..	..	..
20000.0	0.203	0.25	0.4	2.03	-98.10	-98.5	-90	Void
Scan #2	A-Comment: Scan Labeltext				B-Comment: Scan Labeltext			
X-Ref: Value	A-Ref: Value or Void				B-Ref: Value or Void			
X/datacount	A-Y	A-LimLow	A-LimUpp	A-RefY in V	B-Y	B-LimLow	B-LimUpp	B-RefY in V
20.0000	0.201	0.2	0.3	1.01	-98.82	-98.5	-90	Void
..	..	..	..	..	..	..	..	..
20000.0	0.203	0.25	0.4	2.03	-98.10	-98.5	-90	Void

The individual parameters are separated from each other by a semicolon (;).

- Black:** Explanation of the fields. These labels are not stored in the trace file.
- Green:** Fixed entries in the trace file in ASCII format; intended to make assignment of the data below easier.
- Red:** Dynamic entries: text and values.

## Explanation of the terms:

Subsystem	Short name indicating the subsystem from which this trace file was created.	
	TSG	Sweep Graph 1 ... 4
	TFM	FFT Monitor
	TFF	FFT Graph1 and 2
	TWM	Waveform Monitor
	TBG	Bargraph1 and 2
Title	Not used	
Comment	Not used	
<b>X Axis</b>	<b>Trace A</b>	<b>Trace B</b>
X-Axis-Label	Y1-Axis-Label	Y2-Axis-Label
	Label of the X axis, left-hand Y axis (Trace A) and right-hand Y axis (Trace B) in the graphical display.	

X-Unit	A-Unit	B-Unit	Unit of the X axis, left-hand Y axis (Trace A) and right-hand Y axis (Trace B) in the graphical display.
X-Spacing	A-Spacing	B-Spacing	Linear or logarithmic spacing of the X axis, left-hand Y axis (Trace A) and right-hand Y axis (Trace B).
X-Left	A-Bottom	B-Bottom	Left-hand value of the X axis, lower value of the left-hand Y axis (Trace A) and right-hand Y axis (Trace B).
X-Right	A-Top	B-Top	Right-hand value of the X axis, upper value of the left-hand Y axis (Trace A) and right-hand Y axis (Trace B).
	A-LimLow	B-LimLow	<p>Lower limit of the left-hand Y axis (Trace A) and right-hand Y axis (Trace B). If a value is entered here, the value from the configuration panel of the graphic system is used for limit checking:</p>  <p>If VOID is displayed here, the limit check is either deactivated or the limit values come from a limit file:</p> <p>If the limits come from a limit file, the limits interpolated on the X axis are listed under A-LimLow and B-LimLow of the scan data sets.</p> 
	A-LimUpp	B-LimUpp	Ditto for the upper limit of the left-hand Y axis (Trace A) and right-hand Y axis (Trace B).
<b>Scan #Nr</b>	A-Comment	B-Comment	<p><b>Scan #No:</b> Scan number of the following data set, numbered consecutively from 1 to 20. A-Comment (not used) B-Comment (not used)</p>
<b>X-Ref</b>	<b>A-Ref</b>	<b>B-Ref</b>	<p>Reference values for referenced units of the X axis, left-hand Y axis (Trace A) and right-hand Y axis (Trace B). When the trace file is loaded, the value entered here is transferred to the configuration panel of the graphic system and used as a fixed reference value:</p>  <p>If VOID is displayed for A-Ref and/or B-Ref, the reference values come from a reference file and the reference values interpolated on the X axis are listed under "A-RefY in <i>unit</i>" and "B-RefY in <i>unit</i>" of the scan data sets.</p>

<p><b>X/datacount</b></p> <p><b>A-Y</b></p> <p><b>A-LimLow</b></p> <p><b>A-LimUpp</b></p> <p><b>A-RefY in Unit</b></p> <p><b>B-Y</b></p> <p><b>B-LimLow</b></p> <p><b>B-LimUpp</b></p> <p><b>B-RefY in Unit</b></p>	<p><b>X/datacount:</b> Datacount indicates the number of data sets (rows) for this scan.</p> <p><b>X:</b> X value in the unit specified under X-Unit.</p> <p><b>A-Y:</b> Y value of Trace A in the unit specified under A-Unit.</p> <p><b>A-LimLow:</b> Trace A lower limit from a limit file in the unit specified under A-Unit. If VOID is displayed here, there are no limits from a file.</p> <p><b>A-LimUpp:</b> Ditto for the upper limit.</p> <p><b>A-RefY in unit:</b> Unit for the Trace A reference values (from a reference file) interpolated on the X axis.</p> <p><b>B-Y:</b> Y value of Trace B in the unit specified under B-Unit.</p> <p><b>B-LimLow:</b> Trace B lower limit from a limit file in the unit specified under A-Unit. If VOID is displayed here, there are no limits from a file.</p> <p><b>B-LimUpp:</b> Ditto for the upper limit.</p> <p><b>B-RefY in unit:</b> Unit for the Trace B reference values (from a reference file) interpolated on the X axis.</p>
---	---

#### Example of a trace data set:

The trace dataset was generated from the FFT Graph subsystem.

```
TFF;
Heading String;
Commenttext;
X Axis;Trace A;Trace B;
Frequency;FFT Level Ch1;VOID;
Frequency / Hz;FFT Level Ch1 / dBV;VOID;
Hz;dBV;VOID;
LIN;LIN;VOID;
0;-166.85;VOID;
22000;-24.2238;VOID;
VOID;VOID;VOID;
VOID;VOID;VOID;
Scan #0;Labeltext;VOID;
1000;A-Ref: 1;VOID;
X/256;A-Y;A-LimLow;A-LimUpp;A-RefY in V;B-Y;B-LimLow;B-LimUpp;B-RefY in V;
0;-74.9841924221;VOID;VOID;1;VOID;VOID;VOID;VOID;
93.75;-50.1402273369;VOID;VOID;1;VOID;VOID;VOID;VOID;
187.5;-35.6009975743;VOID;VOID;1;VOID;VOID;VOID;VOID;
281.25;-30.5995395094;VOID;VOID;1;VOID;VOID;VOID;VOID;
:
:
23718.75;-141.828231612;VOID;VOID;1;VOID;VOID;VOID;VOID;
23812.5;-140.147505991;VOID;VOID;1;VOID;VOID;VOID;VOID;
23906.25;-135.81278084;VOID;VOID;1;VOID;VOID;VOID;VOID;
```

# Loading and Saving

This section tells you how to load and save different kinds of data sets in the R&S UPV. The file name is chosen through a central file selection box; its type is defined by the extension.

## File selection box and File manager

### File selection box

The file selection box is split into three or four areas. At the top (Recent area) is a list of the file names last selected. This list will always contain the last ten entries. Below this and split into two is space for selecting the required directory (Directory area, left) and the required file (File area, right). If a data set is to be saved, you will also find an entry field at the bottom for the file name.

At the bottom edge of the file selection box are two buttons "Select" and "File Manager". You can work these buttons either with the rotary knob or the softkey below.

To change between the areas, use the rotary knob or the cursor keys. Each of the areas appears with a blue frame when you select it with the rotary knob. Pressing the rotary knob or the **ENTER** key changes your selection to the content of the selected area, and an entry within this area is selected; the **ESC** key takes you back to selection of an area.

---

### **Important:**

*The Directory area and the File area are comprised within the same frame. So to change between the two areas you use the **LEFT** and **RIGHT** cursor keys and not the rotary knob.*

---

If a selection is in the Recent area or File area, the **RETURN** key or a click of the rotary knob will complete selection of the file name and execute the required function. When you are storing data sets, ending entry of the file name with **RETURN** will complete selection of the file name.

For the creation of new directories when saving or organizing saved data sets during loading, the file selection box has a "File Manager" button to open a functionality similar to Windows Explorer.

### File manager

The file manager is split into three areas. At the top is a selection of the possible types of data sets. These are distinguished by their extensions in the file name. Below this and split into two is space for selecting the required directory (Directory area, left) and the required file (File area, right).

At the bottom edge of the file manager are the buttons "Cut", "Copy", "Paste", "Remove", "Rename" and "Create Dir". You can work these buttons either with the rotary knob or the softkey below them. These are a substitute for the popup menu in Windows Explorer on the right mouse key.

To change between the areas, use the rotary knob or the cursor keys. Each of the areas appears with a blue frame when you select it with the rotary knob. Pressing the rotary knob or the **ENTER** key changes your selection to the content of the selected area, and an entry within this area is selected; the **ESC** key takes you back to selection of an area.

---

**Important:**

The Directory area and the File area are comprised within the same frame. So to change between the two areas you use the **LEFT** and **RIGHT** cursor keys and not the rotary knob.

---

Once a file is selected, you activate a button at the edge of the dialog to trigger the required function.

If you want to shift a file from one directory to another for example, you first select the source directory in the Directory area, and then the particular file in the File area. The "Cut" button notes the file to be shifted. Then you select the destination directory in the Directory area and choose the "Paste" button. This moves (pastes) the file from the source directory to the destination directory.

## Loading and Saving Setups

Setups can be loaded and saved at any time. The front panel keys **LOAD** and **SAVE** trigger the required function, opening the appropriate file selection box.

---

**Important:**

Loading and saving setups is also possible through the menu bar. The related entries are in the File menu.

---

### Saving setups

When saving setups, the R&S UPV distinguishes between "complete" and "current" setups.

Saving a complete setup saves the entire instrument settings. These include the settings of generator and analyzer functions that are not active when you save. Saving a current setup only saves the settings of those functions momentarily selected. A complete setup also saves the size and position of all windows in all screens, which a current setup does not.

So if you configured a multiple sinewave with the frequencies 2 kHz, 2.5 kHz and 5 kHz plus levels 0.1 V, 0.5 V and 1 V in an earlier measurement, a complete setup will save these settings, even if you are measuring with a pure sinewave in the meantime. A current setup will ignore these settings. So after a **PRESET** and again loading the setup in the multiple sinewave, you will see the defaults unaltered.

### Loading setups

Loading a setup overwrites the settings of the instrument with the settings that were active when saving the setup. Depending on the type of setup loaded, only the current settings are overwritten ("current" setup) or the entire settings ("complete" setup). A complete setup also sets the size and position of all windows in all screens to how they were set when the setup was saved.

So if you have configured a multiple sinewave with the frequencies 5 kHz, 5.1 kHz and 5.2 kHz plus levels 0.2 V, 0.4 V and 0.6 V, loading both a complete sinewave setup and a current sinewave setup will set the measurement function to sinewave and adopt the function parameters of the sinewave from the particular setup. When you load the current setup however, the settings given for the multiple sinewave remain unchanged. A complete setup will set them to what they were before saving (in the above example that would be the frequencies 2 kHz, 2.5 kHz and 5 kHz plus levels of 0.1 V, 0.5 V and 1 V).

## Printing and Saving the Display Screen

The R&S UPV enables you, at any time, to make and keep an extract of the displayed results for later use. You do this either by a direct printout or by saving to a file or the Windows clipboard. You make the necessary settings, e.g. selection of the result to be output (source) and where it is to be output (destination), in a configuration panel.

### Configuring Print and Save Operations

The "Utilities → Hardcopy" menu opens a configuration panel for you to specify the output parameters.

#### Source

Selection of the screen content to be output.

##### UPV Window (Bitmap)

This setting outputs the entire screen of the R&S UPV as a bitmap. This is the default after firmware installation.

##### Active Graphics (Vector)

This setting outputs the momentarily active graphical window as a vector graphic. This is for the measurement displays "FFT Monitor", "FFT Window", "Waveform Window" and "Sweep Window".

#### Destination

Selection of the destination for the screen content to be output.

##### Printer

The screen content selected under "Source" is output direct to the printer set as the default printer under Windows XP.

##### File

The screen content selected under "Source" is output to a file specified under "File Name".

##### Clipboard

The screen content selected under "Source" is output direct to the Windows clipboard and can be used direct in other applications.

---

#### **Important:**

*If the instrument is being remotely controlled from the Windows XP Remote Desktop, the "Clipboard" setting allows you to transport graphics direct between the instrument and the host computer.*

---

- Orientation** Selection of the orientation wished on the Windows printer (only if "Destination" is configured as "Printer").
- Portrait** Output on the printer is in portrait format.
  - Landscape** Output on the printer is in landscape format.
- File Name** Selection of the name of the file for output to a file (only if "Destination" is configured as "File" and "Store Mode" is not "New"). The file selection box opens for you to change the file name (see section ["File selection box"](#) on page 4.352). Enter the file name without an extension; the "Source" setting specifies the file type.
- Store Mode** Selection of the mode for output to a file (only if "Destination" is configured as "File").
- New** Press  to open the file selection box and enter the name of the destination file. See also section ["Saving setups"](#) on page 4.353.
  - Overwrite** Output is always to the file of "File Name", which is overwritten without asking you each time.
  - AutoIncrement** Output is to a file whose name is composed of two parts: The beginning of the file name is that name entered as "File Name", followed by a consecutive number that is incremented by 1 every time you press .
- Header/Footer** Selection of the required header and footer in the output.
- On** The header and footer are visible.
  - Off** The header and footer are not visible.
- Define Header** Selection of the required text for the header (only if "Header/Footer" is "On"). This text forms the title in the middle of the header line.
- Define Footer** Selection of the required text for the footer (only if "Header/Footer" is "On"). This text forms the legend in the middle of the footer line.



## **Starting Print and Save Operations**

Press the H Copy key to trigger the function for output of measured results. The required action is immediately executed according to your settings in the configuration panel (see section "[Configuring Print and Save Operations](#)" on page 4.354).

---

**Important:**

*If you trigger H Copy during an ongoing measurement, the measurement is first halted and then the action is executed.*

---

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# 5 Remote Control - Fundamentals

## Introduction - Remote Control Fundamentals

In this chapter you will find:

- instructions on starting the Audio Analyzer R&S UPV by remote control,
- a general introduction to the remote control of programmable instruments, including details of command structure and syntax, command processing and the status registers,
- a graphic and tabular presentation of the status registers used in the Audio Analyzer R&S UPV.

The remote control commands of the Audio Analyzer R&S UPV are included in the details of the instrument functions in Chapter 4.

To standard the instrument comes with the following interfaces for remote control:

- IEC/IEEE bus interface in line with the IEC 625.1/IEEE 488.2 standard.
- LAN interface; the network card uses 100 MHz Ethernet IEEE 802.3u; the protocol is based on the VXI-11 standard.

A controller can be connected on the remote control interfaces, either direct or through a network (LAN). The connectors are located on the rear panel of the instrument. These connectors are detailed in Chapter 8.

SCPI commands (messages) are used for remote control. Commands not derived from the standard nevertheless follow SCPI syntax rules. The instrument supports SCPI version 1999 (**S**tandard **C**ommands for **P**rogrammable **I**nstruments). The SCPI standard sets up on the IEEE 488.2 standard, and aims at standardization of device-specific commands, error handling and status registers. For more information on the SCPI concept and definitions, refer to the book "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" by John M. Pieper, R&S ordering code 0002.3536.00.

For the purposes of this chapter it is assumed that you are familiar with the programming and operation of the controller. Refer to the appropriate manuals for details of the interface commands.

The requirements of the SCPI standard in terms of command syntax, error handling and configuration of status registers are explained in detail in the respective sections. Tables give you a fast overview of the bit assignments in the status registers. The tables are supplemented by a detailed description of the status registers.

All program examples for IEC/IEEE bus control are written in Visual Basic. A requisite for Visual Basic programming is that the modules NIGLOBAL (Niglobal.bas) and VBIB32 (Vbib\_32.bas) are added to the projects.

---

**Note:** *Manual control aims at the greatest possible operating ease. The focus in remote control is the predictability of device status after a command. Consequently, remote control programs should always produce a default status to start with (e.g. by the \*RST command) and then make the required settings.*

---

## Brief Instructions

The following short and simple operating sequence allows rapid setup of the instrument on the IEC/IEEE bus and setting of its basic functions. It is assumed that the IEC/IEEE bus address, factory-set to 20, has not yet been altered.

### IEC/IEEE Bus

- Interconnect the instrument and the controller by the IEC/IEEE bus cable and power them on.
- Generate and start the following program on the controller:

CALL IBFIND("DEV1", analyzer%)	Open channel to device.
CALL IBPAD(analyzer%, 20)	Send device address to controller.
CALL IBWRT(analyzer%, "*RST;*CLS")	Reset device.
	Analog generator is set dual-channel to 1 kHz, 0.1 V.
	Measurement function of analog analyzer is set dual-channel to RMS measurement.
CALL IBWRT(analyzer%, "INPut:TYPE GEN1")	Connect analyzer input internally to generator output channel 1.
CALL IBWRT(analyzer%, "INIT:CONT OFF;*WAI")	Trigger single measurement result.
CALL IBWRT(analyzer%, "SENS1:DATA1?")	Request function measurement result (i.e. result of RMS measurement) from channel 1.
CALL IBRD (analyzer%, M\$)	Read in measurement result.
PRINT M\$	Output measurement result onscreen.

The screen shows the RMS function measurement result in V of the generator signal measured by internal coupling.

- Return to manual control: Press the LOCAL key on the front panel.

## Changing to Remote Control

After powering on, the instrument is always in manual control status (LOCAL) and can be controlled from the front panel or a mouse and external keyboard.

In the case of remote control on the IEC/IEEE bus, the instrument is changed to remote control (REMOTE) by sending an addressed command.

For remote control on an Ethernet (LAN) remote control is not automatically set by sending a command. Instead, the instrument must be explicitly set to REMOTE status, e.g. by sending the interface command **&GTR** (Go To Remote).

In REMOTE status, instrument control from the front panel or by a mouse and keyboard is disabled. But the panels can be opened by the mouse and keyboard to verify settings for example. In the Diagnostic Panel you can choose whether or not panels are to be updated during remote control.

SCPI Update

For reasons of speed this updating should be disabled. The panels then show the device status **before** changing to remote control. While generating a remote control program it can be useful to enable updating so that you can see the effect of the remote control commands.

In the middle of the screen you see the message "Remote Operation Active". On the front panel the LED labeled REM illuminates over the **LOCAL** key.

Messages appearing during remote control are shown in the status line over the softkeys.

The instrument remains in REMOTE status until local control is selected either manually with the **LOCAL** key on the front panel or by the interface command **&GTL** on the remote control interface. Then the panels are updated.

The interface command **&LLO** can be used to lock out the **LOCAL** key.

Changing from manual control to remote control and vice versa does not change the instrument settings.

## Remote Control via IEC/IEEE Bus

To be able to control the instrument on the IEC/IEEE bus interface, the instrument and controller must be linked by an IEC/IEEE bus cable. The controller must have an IEC/IEEE bus card, the card drivers and the program libraries for the programming language that is used.

The controller must address the instrument by the set IEC/IEEE bus address. The IEC/IEEE bus address of the instrument is factory-set to 20. It can be altered in the Config Panel (in the Utilities menu). Addresses from 0 to 30 are permissible.



Sending the first command starts remote control.

Returning to manual control is possible from the front panel or on the IEC/IEEE bus.

**Manual:**                   ➤ Press the LOCAL key.

---

### Notes:

- Processing of a command must be completed before changing, otherwise there is an immediate return to remote control.
  - The LOCAL key can be locked out by the interface command &LLO (see Chapter 8, section "[Interfaces](#)") to prevent accidental changeover. Changing to manual control is then only possible on the IEC/IEEE bus.
  - Lockout of the LOCAL key can be canceled by deactivating the REN line of the IEC/IEEE bus (see Chapter 8, section "[Interfaces](#)").
- 

**Via IEC/IEEE bus:**

...

CALL IBLOC(generator%)   Set instrument to manual control.

...

## Remote Control via LAN Interface

For remote control through a network, the controller and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol.

Connection of the R&S UPV to a network and querying of the computer name is explained in Chapter 1, section ["Connecting R&S UPV to Network \(LAN\)"](#).

Software for instrument control and the VISA program library must be installed on the controller. Instrument control is by the VXI-11 standard protocol.

Only the IP address or the computer name is required for connection setup. The IP address/computer name is part of the "resource name" used by programs to identify and control the instrument. The resource name has the form:

**TCPIP::ipaddr::inst0::INSTR**

**ipaddr** has to be replaced by the IP address or the computer name of the instrument.

For instance, if the instrument has the IP address 192.1.2.3, TCPIP::192.1.2.3::inst0::INSTR is the valid resource name. Specification of **inst0** in the resource name is optional. So in this example TCPIP::192.1.2.3::INSTR is also a valid resource name. A resource name with computer name could be TCPIP::RSUPV1::INSTR for example.

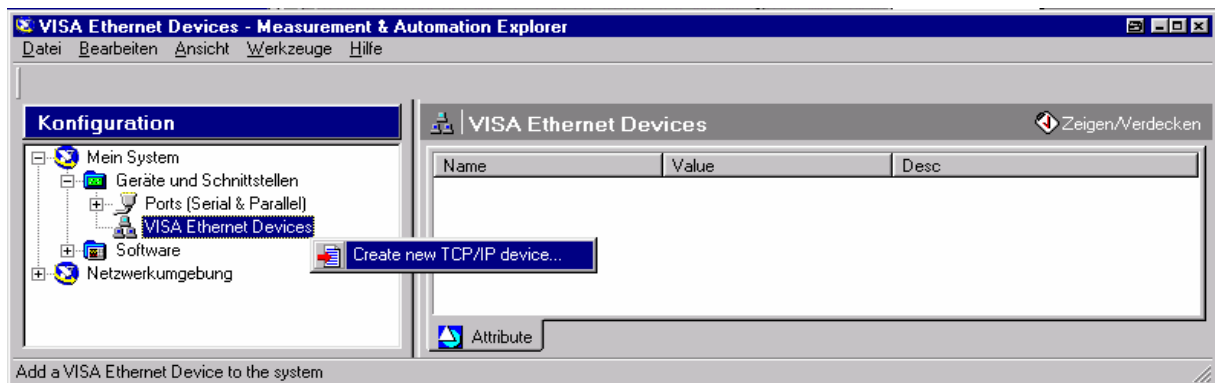
**TCPIP** designates the network protocol used and **INSTR** indicates that the VXI-11 protocol is used.

If several instruments are connected to a network, each instrument has its own IP address and associated resource name. The controller distinguishes these instruments by their resource name.

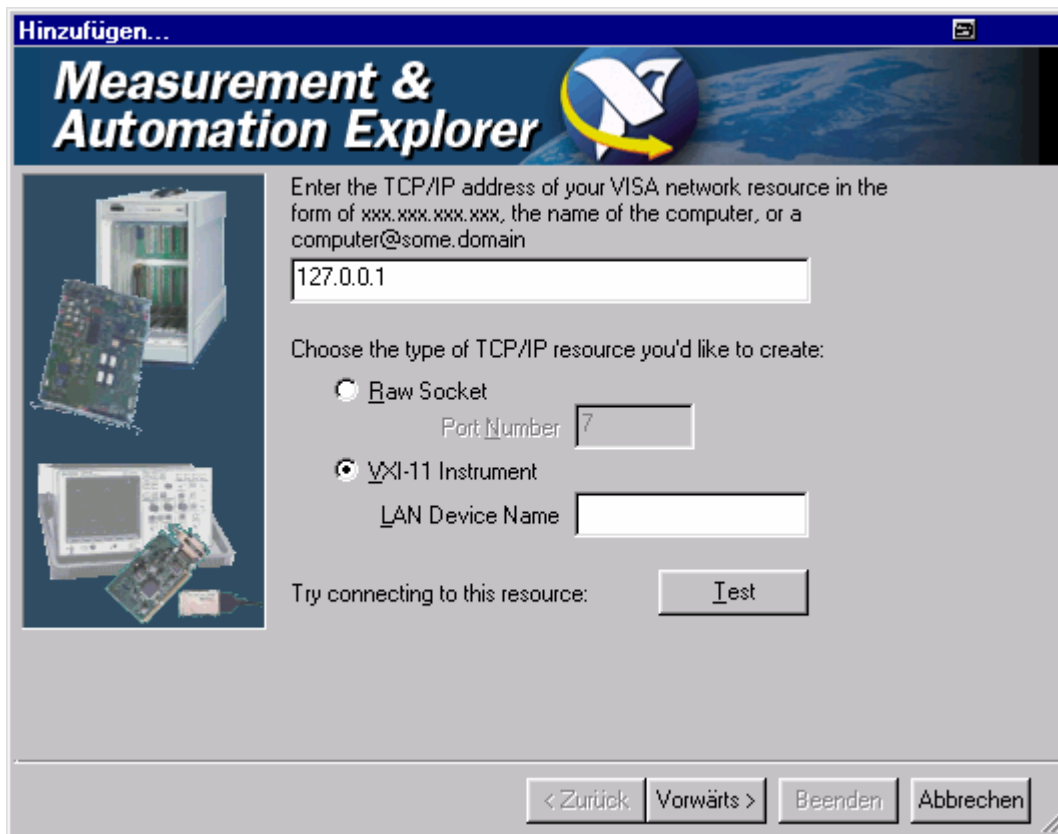
In the example below, the Measurement & Automation Explorer program from National Instruments is used to set up an Ethernet remote control connection. Connection setup with this program is simple and first tests can be performed. The R&S UPV is ready configured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, the computer name must be entered at the position of the IP address. It is also possible to assign the R&S UPV a fixed IP address (see Chapter 1, section ["Connecting R&S UPV to Network \(LAN\)"](#)).

### Configuring control of the R&S UPV in the Measurement & Automation Explorer program

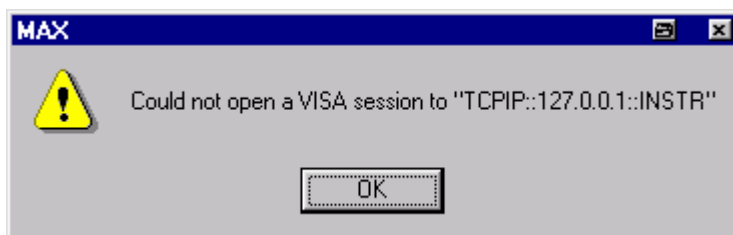
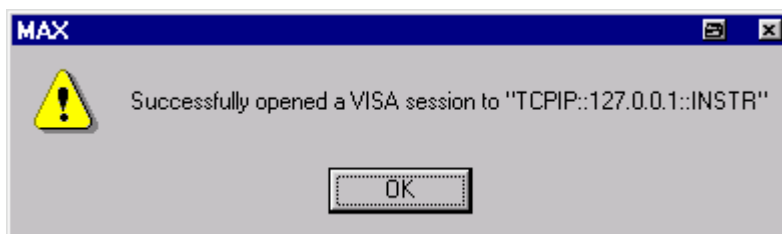
- Start the program on the controller.
- Open the **Create new TCP/IP device** menu with the right mouse key.



- Enter the IP address of the R&S UPV and select **VXI-11 Instrument**. (You can also enter the computer name.)

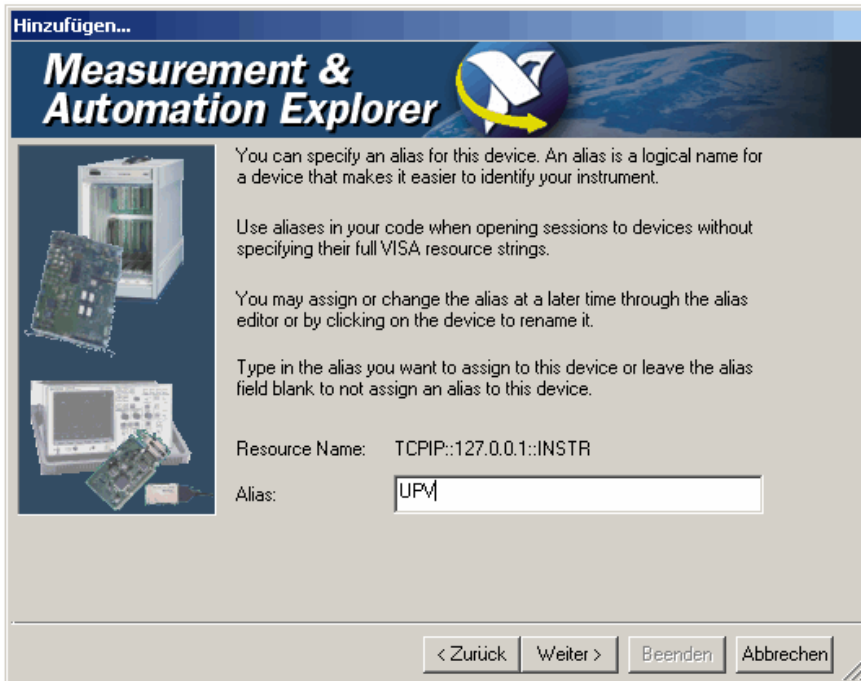


- Press the **Test** button. A message indicates whether the connection to the R&S UPV can be set up or not. If a connection cannot be set up, check whether the controller and the instrument are connected to the network (network cable) and powered on. Correct spelling of the IP address or the computer name can also be checked. For further troubleshooting it is advisable to inform the network administrator. Large networks require specification of additional addresses for connection setup, e.g. gateway and subnet mask, which are known to the network administrator.

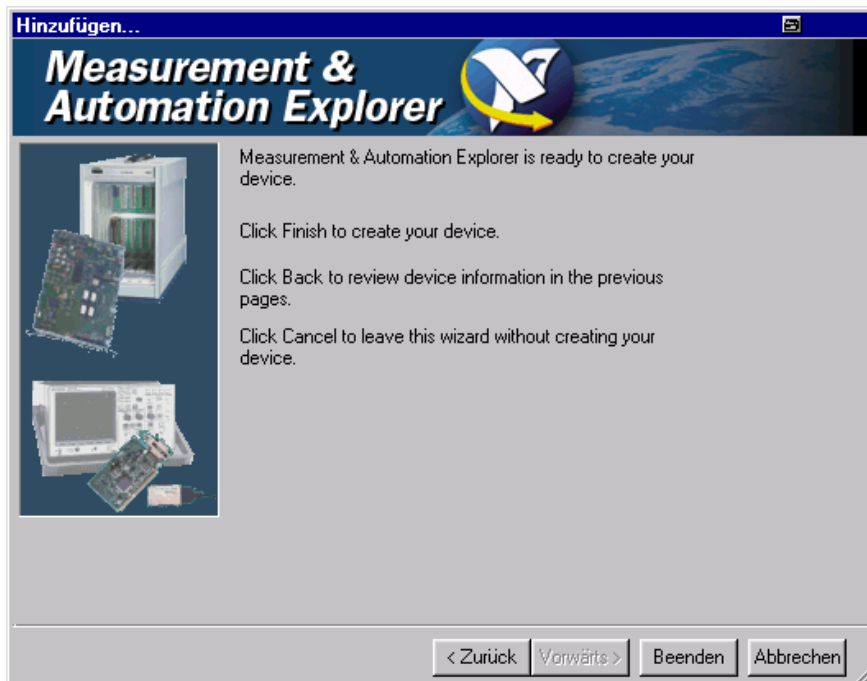




- Press the **Next** button. In the next window you can enter an alias for the instrument. This name must not be mistaken for the computer name. It is only used for instrument identification within the program and displayed in the menu as an option in case of an Ethernet link.

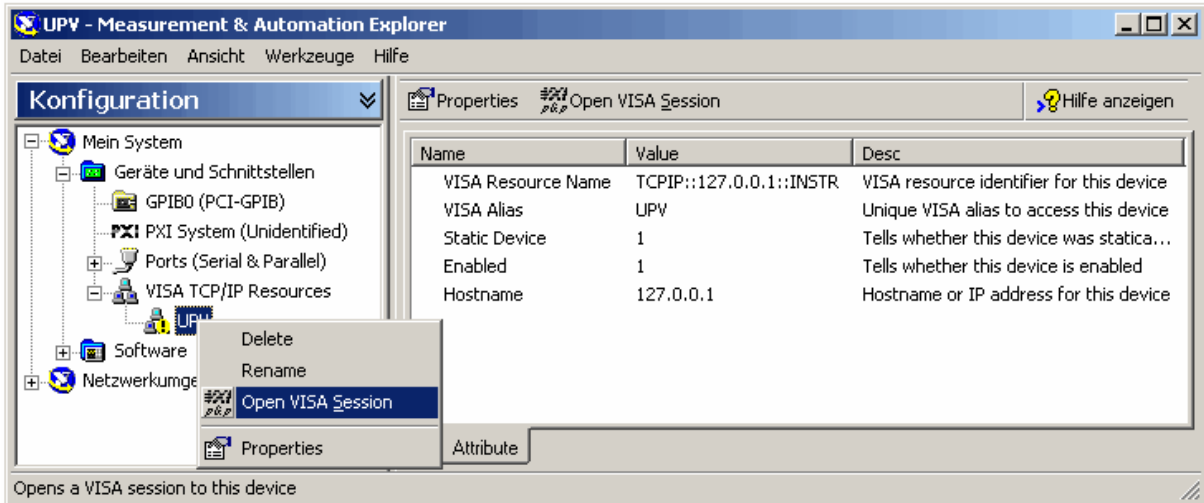


- Press **Next** and then the **Finish** button. The instrument is now configured in the program and can be addressed by the resource name or alias.

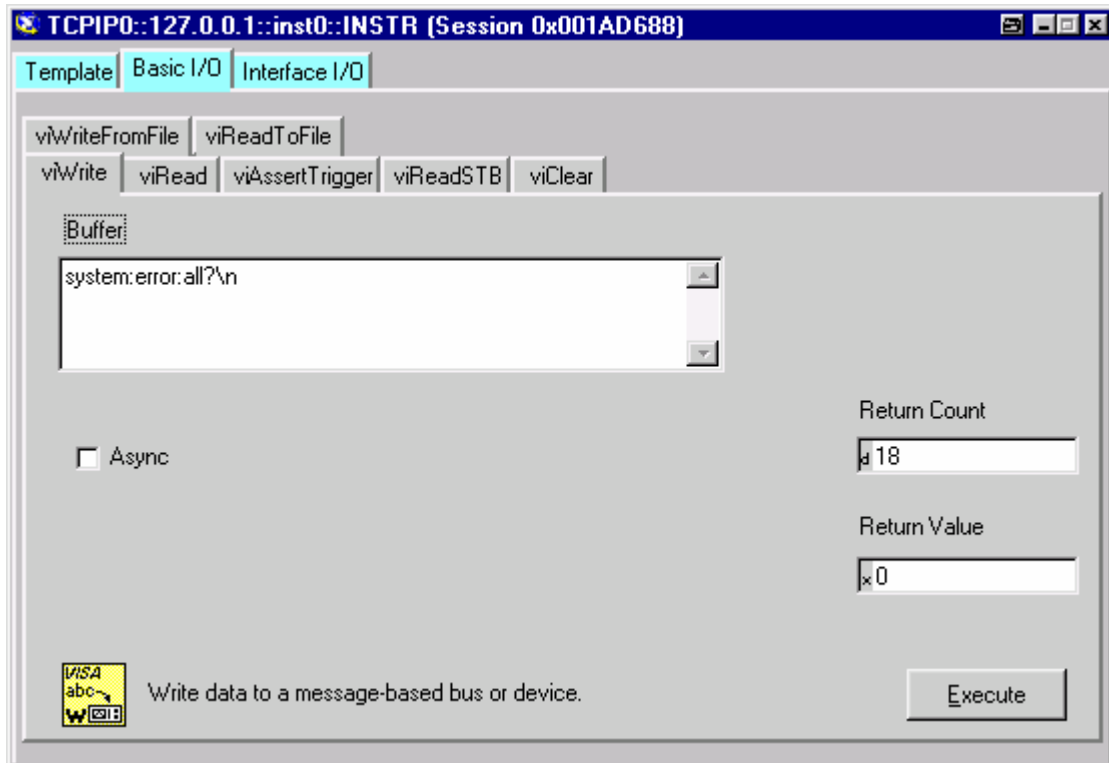


**Starting the Measurement & Automation Explorer program for remote control of the R&S UPV**

- Start the program on the controller.
- In the **Configuration** window, open **Devices and Interfaces** and select R&S UPV (= alias) under **VISA TCP/IP Resources**.
- Open the **Open VISA Session** menu with the right mouse key.



- On the **viWrite** tab under **Basic I/O**, commands can be sent to the instrument; instrument responses are displayed on the **viRead** tab (for further program operation refer to the online help).



Returning to manual control is possible from the front panel or on the LAN interface.

**Manual:** ➤ Press the `LOCAL` key.

---

**Notes:**

- The `LOCAL` key can be locked out by the interface command `&LLO` to prevent accidental changeover. Changing to manual control is then only possible by remote control.
  - Lockout of the `LOCAL` key can be canceled by the interface command `&NREN`.
- 

**Via Ethernet:**

...

`CALL IBLOC(generator%)` Set instrument to manual control.

...

# Messages

The messages transmitted on the data lines of the IEC/IEEE bus or on a TCP/IP network can be divided into two groups:

- **Interface messages**
- **Device-dependent messages**

## Interface Messages

Interface messages are transmitted on the data lines of the IEC/IEEE bus when the ATN control line is active. They are used for communication between the controller and the instrument and can only be sent by a controller which has controller functionality on the IEC/IEEE bus.

Interface messages can be further classified as

- **Universal commands**
- **Addressed commands**

Universal commands affect all devices connected to the IEC/IEEE bus without requiring an address, whereas addressed commands only affect devices addressed as a listener. The interface messages relevant for a device are listed in Chapter 8, section "[Interfaces](#)".

If an Ethernet connection is present, signalling on a hardware control line is not required. The IEC/IEEE bus interface commands are emulated (see Chapter 8, section "[Interfaces](#)").

## Device-Dependent Messages

Device-dependent messages are transmitted on the data lines of the IEC/IEEE bus when the ATN control line is not active. ASCII code is used for data transmission.

If an Ethernet connection is present, signalling on a hardware control line is not required.

Device-dependent messages are identical for the two interfaces (IEC/IEEE bus and Ethernet). They are differentiated by the direction in which they are sent:

**Commands** (program messages) are messages sent by the controller to a device. They operate device functions and request information.

These commands are in turn differentiated by two criteria:

1. The effect they have on the device:

**Setting commands** trigger device settings, e.g. a device reset or setting of the generator frequency.

**Queries** cause data to be put in the output queue, e.g. for device identification or querying a setting. These commands are formed by adding a question mark to the setting command.

2. Their definition in the IEEE 488.2 and SCPI standard:

**Common commands** are precisely defined by the IEEE 488.2 standard in function and notation. They relate to functions such as the management of standard status registers, reset and selftest.

**Device-specific commands** relate to functions that are dependent on device properties, e.g. frequency setting. A large number of these commands are also standardized by the SCPI consortium. Device-specific extensions following SCPI rules are permitted by the standard.

**Device responses** (response messages and service request) are messages sent by a device to the controller after a query. They can include measurement results, device settings or information about device status (see section ["Responses to Queries"](#), page 5.14).

The structure and syntax of device-dependent messages are explained in the following section.

## SCPI Command Structure and Syntax

Commands consist of a header and usually one or more parameters. The header and parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. space). Headers may be composed of several keywords. Queries are formed by adding a question mark direct to the header.

---

**Note:** *The commands used in the following examples are not implemented in the instrument in every case.*

---

**Common commands** Non-device-specific commands consist of a header preceded by an asterisk "\*" and possibly one or more parameters.

**Examples**

*RST	RESET, resets the device.
*ESE 253	EVENT STATUS ENABLE, sets the bits of the Event Status Enable register.
*ESR?	EVENT STATUS QUERY, queries the content of the Event Status register.

### Device-specific commands

**Hierarchy:** Device-specific commands have a hierarchic structure (see figure below). The different levels are represented by compound headers. Headers at the highest level (root level) have one keyword only. This keyword identifies a whole command system.

**Example:** SOURce

This keyword identifies the SOURce command system.

For commands at lower levels the whole path has to be stated. This starts left with the highest level, and the individual keywords are separated by a colon ":".

**Example:** `SOURce:VOLTagE:OFFSet:STATe ON`

This command is on the fourth level of the `SOURce` system. It sets the DC offset of the generator signal.

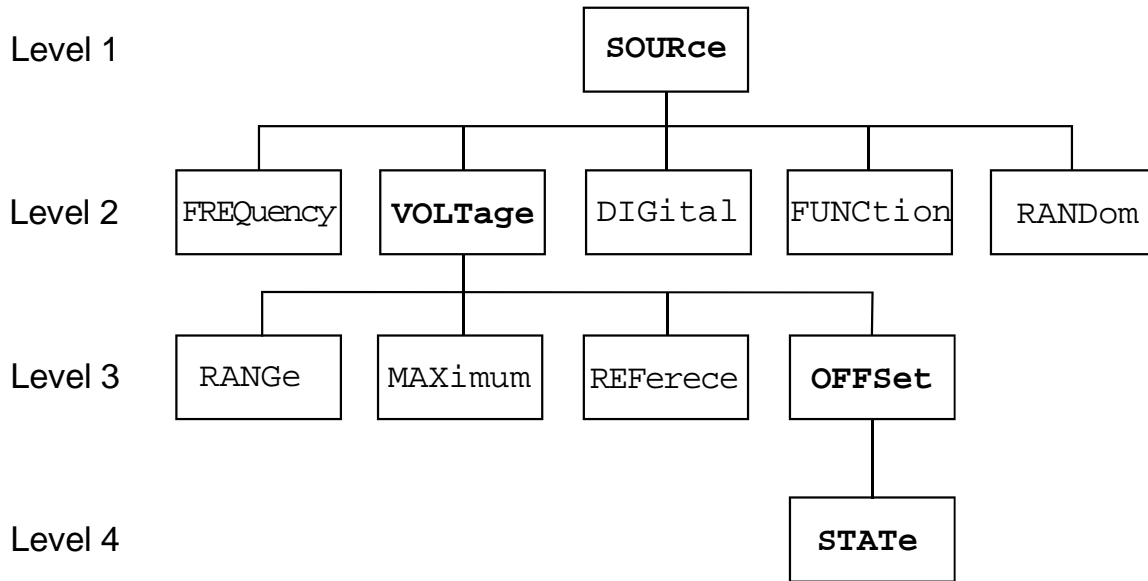


Fig. 5-1 Tree structure of SCPI command systems taking `SOURce` system as example (extract)

Some keywords appear at several levels within a command system. Their effect then depends on the command structure, i.e. where they are inserted in the command header.

**Examples:**

`SENSe:REFerece:MODE VALue | ...`

This command contains the keyword `REFerece` in the second command level.

It specifies that the reference value for referenced units in the function measurement system is entered as a value (by a separate command).

`SOURce:DIGItal:REFerece AZERo | AONE`

This command contains the keyword `REFerece` in the third command level. It specifies that the data of the digital reference generator are all 0 or 1.

**Optional keywords:** In some command systems it is possible to insert certain keywords in the header or omit them. These keywords are identified in the manual by square brackets. For reasons of compatibility with the SCPI standard, the device must be able to recognize the full length of the command. Some commands become considerably shorter when the optional keywords are omitted.

**Example:**

`INSTRument[1][:SElect] ANLG | DIG`

This command sets the generator to analog or digital signal generation. The following command has the same effect:

`INSTRument ANLG | DIG`

---

**Note:** *An optional keyword cannot be omitted if its effect is specified in more detail by a numeric suffix. In the R&S UPV this applies to the keyword SENSE for example, which can always be omitted for the function measurement = SENSE1, but must always be entered for the input measurement = SENSE2, frequency/phase measurement = SENSE3 and SENSE4, FFT monitor = SENSE5, level monitor = SENSE6, waveform monitor = SENSE7.*

---

Long and short form: The keywords have a long form and a short form. Keywords may be entered in short or in long form; other abbreviations are not allowed.

**Example:** SENSE:POWer:REFEreNce:RESistance <nu> =  
SENS:POW:REF:RES <nu>

---

**Note:** *Upper- and lower-case letters are only used to identify the long and short form in the manual; the device itself does not differentiate between the two types of characters.*

---

Parameters: Parameters must be separated from the header by a "white space". If a command contains several parameters, they are separated by a comma ",".

Example: OUTPut:SAMPlE:FREQuency 48000 HZ

Numeric suffix: If an instrument has several identical functions or features, e.g. inputs, the desired function can be selected by a suffix to the command. Entries without a suffix are interpreted as having a suffix 1. Optional keywords must be specified if they select a function with the suffix.

**Example:**

```
SENSE[1]:FUNctIon RMS
SENSE2:FUNctIon IPE
SENSE6:FUNctIon LRMS
```

These commands activate the measurement functions Function, Input and Level Monitor. The keyword SENSE and the numeric suffixes 2 and 6 must be entered in the command.

---

**Note:** *In case of remote control, suffix counting may differ from the numbers of the corresponding selection used in manual control. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is stated.*

---

## Structure of a Program Message

A program message can contain one or more commands. It is terminated by a <New Line> (ASCII code 10 decimal) or <EOI> (EOI line active) together with the last useful character of the program message. Seeing as the <Carriage Return> character (ASCII code 13 decimal) has no effect as a filler before the end character, the combination <Carriage Return><New Line> is also admissible.

Several commands in a program message are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon. A colon ":" at the beginning of a command marks the root node of the command tree, but can be omitted.

**Example:** `":SENSe:VOLTagE:RANGe:MODE FIX;:INPut:CHANnel CH1"`

This program message contains two commands. The first command belongs to the SENSE system and is used to set a fixed range. The second command belongs to the INPut system and activates channel 1.

If the successive commands belong to the same system and therefore have one or more common levels, the program message may be shortened. The second command following the semicolon then starts at the level below the common levels (see also [Fig. 5-1](#)). The colon after the semicolon must then be omitted.

**Example:** `":OUTP:DIG:UNB:OUTP AOUT;:OUTP:DIG:CSIM SIM"`

This program message is shown in full length and contains two commands separated by a semicolon. Both commands belong to the OUTPut system and its DIG subsystem, i.e. they have two common levels.

In the shortened program message the second command starts at the level below OUTP:DIG. The colon after the semicolon is omitted.

The shortened form of the program message is:

`":OUTP:DIG:UNB:OUTP AOUT;CSIM SIM"`

A new program message always starts with the full path however.

**Example:** `":OUTP:DIG:UNB:OUTP AOUT"`  
`":OUTP:DIG:CSIM SIM"`

## Responses to Queries

Unless expressly specified otherwise, a query is defined for each setting command. It is formed by adding a question mark to the associated setting command. Some of the SCPI rules for query responses are stricter than those of the IEEE 488.2 standard:

1. Numeric parameter

Example: `:OUTPut:SAMPle:FREQuency?` Response: 48000 HZ

2. Strings are returned in single quotation marks.

Example: `:MMEMory:STORe:MON_AB?` Response: 'MYTRACE.TRC'

3. Text parameters (character data) are returned in short form.

Example: `:SENSe:FUNCTion?` Response (for RMSSelectiv): RMSS



## Parameters

Most commands require the entry of a parameter. Parameters must be separated from the header by a "white space". Parameters may be numeric values, Boolean parameters, text, character strings or block data. The type of parameter required for the particular command is stated in the details of the command.

**Numeric values** Numeric values may be entered in any customary form, i.e. with sign, decimal point and exponent. The range of values is -9.9E37 to 9.9E37. The exponent is denoted by "E" or "e". The exponent alone must not be used.

**Units** Physical quantities may be stated with the unit. Permissible prefixes for units are MA (mega, MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If no unit is specified, the basic unit is assumed.

**Example:**

```
SOURce:FREQuency 1.5 kHz = SOURce:FREQuency 1.5E3
```

**Text** Text parameters follow the syntax rules for keywords, i.e. they also have a long and a short form. They must be separated from the header by a "white space" like any other parameter. A query returns the short form of the text.

**Example:**

```
Setting command: :SOURce:SWEep:CONTRol ASweep  
Query: :SOURce:SWEep:CONTRol? Response: ASW
```

**Character strings** Character strings must always be entered between single or double quotation marks.

**Example:** MMEMory:LOAD:STATe 'c:\Config\setup\default.xml'

## Overview of Syntax Elements

The following list gives you an overview of the syntax elements.

- :** The colon separates the keywords of a command.  
In a command line, the colon following a semicolon identifies the highest command level.
  
- ;** The semicolon separates two commands in a command line. It does not change the path.
  
- ,** The comma separates several parameters of a command.
  
- ?** The question mark forms a query.
  
- \*** The asterisk identifies a common command.
  
- "** Quotation marks denote the beginning of a character string and terminate it.
  
- #** The double cross denotes the beginning of block data.
  
- A "white space" (ASCII code 0 to 9, 11 to 32 decimal, eg space) separates header and parameter.
  
- .** Decimal point of numeric values.

## Device Model and Command Processing

The device model shown in the following figure was created from the point of view of processing SCPI commands. The individual components operate independently of each other and simultaneously. They communicate with each other by means of messages.

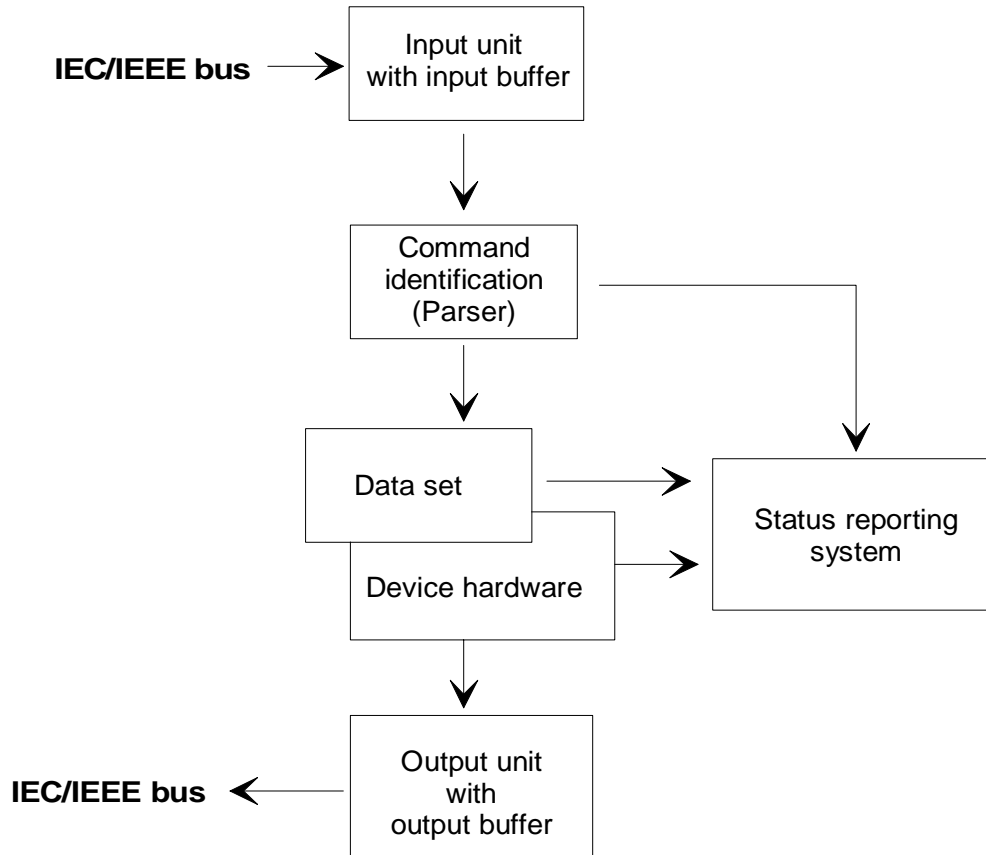


Fig. 5-2 Device model for remote control via IEC/IEEE bus or TCP/IP network

### Input Unit

The input unit receives commands in the form of characters from the IEC/IEEE bus or Ethernet and collects them in the input buffer. The input unit sends a message to the parser as soon as it detects an end character, <PROGRAM MESSAGE TERMINATOR> according to IEEE 488.2, the interface message DCL or a full input buffer.

If the input buffer is full, the IEC/IEEE bus or Ethernet transfer is halted and the data received until then are processed. Then the IEC/IEEE bus or Ethernet transfer is continued. If the buffer is not yet full when the end character is received however, the input unit can receive the next command while the previous command is parsed and executed. Reception of a DCL clears the input buffer and immediately triggers a message to the parser.

## Command Identification (Parser)

The parser analyzes the data received from the input unit. Data are processed in the sequence in which they were received. Only a DCL is given priority; a GET (Group Execute Trigger) for example is not processed until after the previously received commands. Every command detected as correct is immediately forwarded to the database and executed.

Syntax errors are recognized by the parser and forwarded to the status reporting system. The remainder of a program message after a syntax error is, in as much as possible, further analyzed and processed. After the syntax test, the value range of the parameter may be checked.

## Database and Device Hardware

The term "device hardware" refers to that part of the device which performs the actual instrument function, e.g. generator setting, analyzer setting. This does not include the controller.

The term "database" denotes a database that manages all the parameters and associated settings required for setting the device hardware.

Setting commands lead to a change in the data set of the database. The database administration enters the new values (e.g. frequency) and immediately sets the hardware.

An IEC/IEEE bus program message that may contain several setting commands is sent to the parser, which examines the IEC/IEEE bus commands for syntax and semantic errors. Once a command is identified as correct, a check is immediately made with current settings to see whether the command is admissible. If the command is admissible, it is transferred to the database of the R&S UPV and the device hardware is set. If existing settings show that the command is illegal, it is rejected, an execution error is sent to the status reporting system and the device hardware is not set for this command. Subsequent commands that are admissible on the basis of the existing settings are executed (see following section).

This strictly hierarchic procedure ensures that no illegal device status can occur at any time.

## Command Sequence (IEC/IEEE)

Every IEC/IEEE bus command received by the R&S UPV is immediately checked for its admissibility. This is only possible if the R&S UPV knows for which instrument or function the command is intended, i.e. the appropriate instrument or function was activated **before**.

### Example:

For a balanced output it is possible to select an impedance of 600 ohms, but not for an unbalanced output.

If these checks and the appropriate error messages were omitted, measurements would be performed with erroneous settings, or even be impossible, and the user would not know why.

Identical menu items in different instruments or functions are addressed by the same command in remote control, so they can only be distinguished by reference to the particular instrument or function.

**Example:**

The command "INPut:SElect CH1" is admissible for all analyzer instruments.

To be able to preset individual parameters of functions that are not yet active, each IEC/IEEE bus command would have to be told to which instrument and which function it refers. The internally managed addressing of commands by the R&S UPV would then be the job of the IEC/IEEE bus programmer, who would have to handle a multiple number of commands.

A major feature in operation of the R&S UPV is its ability to note the settings for individual generator and analyzer functions and to restore all required parameters when one of these functions is selected. This does away with the need to reset all parameters when a function is changed.

**Example:**

The generator function Mod Dist is set with frequencies of 400 Hz and 7 kHz. When you switch to the DFD function, the frequency pair 11 kHz and 12 kHz last used with the DFD function is automatically restored.

This functionality is also available under IEC/IEE bus control, i.e. even in remote control all parameters are **automatically** set when the function is changed. This is much faster and surer than the user having to set the parameters each time on the IEC/IEEE bus.

If the UPL did not have this ability, the user could overwrite parameters for instruments that are not active, and the parameters of the function last used would no longer be available.

Since manual and remote control work with the same internal data sets and a mixture of manual and remote control must be possible, only one uniform method of internal parameter processing can be used for the two modes. Automatic parameter restoration is indispensable for manual control, so it must also be used for remote control.

To relieve the user of the need to watch out for relationships that are in part not apparent, the following applies to both remote control and manual control of the R&S UPV:

*Nothing can be set on the R&S UPV that is not admissible.*

The disadvantage of this is that sometimes a certain operating sequence has to be adhered to even in remote control. But this is more than compensated by the fact that possible setting errors are immediately indicated by the instrument.

## Status Reporting System

The status reporting system collects information about the device status and makes it available to the output unit on request. The structure and function are explained in section "[Status Reporting System](#)", page 5.24.

## Output Unit

The output unit collects the information requested by the controller and which it obtains from database administration. It processes the information in line with SCPI rules and makes it available in the output buffer.

If the device is addressed as a talker and the output buffer does not contain any data or expect data from the database, the output unit sends the error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC/IEEE bus or Ethernet, and the controller waits for the set time limit. This procedure is prescribed by SCPI.

## Triggering Measurement or Sweep

There are three ways of triggering a measurement or a sweep :

- By the SCPI-specific command **"INIT"**
- By the common command **"\*TRG"**
- By the addressed command **Group Execute Trigger "GET"**

All three possibilities are equivalent and similar in the time they take to execute.

There are also three ways of waiting for a triggered measurement result, which are looked at in the next section. To demonstrate the three trigger possibilities together with singly triggered measurement results, command synchronization with \*WAI is used in what follows.

## Command Synchronization

To ensure that commands are executed in a certain sequence, one of the commands \*OPC, \*OPC? or \*WAI must be used. As a result of these commands, a certain action is not triggered until the hardware is set and settled. The controller can be forced through appropriate programming to wait for the appearance of an action.

Table 5-1 Synchronization with \*OPC, \*OPC? and \*WAI

Command	Effect	Programming of controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	- Set bit 0 in ESE. - Set bit 5 in SRE. - Wait for Service Request.
*OPC?	Stops further command processing until 1 is returned. This is not the case until the Operation Complete bit is set in the ESR. This bit indicates that the previous setting has been completed.	Send *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Send *WAI directly after the command whose processing should be terminated before other commands are executed.

In remote control of the R&S UPV it is essential to wait for the end of a measurement or sweep before the measured results are fetched and the hardware is newly set.

The following table explains the effect of different combinations of measurement or sweep triggering in conjunction with a synchronization command.

Table 5-2 Trigger command with/without synchronization

Trigger command with/without synchronization	Description
"INIT:CONT OFF; *WAI"	A single measurement or sweep is triggered. Subsequent commands are processed after the measurement or sweep is completed. Generator and analyzer setting commands <b>do not</b> trigger a new measurement. A new measurement must be triggered with "INIT; *WAI"  <i>This command is the simplest to use and should preferably be used to trigger a measurement.</i>
"INIT:CONT OFF" <b>without</b> *WAI	When a generator or analyzer setting command is sent <b>during a single measurement</b> , i.e. before the measurement is completed, the measurement is restarted to avoid incorrect results (incorrect results could be obtained, for instance, if the generator voltage is varied during the measurement). Generator or analyzer setting commands sent <b>after the single measurement has been terminated</b> will <b>not</b> trigger a new measurement. A new measurement must be triggered with "INIT".
"INIT:CONT ON" <b>without</b> *WAI	Each generator or analyzer setting command restarts a measurement to avoid incorrect measurement results (incorrect results could be obtained, for instance, if the generator voltage is varied during the measurement).

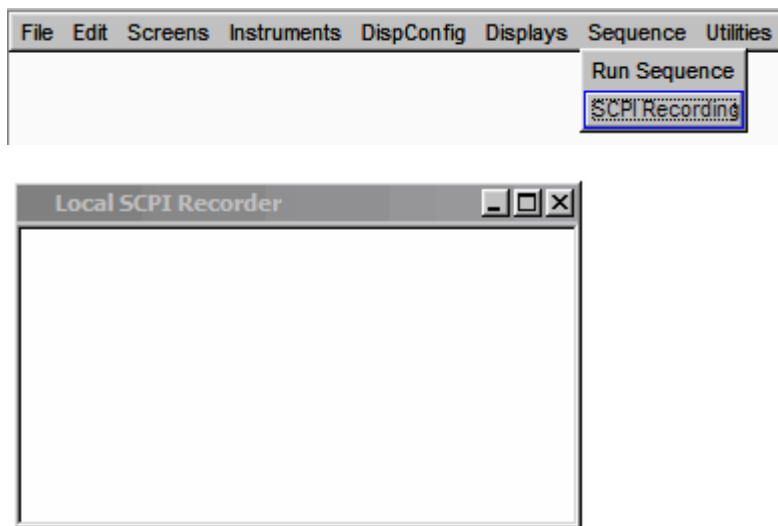
## Command Recording

The R&S UPV offers the possibility of recording the equivalent IEC/IEEE bus commands in a separate window during manual control. Recording begins as soon as the window has been opened. Recording continues after the window is closed and until the R&S UPV is powered off. The contents of the window can be edited (also deleted) and copied to the clipboard.

In this way it is very easy to produce the matching IEC/IEEE bus control program from a manual control sequence without having to look up the commands in the manual. This also eliminates malfunctions through the wrong notation.

### Starting Recording

Open the window through the menu by Sequence → SCPI Recording.

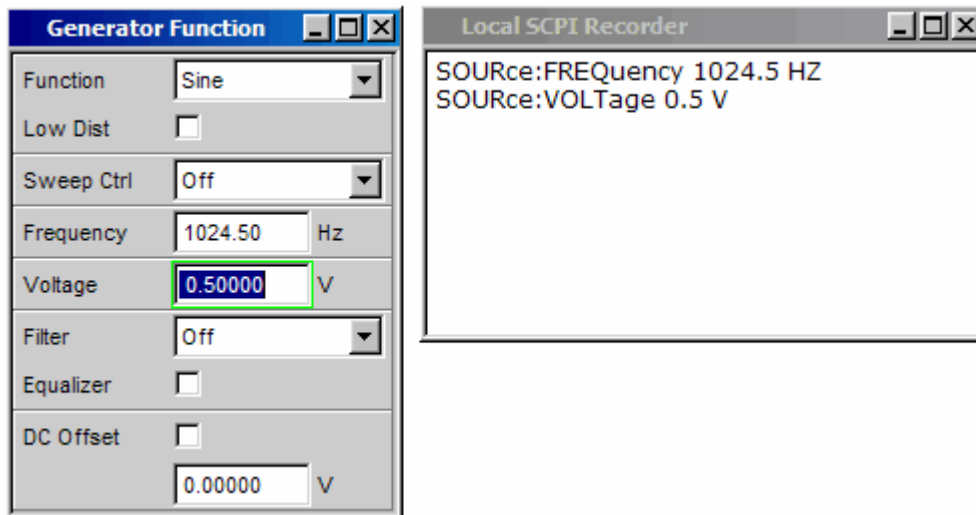


Opening the window starts the recording. The window is visible on all screens.



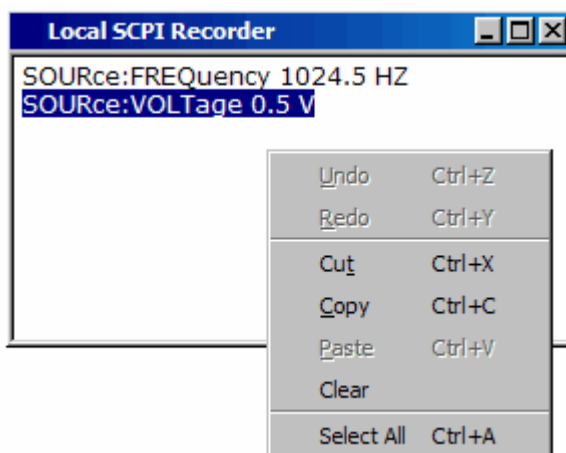
## Recording Commands

As soon as the SCPI Recording window is opened, all settings of manual control are recorded. In this example the generator frequency was set to 1024.5 Hz and the level to 0.5 V.



## Editing Commands

The contents of the SCPI Recording window can be edited and copied through the clipboard into a file. From the commands in this file it is possible to generate an IEC/IEEE bus control program. Open the context menu by clicking on the right mouse key. To operate the SCPI Recorder you need an external keyboard and mouse.



## Status Reporting System

The status reporting system stores all information about the current operating status of the device, e.g. that it is performing system error correction, and about occurred errors. This information is stored in the status registers and the error queue. The contents of status registers and the error queue can be queried on the IEC/IEEE bus or Ethernet.

Information is hierarchically structured. The highest level is formed by the Status Byte (STB) register defined in IEEE 488.2 and the associated Service Request Enable (SRE) register. The STB receives information from the Standard Event Status (ESR) register, also defined in IEEE 488.2, and the associated Standard Event Status Enable (ESE) register, the SCPI-defined STATus:OPERation and STATus:QUEStionable registers, and the device-specific STATus:XQUEstionable register, which contain detailed information about the device.

The status reporting system also includes the IST (Individual Status) flag and the Parallel Poll Enable (PPE) register assigned to it. The IST flag, like the SRQ, combines the complete device status in a single bit. The PPE has the same function for the IST flag as the SRE has for the service request.

The output buffer contains messages that the device sends back to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB.

## Structure of SCPI Status Register

Each SCPI register consists of five 16 bit parts with different functions (see figure below). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number that is the same for all five parts. For instance, bit 5 of the STATUS:OPERation register is assigned to the Wait for Trigger hardware status in all five parts. Bit 15 (the most significant bit) is set to 0 in all parts. So the contents of register parts can always be processed by the controller as a positive integer.

Queries return the current value of the particular part register to allow a check of the device status. A decimal value between 0 and 32767 ( $= 2^{15}-1$ ) is returned.

The configuration commands set the respective part register, thus determining which status changes of the R&S UPV cause a change in status registers. A decimal value between 0 and 32767 ( $= 2^{15}-1$ ) is set.

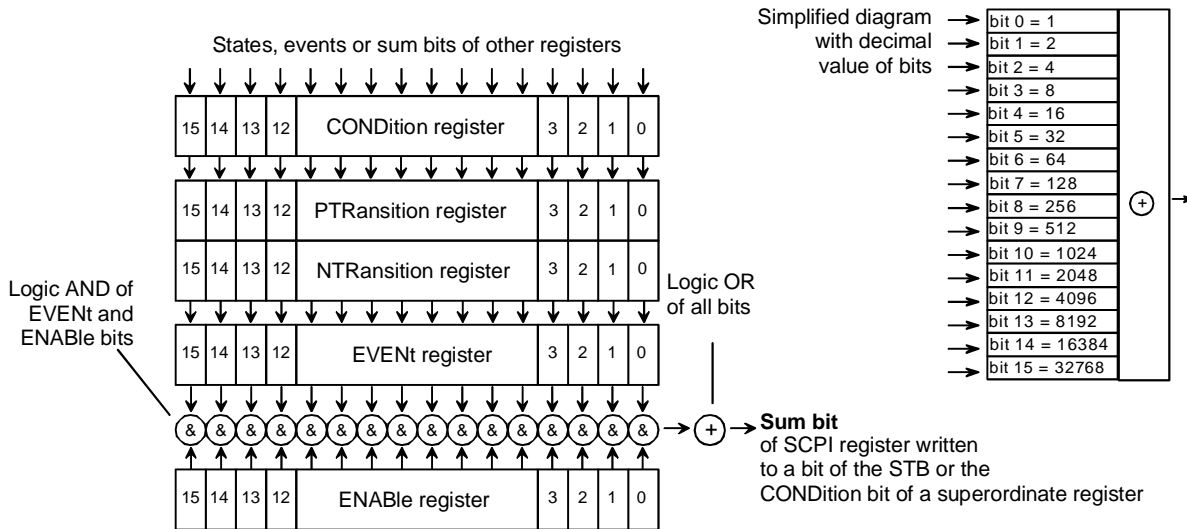


Fig. 5-3 Standard SCPI status register

**CONDition part** The CONDition part is written direct by the hardware or the summary bit of the subordinate register. Its contents indicate current device status. This register part can only be read, not written or cleared. Reading the register does not change its contents.

**PTRansitionpart** The Positive TRansition part acts as an edge detector. On transition of a bit of the CONDition part from 0 to 1, the associated PTR bit decides whether the EVENT bit is set to 1.  
 PTR bit = 1: the EVENT bit is set.  
 PTR bit = 0: the EVENT bit is not set.

This part can be written and read. Reading does not change its contents.

- NTRansition part** The Negative TRansition part also acts as an edge detector. On transition of a bit of the CONDition part from 1 to 0, the associated NTR bit decides whether the EVENT bit is set to 1.  
NTR bit = 1: the EVENT bit is set.  
NTR bit = 0: the EVENT bit is not set.  
This part can be written and read. Reading does not change its contents.
- These two transition register parts enable you to define the status change of the CONDition part (none, 0 to 1, 1 to 0 or both) that is to be held in the EVENT part.
- EVENT part** The EVENT part indicates whether there has been an event since last readout – it is the "memory" of the CONDition part. It only indicates events passed through the transition filters. The EVENT part is continuously updated by the device. This part is read-only. Reading clears its contents. This part is often equated with the overall register.
- ENABLE part** The ENABLE part determines whether the associated EVENT bit contributes to the summary bit (see below). Each bit of the EVENT part is ANDed (symbol '&') with the associated ENABLE bit. The results of all logical operations of this part are ORed (symbol '+') and passed on to the summary bit.  
ENABLE bit = 0:  
the associated EVENT bit does not contribute to the summary bit.  
ENABLE bit = 1:  
if the associated EVENT bit is 1, the summary bit is also set to 1.
- This part can be written and read as required. Reading does not change its contents.
- Summary bit** As stated above, the summary bit for each register is derived from the EVENT and ENABLE parts. The result is then entered into a bit of the CONDition part of the superordinate register.  
The device automatically generates the summary bit for each register. An event, e.g. a non-locking PLL, can thus produce a service request through all hierarchical levels.

---

**Note:** *The Service Request Enable (SRE) register defined by IEEE 488.2 can be understood as the ENABLE part of the STB if the STB is structured to SCPI. By analogy, the ESE can be understood as the ENABLE part of the ESR.*

---

## Overview of Status Registers

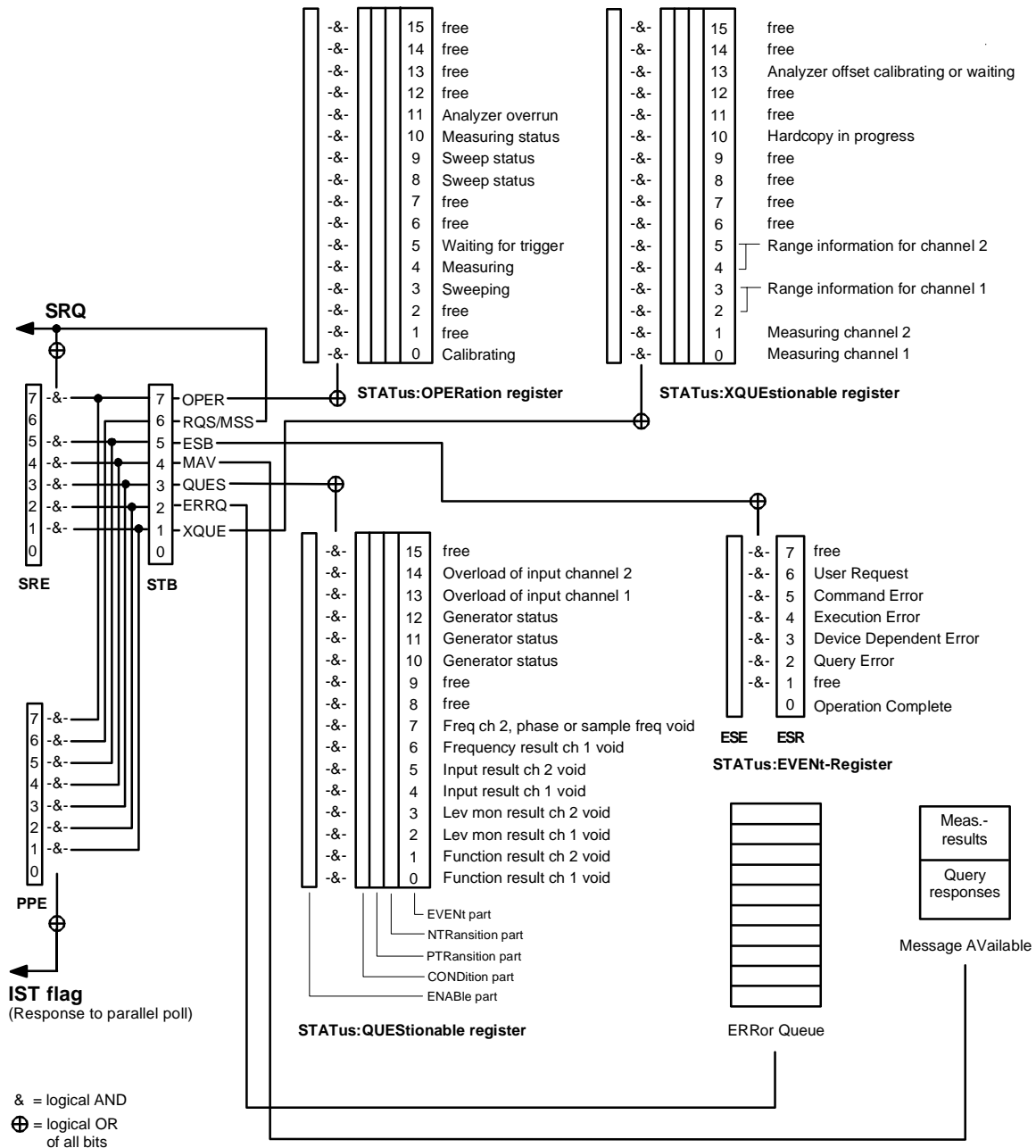


Fig. 5-4 Overview of status registers

## Status Byte (STB) and Service Request Enable (SRE) Register

The STB is already defined in IEEE 488.2. It gives a rough overview of the device status, collecting information from the lower-level registers. So it is comparable with the CONDition part of an SCPI register and is at the highest level of the SCPI hierarchy. It is special in that bit 6 acts as the summary bit of all other bits of the status byte.

The status byte is read by the command \*STB? or a serial poll.

Associated with the STB is the SRE. The function of the SRE corresponds to that of the ENABLE part of the SCPI registers. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) will be generated on the IEC/IEEE bus or Ethernet, which triggers an interrupt in the controller configured for this purpose, and can be further processed by the controller.

The SRE can be set by the command \*SRE and read by the query \*SRE?.

Reading the EVENT part of a status register deletes the associated bit in the status byte register (e.g. STAT:OPER:EVEN? deletes the OPER bit (d7) in the OPERation register).

Table 5-3 Meaning of bits in status byte

Bit no.	Meaning
0	This is the case for hardcopy output to a printer or plotter on the IEC/IEEE bus interface.
1	<b>XQUEstionable status summary bit</b> This bit is set if an EVENT bit is set in the XQUEstionable status register and the associated ENABLE bit is set to 1. The register can be read by the queries STATus: XQUESti onabl e: CONDi ti on? or STATus: XQUESti onabl e[: EVENt] ?.
2	<b>Error queue not empty</b> The bit is set if the error queue has an entry. This can be fetched by the command SYSTem:ERRor?. If this bit is enabled by the SRE, each entry of the error queue will generate a service request. An error can thus be recognized and specified in more precisely by querying the error queue.
3	<b>QUEstionable status summary bit</b> This bit is set if an EVENT bit is set in the QUEstionable status register and the associated ENABLe bit is set to 1. A set bit denotes a questionable device status, which can be specified more precisely by querying the QUEstionable status register with STATus:QUEstionable:CONDi tion? or STATus:QUEstionable[:EVENt] ?.
4	<b>MAV bit (message available)</b> This bit is set if there is a readable message in the output buffer. A measurement result or response to a query (i.e. IEC/IEEE bus command with '?') is present and can be read.
5	<b>ESB bit</b> Summary bit of the event status register. This bit is set if one of the bits in the event status register is set and enabled in the event status enable register. A set bit indicates an error or event that can be specified more precisely by querying the event status register by the command *ESR?.
6	<b>MSS bit (master status summary bit)</b> This bit is set if the device triggers a service request. This is the case if one of the other bits of this register is set together with its mask bit in the service request enable register.
7	<b>OPERation status register summary bit</b> This bit is set if an EVENT bit is set in the OPERation status register and the associated ENABLe bit is set to 1. A set bit indicates that the device is executing an action. The type of action can be determined by querying the OPERation status register with STATus:OPERation:CONDi tion? or STATus:OPERation[:EVENt] ?.

## IST Flag and Parallel Poll Enable (PPE) Register

Similar to the SRQ, the IST flag combines the complete status information in a single bit. It can be queried by a parallel poll (see section "*Parallel Poll*", page 5.36) or the \*IST? command.

The parallel poll enable (PPE) register determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, bit 6 also being used - in contrast to the SRE. The IST flag is the product of ORing all results. The PPE can be set by the \*PRE command and read by the \*PRE? query.

## STATus:EVENT Register (ESR)

The ESR is already defined in the IEEE 488.2 standard. It is comparable to the EVENT part of an SCPI register. The event status register can be read out by the \*ESR? query.

The ESE is the associated ENABLE part. It can be set by the \*ESE command and read out by the \*ESE? query.

Table 5-4 Meaning of bits in event status register

Bit no.	Meaning
0	<b>Operation complete</b> When the *OPC command is received, this bit is set if all previous commands have been executed.
1	<b>Request control</b> This bit is set if the device requests the controller function. This is the case for hardcopy output to a printer or plotter on the IEC/IEEE bus interface.
2	<b>Query error</b> This bit is set in either of the two following cases: the controller wants to read data from the device but has not sent a query, or it sends new commands to the device before it retrieves existing requested data.
3	<b>Device-dependent error</b> This bit is set if a device-dependent error occurs. An error message naming the error more precisely is entered in the error queue.
4	<b>Execution error</b> This bit is set if the syntax of a received command is correct but the command cannot be executed due to various marginal conditions. An error message naming the error more precisely is entered in the error queue.
5	<b>Command error</b> This bit is set if an undefined command or a command with incorrect syntax is received. An error message naming the error more precisely is entered in the error queue.
6	<b>User request</b> This bit is set on pressing the LOCAL key, i.e. when the device is switched to manual control.
7	Not used





## **STATus:QUEStionable Register**

This register contains information about questionable device statuses. These may occur when the device is operated beyond its specifications. The register can be read by the query `STATus:QUEStionable:CONDition?` or `STATus:QUEStionable[:EVENT]?`.

Table 5-6 Meaning of bits in STATus:QUEStionable register

Bit no.	Meaning																
0	<b>Function channel 1</b> This bit is set if the function measurement result in channel 1 is invalid.																
1	<b>Function channel 2</b> This bit is set if the function measurement result in channel 2 is invalid.																
2	<b>Level monitor channel 1</b> This bit is set if the level monitor result in channel 1 is invalid.																
3	<b>Level monitor channel 2</b> This bit is set if the level monitor result in channel 2 is invalid.																
4	<b>Input channel 1</b> This bit is set if the input result in channel 1 is invalid.																
5	<b>Input channel 2</b> This bit is set if the input result in channel 2 is invalid.																
6	<b>Frequency channel 1</b> This bit is set if the frequency measurement result in channel 1 is invalid.																
7	<b>Freq Ch 2, phase or sample frequency</b> This bit is set if the frequency measurement result in channel 2, the phase or the sample frequency is invalid.																
8 and 9	<b>Not used</b>																
10 to 12	<p><b>Generator status</b></p> <p>Bit 12, 11, 10</p> <table> <tr> <td>0 0 0 = Not used</td> <td></td> </tr> <tr> <td>0 0 1 = Generator Off</td> <td>Both generator channels are off</td> </tr> <tr> <td>0 1 0 = Generator Running</td> <td>Generator outputs signal</td> </tr> <tr> <td>0 1 1 = Not used</td> <td></td> </tr> <tr> <td>1 0 0 = Not used</td> <td></td> </tr> <tr> <td>1 0 1 = Generator Overrun</td> <td>The sampling rate on the external input is too high for the selected digital instrument Samples missing in signal</td> </tr> <tr> <td>1 1 0 = Generator Overload</td> <td>Generator overloaded, output disabled</td> </tr> <tr> <td>1 1 1 = Output Off</td> <td>Output disabled</td> </tr> </table>	0 0 0 = Not used		0 0 1 = Generator Off	Both generator channels are off	0 1 0 = Generator Running	Generator outputs signal	0 1 1 = Not used		1 0 0 = Not used		1 0 1 = Generator Overrun	The sampling rate on the external input is too high for the selected digital instrument Samples missing in signal	1 1 0 = Generator Overload	Generator overloaded, output disabled	1 1 1 = Output Off	Output disabled
0 0 0 = Not used																	
0 0 1 = Generator Off	Both generator channels are off																
0 1 0 = Generator Running	Generator outputs signal																
0 1 1 = Not used																	
1 0 0 = Not used																	
1 0 1 = Generator Overrun	The sampling rate on the external input is too high for the selected digital instrument Samples missing in signal																
1 1 0 = Generator Overload	Generator overloaded, output disabled																
1 1 1 = Output Off	Output disabled																
13 and 14	<p><b>Analyzer status</b></p> <p>Bit 14, 13</p> <table> <tr> <td>0 0 =</td> <td>Normal operating status (none of input channels overloaded)</td> </tr> <tr> <td>0 1 = Anlr1 Overload</td> <td>Input channel 1 overloaded</td> </tr> <tr> <td>1 0 = Anlr2 Overload</td> <td>Input channel 2 overloaded</td> </tr> <tr> <td>1 1 = Anlr1, Anlr2 Overload</td> <td>Both input channels overloaded</td> </tr> </table> <p>One or both input channels with input impedance 300 Ω or 600 Ω are overloaded To protect the analyzer input, the input impedance was temporarily switched to 200 kΩ and the generator output disabled. Measurement is continued.</p> <p><b>Ways to recover from overload:</b></p> <ul style="list-style-type: none"> <li>- Remove overvoltage (maximum input voltage on 300 Ω and 600 Ω is 25 V)</li> <li>- Set input impedance to 200 kΩ (INP:IMP R200K)</li> </ul> <p>Reactivate the generator by the OUTPut ON command.</p>	0 0 =	Normal operating status (none of input channels overloaded)	0 1 = Anlr1 Overload	Input channel 1 overloaded	1 0 = Anlr2 Overload	Input channel 2 overloaded	1 1 = Anlr1, Anlr2 Overload	Both input channels overloaded								
0 0 =	Normal operating status (none of input channels overloaded)																
0 1 = Anlr1 Overload	Input channel 1 overloaded																
1 0 = Anlr2 Overload	Input channel 2 overloaded																
1 1 = Anlr1, Anlr2 Overload	Both input channels overloaded																
15	<b>Not used</b>																

## STATUS:XQUESTIONABLE REGISTER

This register contains extra information to the status operation register and seldom occurring status information. It can be read by the query STATUS:XQUESTIONABLE:CONDITION? or STATUS:XQUESTIONABLE[:EVENT]?

Table 5-7 Meaning of bits in STATUS:XQUESTIONABLE register

Bit no.	Meaning
0	Bit set: The information of the measuring bit (d4) and the measuring status bit (d10) of the status operation register refers to <b>Channel 1</b> .  ÚÄÄÄÄ Measuring bit (d4) ³ ÚÄÄ Measuring status bit (d10)  0 0 = Measuring Terminated                      Single measurement completed 0 1 = Measuring Stopped                              Measurement is halted 1 0 = Measuring Single                                Single measurement is being performed 1 1 = Measuring Cont                                    Continuous measurement is being performed
1	Bit set: The information of the measuring bit (d4) and the measuring status bit (d10) of the status operation register refers to <b>Channel 2</b> .  As for bit no. 0.
2 and 3	Additional range information for <b>channel 1</b>  d3 d2 0 0 = Measurement result valid 0 1 = Not used 1 0 = Underrange (measurement result possibly inaccurate) on channel 1 1 1 = Overage (measurement result invalid) on channel 1 Simultaneously with the underrange or overrange bit, the function bit d0 (invalid function measurement result) is set in the status questionable register.
4 and 5	Additional range information for <b>channel 2</b>  d3 d2 0 0 = Measurement result valid 0 1 = Not used 1 0 = Underrange (measurement result possibly inaccurate) on channel 2 1 1 = Overage (measurement result invalid) on channel 2 Simultaneously with the underrange or overrange bit, the function bit d1 (invalid function measurement result) is set in the status questionable register.
6	Not used
7	Not used
8	Not used
9	Not used
10	Bit set: The screen content is read out to the printer or a file for a screen copy. Operation of the R&S UPV is disabled for a few seconds.
11	Not used
12	Not used
13	Bit set: Analyzer offset is calibrating or waiting for calibration.
14	Not used
15	Not used

## Use of Status Reporting System

For efficient use of the status reporting system, the information it contains has to be transferred to the controller and further processed. There are various methods, which are described below. Detailed program examples can be found in Chapter 7, Program Examples.

### Service Request, Use of Hierarchical Structure

Under certain conditions the device may send a service request to the controller. This service request usually triggers an interrupt on the controller to which the control program can respond by suitable actions. As seen from section "[Overview of Status Registers](#)", page 5.27, an SRQ is always triggered when one or more of the bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information from another register, from the error queue or the output buffer. If the ENABLE registers of the status registers are set accordingly, any bit in any status register will be able to trigger an SRQ.

Example:

Use the \*OPC command to generate an SRQ.

- CALL IBWRT(analyzer%, "\*ESE 1") Set bit 0 (operation complete) in the ESE
- CALL IBWRT(analyzer%, "\*SRE 32") Set bit 5 (ESB) in the SRE

The device generates an SRQ on completion of its settings.

The SRQ is the only way for the device to become active on its own. Each controller program should set the device such that a service request is triggered in case of malfunctions. The program should respond accordingly to the service request. A detailed example of a service request routine can be found in Chapter 7, Program Examples.

### Serial Poll

Serial poll is mainly used for a fast overview of the status of several devices connected to the IEC/IEEE bus or Ethernet.

Like the \*STB? command, the serial poll is used to query the status byte of a device. Querying is implemented by interface messages, however, making it much faster. The serial poll method is already defined in the IEEE 488.1 standard, and used to be the only uniform method of querying the status byte. This method also works with devices that conform neither to SCPI nor to IEEE 488.2.

The Visual Basic command for executing a serial poll is `IBRSP( )`.

**Program Example:**

```

Public UPV As Integer
Public Info As Integer
Dim StartT As Single
Dim Response As String * 1000

Private Sub ReadESR():
    'subroutine for readout of ESR
    Call ibwrt(UPV, "*ESR?")
    'ask for ESR data
    Call ibrd(UPV, Response)
    'read ESR data
    EventList.AddItem "ESR register is: " + Left(Response, ibcntl - 1)
    DoEvents
End Sub

'SRQ subroutine in case RQS was set
Private Sub GPIB_Notify(ByVal LocalUPV As Long, ByVal Localbsta As Long, ByVal Localberr As Long, ByVal Localbcntl As Long, RearmMask As Long)
    Call ibrsp(UPV, Info):
    'do a serial poll and read STB
    EventList.AddItem "SRQ " + " was fired after " + Trim(Str(Timer - StartT)) + " s"
    EventList.AddItem "STB register is: " + Trim(Str(Info))
    Call ReadESR
    ibloc UPV
    'switch UPV to local
    ibonl UPV, 0
    'switch interface offline
End Sub

Private Sub Test_Click():
    'main program
    Call ibdev(0, 20, 0, T3s, 1, 0, UPV)
    'attach instrument
    Call ibconfig(0, lbcAUTOPOLL, 1)
    'enable auto serial polling
    Call ibconfig(0, lbcEndBitIsNormal, 1)
    'set END bit on EOS match during read
    Call ibconfig(0, lbcEOScmp, 0)
    '7 bit EOS char
    Call ibconfig(0, lbcEOSrd, 1)
    'terminate read by EOS char
    Call ibconfig(0, lbcEOSchar, 10)
    'EOS character LF as terminator
    Call ibclr(UPV)
    'device clear
    Call ibwrt(UPV, "*IDN?")
    'ask for instrument identity
    Call ibrd(UPV, Response)
    'read query result
    EventList.AddItem Left(Response, ibcntl - 1)
    'display query result as message box
    DoEvents

    Call ibwrt(UPV, "*CLS")
    'reset registers
    Call ibwrt(UPV, "**ESE 1")
    'enable operation complete bit to set ESB
    Call ibwrt(UPV, "**SRE 32")
    'ESB bit generates SRQ
    Call ReadESR
    'reading clears ESR register

    GPIB.SetupMask = RQS
    'set notify mask to Service Request
    GPIB.SetupNotify UPV
    'call and enable notify function
    EventList.AddItem "SRQ enabled ..."
    DoEvents

    EventList.AddItem "sending INIT command ..."
    DoEvents
    StartT = Timer
    Call ibwrt(UPV, "INIT;*OPC")
    'trigger measurement, rise OPC when ready
    EventList.AddItem "waiting for SRQ ..."
    EventList.AddItem "-----"
    DoEvents

    'here the program could do anything else until a SRQ is set
End Sub

```

## Parallel Poll

In the case of a parallel poll up to eight devices are simultaneously requested by a command from the controller to transmit one bit of information on the data lines, i.e. to set the data line assigned to each device to logic 0 or 1. Analogously to the SRE register, which determines the conditions for generating an SRQ, a parallel poll enable (PPE) register is present that is ANDed bit-by-bit with the STB (taking into account bit 6). The results are ORed and the result is then sent (possibly inverted) to the controller as a response to a parallel poll. The result can also be read without a parallel poll by the command \*IST.

The device must first be set for parallel poll by the Visual Basic command `IBPPC()`. This command assigns the device a data line and specifies whether the response is to be inverted. The parallel poll itself is performed with `IBRPP()`.

The parallel poll mode is mainly used to quickly find out which of the many devices connected to the IEC/IEEE bus or Ethernet caused an SRQ. For this purpose, SRE and PPE must be set to the same value.

## Queries

Each part of a status register can be read out by queries. The queries are given in the description of the status commands (STATus subsystem). The queries always yield a number representing the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are mainly used after the appearance of an SRQ to obtain more information about the cause of the SRQ.

## Error Queue Query

Each error in the device causes an entry in the error queue. The entries in the error queue are detailed error messages in plain text that can be read out on the IEC/IEEE bus or Ethernet by the query `SYSTEM:ERROR?`. Each `SYSTEM:ERROR?` query is answered by an entry from the error queue. If there are no more error messages in the error queue, the device responds with 0 = "No error".

The error queue should be queried in the controller program after each SRQ since the queue entries provide a more precise description of the error cause than the status registers. In particular, in the test phase of a controller program the error queue should be queried at regular intervals since it also registers faulty commands from the controller to the device.

## Initializing the Status Reporting System

The commands \*RST, \*DCL and SYSTem:PRESet also influence the status reporting system. None of the commands, except \*RST and SYSTem:PRESet, influence functional device settings. \*DCL in particular does not alter device settings.

Table 5-8 Resetting device functions

Event	DCL, SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
Effect				
Clear STB, ESR	–	–	–	yes
Clear SRE, ESE	–	–	–	–
Clear PPE	–	–	–	–
Clear EVENT parts of registers	–	–	–	yes
Clear ENABLE parts of all OPERATION and QUESTIONABLE registers, fill ENABLE parts of all other registers with "1"	–	–	yes	–
Fill PTRansition parts with "1", clear NTRansition parts	–	–	yes	–
Clear error queue	–	–	–	yes
Clear output buffer	yes	1)	1)	1)
Clear command processing and input buffer	yes	–	–	–

1) Any command that is the first in a program message clears the output buffer.

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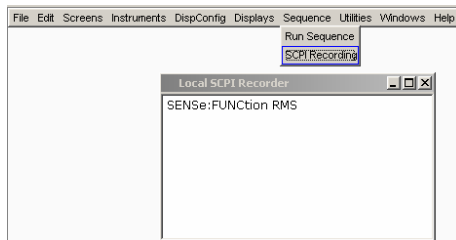
### "Remote Control - Description of Commands"

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## 6 Remote Control - Commands

A description of remote control commands together with the associated manual settings is given in Chapter 4. The meaning of the parameter setting fields and the effect of the individual parameters are explained in detail. The parameters shown in the panels can be unambiguously assigned to the parameters included in the remote control commands.



Moreover, the SCPI recording function (see Chapter 5, section "[Command Recording](#)") offers a very convenient means of recording manual settings, thus allowing remote control commands to be assigned to the parameter fields in the panels. Since the panels do not provide for any settings relating to the triggering of measurements or reading of results, these functions are not recorded.

This chapter gives a description of the commands that are not available in manual control (see Chapter 4), including for example commands for triggering measurements and reading results, as well as commands relating to the STATus and SYSTem subsystems.

In chapter 5, you will find a general introduction to remote control as well as a description of the status registers.

## Notation of Commands

**Upper/lowercase notation** Upper- and lowercase letters are used to identify the long form and the short form of the keywords of the commands given in the manual. The instrument itself does not distinguish between the two types of characters.

**Special characters** | For some commands, there exists a choice of keywords with identical effect. The keywords are entered in the same line and separated by vertical lines (pipes). Only one of the keywords has to be entered in the command header. The command always has the same effect, no matter which of the keywords is chosen.

Example: `SOURce:FREQuency[:CW|:FIXed] 1 kHz`

The two following commands with identical effect can be created. Either command sets the generator frequency to 1 kHz.

`SOURce:FREQuency:CW 1E3 = SOURce:FREQuency:FIXed 1E3`

A vertical line (pipe) in the parameter notation indicates alternative parameter options and is to be read as an "or". The command has a different effect depending on the parameter chosen.

Example: Selecting a parameter for the following command:

```
INPut:COUPling AC | DC
```

If AC is selected, only the AC component is measured; if DC is selected, both the DC and the AC component are measured.

- [ ] Keywords in square brackets can be omitted in the header (see Chapter 5, "*SCPI Command Structure and Syntax*"). The command is accepted by the instrument as having the full length for reasons of compatibility with the SCPI standard. Likewise, parameters in square brackets can be omitted or entered in the command.

Example: `INSTRument2[:SElect] ANLG | DIG`

The second instrument (analyzer) can be selected by either of the following commands:

```
INSTRument2 ANLG = INSTRument2:SElect ANLG
```

## Description of parameters

**<n>**

This argument indicates that an integer value is required.

Example: `OUTPut:AUDiobits <n>`

Setting command: `OUTPut:AUDiobits 24`

Query command: `OUTPut:AUDiobits?`

Response: 24

**<nu>**

This argument indicates that a numeric parameter is required to which a unit can be added.

Example: `SOURce:FREQuency:REFerence <nu>`

Setting command: `SOURce:FREQuency:REFerence 1000 Hz`

Query command: `SOURce:FREQuency:REFerence?` Response: 1000 Hz

## Text parameters

Text parameters are based on the syntax rules for keywords, i.e. they have a long form and a short form. Like all parameters, they must be separated from the header by a white space. In command recording (SCPI recording) or in response to a query command, the short form of the text parameter is used.

Example:

Setting command: `INPut:CHANnel CH1And2`

Query command: `INPut:CHANnel?`

Response: CH1A

## 'Character strings'

Character strings must, in accordance with SCPI, always be given in single or double quotation marks. Normally, single quotation marks are used, since double quotation marks are employed to identify the entire IEC/IEEE bus command as a string.

Example:

Setting command: `MMEMemory:LOAD:STATE 'filename'`

Query command: `MMEMemory:LOAD:STATE?` Response: 'filename'

## Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625.2) standard. Identical commands have an identical effect in different instruments. The header of these commands consists of an asterisk (\*) followed by three letters. Many common commands relate to the status reporting system, which is described in detail in Chapter 5.

Command	Parameters	Remarks
*CLS		Clear status; no query
*ESE	0 to 255	Event status enable
*ESR?	0 to 255	Standard event status query; query only
*IDN?		Identification query; query only
*IST?	0 to 255	Individual status query; query only
*OPC		Operation complete
*OPT?		Option identification query; query only
*PRE	0 to 255	Parallel poll register enable
*PSC	0   1	Power on status clear
*RST		Reset; no query
*SRE	0 to 255	Service request enable
*STB?		Status byte query; query only
*TRG		Trigger; no query
*TST?		Self test query; query only
*WAI		Wait to continue; no query

### \*CLS

**CLEAR STATUS** sets the status byte (STB), the event status register (ESR) and the EVENT part of the OPERATION, the QUESTIONABLE and the XQUESTIONABLE registers to zero. The command does not change the mask and transition parts of the registers. It clears the output buffer.

### \*ESE 0...255

**EVENT STATUS ENABLE** sets the event status enable register to the specified value. The query command \*ESE? returns the content of the event status enable register in decimal form.

### \*ESR?

**STANDARD EVENT STATUS QUERY** returns the content of the event status register in decimal form (0 to 255) and sets the register to zero.

### \*IDN?

**IDENTIFICATION QUERY** queries the instrument ID. The instrument type, the serial number and the firmware version are returned. Example:

```
Rohde&Schwarz,UPV,1146.2003k02/100020,0.0.1,1.40.9.7
```

**\*IST?**

**INDIVIDUAL STATUS QUERY** returns the content of the IST flag in decimal form (0 | 1). The IST flag is the status bit that is sent during a parallel poll query.

**\*OPC**

**OPERATION COMPLETE** sets bit 0 in the event status register when all previous commands have been processed. This bit can be used to trigger a service request.

**\*OPC?**

**OPERATION COMPLETE QUERY** returns a 1 when all previous commands have been processed. It is important that the timeout set on the IEC/IEEE bus is sufficiently long.

**\*OPT?**

**OPTION IDENTIFICATION QUERY** queries the options installed in the instrument and returns a list of the options installed. The options are separated by commas.

**\*PRE 0 ... 255**

**PARALLEL POLL REGISTER ENABLE** sets the parallel poll enable register to the specified value. The query command \*PRE? returns the content of the parallel poll enable register in decimal form.

**\*PSC 0 | 1**

**POWER ON STATUS CLEAR** determines whether the contents of the ENABLE registers are retained or reset on power on.

<b>Parameters:</b>	<b>0</b>	The contents of the status registers are retained on power on. With appropriate configuration of the ESE and SRE status registers, the contents may cause a service request to be triggered on power on.
	<b>1</b>	The contents of the status registers are reset on power on.

The query command \*PSC? returns the content of the Power On Status Clear flag. The answer may be either 0 or 1.

**\*RST**

**RESET** sets the instrument to a defined default state. The command has the same effect as pressing the PRESET key.

**\*SRE 0 ... 255**

**SERVICE REQUEST ENABLE** sets the service request enable register to the specified value. Bit 6 (MSS mask bit) remains 0. This command determines the conditions under which a service request is triggered. The query command \*SRE? returns the content of the service request enable register in decimal form. Bit 6 is always 0.

**\*STB?**

**READ STATUS BYTE QUERY** returns the content of the status byte in decimal form.

**\*TRG**

**TRIGGER** triggers a measurement or a sweep.

**\*TST?**

**SELF TEST QUERY** triggers the selftest of the instrument and, if an error is found, outputs an error code.

**\*WAI**

**WAIT-to-CONTINUE** does not allow subsequent commands to be processed until all previous commands have been eXEcuted.

# Triggering Measurements and Reading Results

This chapter describes how to start single measurements or continuous measurements and how to read results from the instrument by means of remote control commands.

These commands cannot be logged by means of the SCPI recording function.

## Starting Measurements

See also section "[Starting Measurements](#)" in chapter 4 "[Instrument Functions](#)".

### Continuous measurement:

This is the standard operating mode of the measurement system to which the R&S UPV is set on switch-on. All types of measurements that are activated are performed continuously.

You can start a continuous measurement by pressing the **START** key.

The **START LED** is on to indicate that the continuous measurement mode is active.

### Single measurement:

The R&S UPV carries out a single measurement for all measurement types activated; then the measurement system goes to the "Terminated" state. It is not mandatory that valid results be produced by the measurements: if an error occurs during a measurement, the result is indicated as being invalid. In such case, "----" rather than the measured value will be displayed in the associated result window. With remote control, a NAN ("not a number", 9.97e37) value will be returned.

You can start a single measurement by pressing the **SINGLE** key.

The **START LED** and the **SINGLE LED** are on to indicate that the single measurement mode is active.

Command	Parameters	Remarks
:INITiate:CONTinuous or :INITiate:FORCe	ON START	Starts a continuous measurement
:INITiate:CONTinuous or INITiate:FORCe	OFF SINGLE	Starts a single measurement
:INITiate[:IMMediate]		Starts a single measurement. This command has no effect if it is output while a continuous measurement is being performed.

## Reading Measurement Results

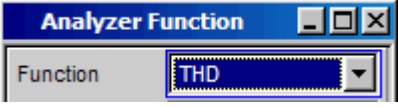
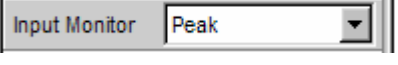
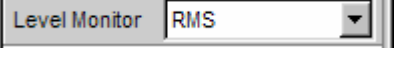
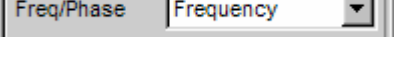
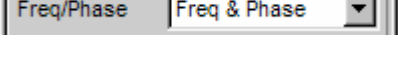
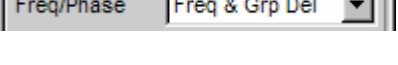
Depending on the measurements activated in the *Analyzer* panel, the R&S UPV indicates up to eight results in the numeric display. The results are also available in buffers from where they can be read by remote control.

The remote control commands for reading measurement results are in general structured as follows:

```
:SENSe<n>:DATA[1]|2?
```

The parameter **n** specifies the type of measurement whose result is queried.

DATA 1 or 2 selects channel 1 or 2.

Command	Measurement result	Analyzer Function panel
SENSe[1]:DATA[1]? SENSe[1]:DATA2?	Meas. function, channel 1 Meas. function, channel 2	
SENSe2:DATA[1]? SENSe2:DATA2?	Input Monitor, channel 1 Input Monitor, channel 2	
SENSe6:DATA[1]? SENSe6:DATA2?	Level Monitor, channel 1 Level Monitor, channel 2	
SENSe3:DATA[1]? SENSe3:DATA2?	Frequency, channel 1 Frequency, channel 2	
SENSe3:DATA[1]? SENSe4:DATA[1]?	Frequency, channel 1 Phase, channel 1	
SENSe3:DATA[1]? SENSe4:DATA[1]?	Frequency, channel 1 Group delay, channel 1	

The figure below shows the assignment of remote control commands to the results indicated in the numeric display.

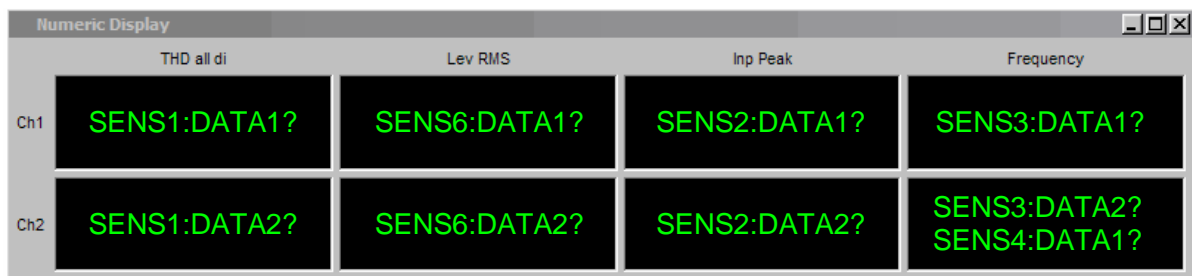


Fig. 6-1 Indication of results in the numeric display and associated remote control commands

The result returned in response to a remote control command comes in exponential notation with the same unit as shown in the numeric display. Results returned by remote control, however, come with the basic unit (no engineering, see example below).

**Example:**



Result indication in numeric display, channel 1

"SENS3:DATA1?"

Queries the frequency result for channel 1

"3.15000E3 HZ"

Result returned by remote control

# STATus Subsystem

This system contains the commands for the status reporting system. \*RST has no effect on status registers.

The query commands return the current value of the subregister in question, thus allowing a check of the device status. A decimal value between 0 and 32767 (=  $2^{15}-1$ ) is returned.

The configuration commands set the subregister in question and thus determine which state changes of the R&S UPV are to cause a change in the status registers. A decimal value between 0 and 32767 (=  $2^{15}-1$ ) is set.

The most significant bit is set to zero in all registers. The register content can thus always be interpreted as a positive integer.

Command	Parameters	Remarks
:STATus:PRESet		No query
:STATus:OPERation:CONDition?		Query only
:STATus:OPERation:ENABLE	0 to 32767	
:STATus:OPERation[:EVENT]?		Query only
:STATus:OPERation:NTRansition	0 to 32767	
:STATus:OPERation:PTRansition	0 to 32767	
:STATus:QUESTionable:CONDition?		Query only
:STATus:QUESTionable:ENABLE	0 to 32767	
:STATus:QUESTionable[:EVENT]?		Query only
:STATus:QUESTionable:NTRansition	0 to 32767	
:STATus:QUESTionable:PTRansition	0 to 32767	
:STATus:XQUESTionable:CONDition?		Query only
:STATus:XQUESTionable:ENABLE	0 to 32767	
:STATus:XQUESTionable[:EVENT]?		Query only
:STATus:XQUESTionable:NTRansition	0 to 32767	
:STATus:XQUESTionable:PTRansition	0 to 32767	

## :STATus:PRESet

The command resets the status registers. All PTRansition parts are set to 7FFFh (32767), i.e. all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e. a transition from 1 to 0 of a CONDition bit is not detected. The ENABLE parts of the STATus:OPERation, STATus:QUESTionable and STATus:XQUESTionable registers are set to 0, i.e. none of the events in these registers is passed on.

The command triggers an event and therefore has no query and no \*RST value.



**:STATus:OPERation:CONDition?**

The command queries the content of the CONDition part of the STATus:OPERation register. This part contains the information about the current instrument state.

Reading the information does not clear the register.

**:STATus:OPERation:ENABLE**

The command sets the bits of the ENABLE part of the STATus:OPERation register. This setting determines which events of the EVENT part of the STATus:OPERation register are to be passed on to the summary bit of the status byte. These events can be used to trigger a service request.

Reset value: all bits are reset (0)

**:STATus:OPERation:EVENT?**

The command queries the content of the EVENT part of the STATus:OPERation register. This part contains the information about the current instrument state since the last readout.

A bit set in the EVENT register indicates a change of the corresponding bit in the CONDition register. Whether bits in the EVENT register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the PTRansition and the NTRansition registers.

Reading the information clears the register.

**:STATus:OPERation:NTRansition**

The command sets the bits of the NTRansition part of the STATus:OPERation register. A bit set in the NTRansition register causes a bit transition from 1 to 0 in the CONDition register to produce an entry in the EVENT register.

Reading the information does not clear the register.

Reset value: all bits are reset (0)

**:STATus:OPERation:PTRansition**

The command sets the bits of the PTRansition part of the STATus:OPERation register. A bit set in the PTRansition register causes a bit transition from 0 to 1 in the CONDition register to produce an entry in the EVENT register. Reading the information does not clear the register.

Reset value: all bits are set (32767)

**:STATus:QUEStionable:CONDition?**

The command queries the content of the CONDition part of the STATus:QUEStionable register. This part contains the information about the current instrument state.

Reading the information does not clear the register.

**:STATus:QUEStionable:ENABle**

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This setting determines which events of the EVENT part of the STATus:QUEStionable register are to be passed on to the summary bit of the status byte. These events can be used to trigger a service request.

Reset value: all bits are reset (0)

**:STATus:QUEStionable:EVENT?**

The command queries the content of the EVENT part of the STATus:QUEStionable register. This part contains the information about the current instrument state since the last readout.

A bit set in the EVENT register indicates a change of the corresponding bit in the CONDition register. Whether bits in the EVENT register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the PTRansition and the NTRansition registers.

Reading the information clears the register.

**:STATus:QUEStionable:NTRansition**

The command sets the bits of the NTRansition part of the STATus:QUEStionable register. A bit set in the NTRansition register causes a bit transition from 1 to 0 in the CONDition register to produce an entry in the EVENT register.

Reading the information does not clear the register.

Reset value: all bits are reset (0)

**:STATus:QUEStionable:PTRansition**

The command sets the bits of the PTRansition part of the STATus:QUEStionable register. A bit set in the PTRansition register causes a bit transition from 0 to 1 in the CONDition register to produce an entry in the EVENT register.

Reading the information does not clear the register.

Reset value: all bits are set (32767)

**:STATus:XQUEStionable:CONDition?**

The command queries the content of the CONDition part of the STATus:XQUEStionable register. This part contains the information about the current instrument state.

Reading the information does not clear the register.

**:STATus:XQUEStionable:ENABle**

The command sets the bits of the ENABle part of the STATus:XQUEStionable register. This setting determines which events of the EVENT part of the STATus:XQUEStionable register are to be passed on to the summary bit of the status byte. These events can be used to trigger a service request.

Reset value: all bits are reset (0)

**:STATus:XQUEstionable:EVENT?**

The command queries the content of the EVENT part of the STATus:XQUEstionable register. This part contains the information about the current instrument state since the last readout.

A bit set in the EVENT register indicates a change of the corresponding bit in the CONDition register. Whether bits in the EVENT register are set due to a bit transition from 0 to 1 or from 1 to 0 depends on the bits set in the PTRansition and the NTRansition registers.

Reading the information clears the register.

**:STATus:XQUEstionable:NTRansition**

The command sets the bits of the NTRansition part of the STATus:XQUEstionable register. A bit set in the NTRansition register causes a bit transition from 1 to 0 in the CONDition register to produce an entry in the EVENT register.

Reading the information does not clear the register.

Reset value: all bits are reset (0)

**:STATus:XQUEstionable:PTRansition**

The command sets the bits of the PTRansition part of the STATus:XQUEstionable register. A bit set in the PTRansition register causes a bit transition from 0 to 1 in the CONDition register to produce an entry in the EVENT register.

Reading the information does not clear the register.

Reset value: all bits are reset (32767)

# SYSTEM Subsystem

This section describes the commands of the SYSTEM subsystem.

Command	Parameter	Remarks
:SYSTEM:COMMunicate:GTL		
:SYSTEM:ERRor?	'Character string'	Query only
:SYSTEM:PRESet		
:SYSTEM:VERSion?	<n>	Query only

## :SYSTEM:COMMunicate:GTL

The command switches the instrument to local operation.

## :SYSTEM:ERRor?

The command queries the oldest entry in the error queue and deletes this entry. Positive error numbers denote device-specific errors, negative error numbers denote error messages defined by SCPI (see Chapter 9, section "[Error messages](#)"). If the error queue is empty, 0 ('no error') is returned. The command has the same effect as the command `STATUS:QUEUE:NEXT?`

**Example:**           ":SYST:ERR?"           'Queries the oldest entry in the error queue.  
                           Response: "0, 'No error'"   'No error has occurred since the error queue was last read out.

## :SYSTEM:PRESet

The command triggers an instrument reset. The command has the same effect as the \*RST command or pressing the `PRESET` key on the instrument front panel.

## :SYSTEM:VERSion?

The command queries the SCPI version with which the instrument is compliant. The SCPI version is returned in the form of a calendar year.

**Example:**           ":SYST:VERS?"           'Queries the SCPI version.  
                           Response: 1996           'The instrument is compliant with the 1996 SCPI version.

# Alphabetical List of Commands

In the following, all remote-control commands implemented in the R&S UPV will be listed with their parameters and page numbers. They are arranged alphabetically according to the first keyword of the command.

Command	Parameter	Remarks	Page
AUXiliaries:AAUXout	CH1Speaker   DC		4.262
AUXiliaries:DCValue	<nu>		4.262
AUXiliaries:SPEaker	ON   OFF		4.258
AUXiliaries:SPEaker:CHANnel	CH1   CH2   STEReo		4.260
AUXiliaries:SPEaker:SOURce	FUNCTION   GENERator INPut   MONitor		4.258, 4.259
AUXiliaries:SPEaker:VOLume	<n>		4.261
INIT:CONT	ON   OFF	Starting Measure- ments	4.138 to 4.140
		Sweep	4.145 to 4.148
INPut:AUDiobits	<n>		4.125, 4.131
INPut:AUDiobits	W16   W24   W32		4.128
INPut:BANDwidth:MODE	B22   B40   B80   B250		4.111, 4.124
INPut:CHANnel	BOTH   CH1   CH2   CH1Is2 CH2Is1   CH1And2		4.109, 4.121, 4.127
INPut:COUPling	AC   DC		4.110
INPut:FILTer	OFF   UFIL1   UFIL2 UFIL3   UFIL4   UFIL5 UFIL6   UFIL7   UFIL8 UFIL9   AWE   CARM   CCIU CCIR   CCIT   CMES DEMP17   DCN   DEMP5015 DEMP50   DEMP75   IECT JITT   URUM   WRUM		4.112, 4.125, 4.131, 4.240
INPut:FORMat	SI2S   USER		4.132
INPut:FSLope	LFTF   LFTR		4.132
INPut:INPut	DSUB   INT		4.131
INPut:SAMPlE:FREQuency	<nu>		4.130
INPut:SAMPlE:FREQuency:MODE	F08   F11   F16   F22 F32   F44   F48   F88 F96   F176   F192   F384 VALue		4.123, 4.124, 4.129, 4.130
INPut:TYPE	BALanced   INTern OPTical   UNBalanced		4.125, 4.126
INPut:WRDOffset	<n>		4.133
INPut[1] 2:COMMon	FLOat   GROund		4.115
INPut[1] 2:IMPedance	R200K   R300   R600		4.114
INPut[1] 2:TYPE	BALanced   GEN1   GEN2		4.112
INSTRument[1][:SElect]	ANLG   DIG		4.1
INSTRument2[:SElect]	ANLG   DIG		4.107
MMEMory:LOAD:FREQuency	'filename'		4.101
MMEMory:LOAD:IEQualize	'filename'		4.195

Command	Parameter	Remarks	Page
MMEMemory:LOAD:INTERval	'filename'		4.102
MMEMemory:LOAD:LIST	ARbitrary,'filename' EQUalizer,'filename'		4.47 to 4.76
MMEMemory:LOAD:ONTime	'filename'		4.102
MMEMemory:LOAD:PHASe	'filename'		4.102
MMEMemory:LOAD:VOLTage	'filename'		4.101
OUTPut:AUDIobits	<n>		4.28, 4.37
OUTPut:BANDwidth:MODE	B22   B40   B80		4.6
OUTPut:CHANnel	CH1   CH2   CH2Is1   OFF		4.3, 4.18, 4.31
OUTPut:DIGital:AUXiliary	AINPut   AINReclock AOUTput   AUXin RGENerator		4.25, 4.26
OUTPut:DIGital:CSIMulator	OFF   SIMLong		4.29
OUTPut:DIGital:INTClockfreq	<nu>		4.24
OUTPut:DIGital:SYNC:OUTPut	ADINput   ADOutput AXINput   AXOutput GSYP11   INTClock JRFPl1   SYINput		4.22, 4.23
OUTPut:DIGital:SYNC:TYPE	BCLock   WCLock		4.24
OUTPut:DIGital:UNBalanced:OUTPut	AINPut   AOUTput		4.29
OUTPut:FORMat	USER   SI2S		4.37, 4.38
OUTPut:FPulse	LFTL   LFTH POS   NEG		4.38, 4.39
OUTPut:FREQuency	<nu>		4.34
OUTPut:FShape	BITP   SQU		4.38
OUTPut:IMPedance	R10   R200   R600		4.5
OUTPut:LOW	FLOat   GROund		4.6
OUTPut:MCLKratio	M64   M96   M128   M192 M256   M384   M512		4.36, 4.37
OUTPut:SAMPle:FREQuency	<nu>		4.21
OUTPut:SAMPle:MODE	F08   F11   F16   F22 F32   F44   F48   F88 F96   F176   F192   F384 SYNChron   VALue		4.21, 4.33, 4.34
OUTPut:SIGNAL:BALanced:LEVel	<nu>		4.28
OUTPut:SIGNAL:LEVel	<nu>		4.28
OUTPut:TYPE	BALanced   UNBalanced		4.4
OUTPut:WORDlength	W16   W24   W32		4.32
OUTPut:WRDOffset	<n>		4.39
SENSe:DIGital:JITTer:REFerence	INTClock   REFPl1		4.122
SENSe:DIGital:MMODE	ADATA   CINPut   JPHase		4.119, 4.120, 4.121
SENSe:SWEep:CONTRol	ALISt   ASWep   MLISt MSWep   OFF		4.165, 4.166
SENSe:SWEep:POINts	<nu>		4.168
SENSe:SWEep:SPACing	LINPoints   LINSteps LOGPoints   LOGSteps		4.167
SENSe:SWEep:STARt	<nu>		4.168
SENSe:SWEep:STEP	<nu>		4.169

Command	Parameter	Remarks	Page
SENSe:SWEep:STOP	<nu>		4.168
SENSe:UFILter<i>:ORDer	N4   N8		4.244
SENSe[1]:CHANnel:DELay	<nu>		4.215
SENSe[1]:FILTer SENSe[1]:FILTer2 SENSe[1]:FILTer3	OFF   UFIL1   UFIL2 UFIL3   UFIL4   UFIL5 UFIL6   UFIL7   UFIL8 UFIL9   AWE   CARM   CCIU CCIR   CCIT   CMES DEMP17   DCN   DEMP5015 DEMP50   DEMP75   IECT JITT   URUM   WRUM		4.155, 4.218, 4.241
SENSe[1]:FREQuency:LIMit:LOWer	<nu>		4.195
SENSe[1]:FREQuency:LIMit:UPPer	<nu>		4.196
SENSe[1]:FUNctIon	DC   DFD   FFT   MDIST PEAK   QPEak   RMS RMSselect   THD THDNs ndr		4.156 to 4.214
SENSe[1]:FUNctIon:APERTure:MODE	AFAST   AUTO   GENTrack MEDium   NARRow   VALue WIDE		4.157 to 4.192
SENSe[1]:FUNctIon:DCSuppression	ON   OFF		4.151, 4.215
SENSe[1]:FUNctIon:DISToRtion<i> <i> describes the Harmonics 2, 4, 6, 8)	ON   OFF		4.183
SENSe[1]:FUNctIon:DISToRtion<i> <i> describes the Harmonics 3, 5, 7, 9)	ON   OFF		4.183
SENSe[1]:FUNctIon:DMODE	FAST   PRECision		4.179
SENSe[1]:FUNctIon:FFT:AVErAge	<n>		4.220
SENSe[1]:FUNctIon:FFT:AVErAge:MODE	EXponential   NORMal OFF		4.219
SENSe[1]:FUNctIon:FFT:CENTer	<nu>		4.222
SENSe[1]:FUNctIon:FFT:MTIME?			4.206
SENSe[1]:FUNctIon:FFT:RESolution?			4.206
SENSe[1]:FUNctIon:FFT:Size	S512   S1K   S2K   S4K S8K   S16K   S32K   S64K S128K   S256K		4.206
SENSe[1]:FUNctIon:FFT:START?			4.223
SENSe[1]:FUNctIon:FFT:STATe	ON   OFF		4.212
SENSe[1]:FUNctIon:FFT:STOP?			4.223
SENSe[1]:FUNctIon:FFT:WINDow	BLACKman_harris   FLATtop HAMming   HANNing RECTangular   RIF1   RIF2 RIF3		4.208, 4.209
SENSe[1]:FUNctIon:FFT:ZOOM <n> = 2..128)	<n>   1		4.221, 4.222
SENSe[1]:FUNctIon:MMODE	D2_118   D2_268   D3_118 D3_268   DALL   DEVen DODD   LDALl   LDEVen LDODd   LNOise LSElectdi   LTHDn   NOISE NPEak   PABSolut   PPEak PTOPeak   SElectdi SNDRatio   THDN		4.172 to 4.200
SENSe[1]:NOTCh	DB0   DB12   DB30   OFF		4.152, 4.216
SENSe[1]:NOTCh:FREQuency	<nu>		4.153, 4.217

Command	Parameter	Remarks	Page
SENSe[1]:NOTCh:FREQuency:MODE	FIXed   GENTrack		4.153, 4.217
SENSe[1]:POWer:REFEreNce:RESistance	<nu>		4.118
SENSe[1]:THDN:REJection	NARRow   WIDE		4.190
SENSe[1]:UFILter<i>	LPASS   HPASS   BPASS BSTOp   NOTCh   TOCTave OCTave   FILE		4.243
SENSe[1]:UFILter<i>:ATTenuation	<nu>		4.251
SENSe[1]:UFILter<i>:CENTer	<nu>		4.247
SENSe[1]:UFILter<i>:DELay	<nu>		4.251
SENSe[1]:UFILter<i>:DELay?			4.251
SENSe[1]:UFILter<i>:FNAMe	'filename'		4.249
SENSe[1]:UFILter<i>:PASSb	<nu>		4.244
SENSe[1]:UFILter<i>:PASSb:LOWer	<nu>		4.245
SENSe[1]:UFILter<i>:PASSb:UPPer	<nu>		4.245
SENSe[1]:UFILter<i>:STOPb:LOWer?			4.245, 4.247
SENSe[1]:UFILter<i>:STOPb:UPPer?			4.246, 4.247
SENSe[1]:UFILter<i>:STOPb?			4.244
SENSe[1]:UFILter<i>:WIDTh	<nu>		4.247
SENSe[1]:VOLTagE:APERture	<nu>		4.158, 4.161, 4.177
SENSe[1]:VOLTagE:EQUalize	ON   OFF		4.195
SENSe[1]:VOLTagE:FUNDamental	<nu>		4.184, 4.192
SENSe[1]:VOLTagE:FUNDamental:MODE	AUTO   GENTrack   VALue		4.183, 4.184, 4.192, 4.193
SENSe[1]:VOLTagE:INTVtime	<nu>		4.173, 4.174
SENSe[1]:VOLTagE:INTVtime:MODE	FAST   FIXed   SFAST SLOW   VALue		4.173, 4.174
SENSe[1]:VOLTagE:RANGe[1] 2:MODE	AUTO   FIX   LOWER <n> [V]		4.116, 4.117
SENSe2:FUNCTion	DIGinpampl   IPEAK   OFF PHASetoref   DIGinpampl		4.236, 4.237
SENSe3:FREQuency:APERture:MODE	FAST   PRECision		4.233
SENSe3:FUNCTion	FQGRoupdelay   FQPHase FREQuency   OFF SFRequency   FQSamplefrequency		4.230, 4.231, 4.232
SENSe3:PHASe:FORMAt	INFinite   NEGative POSitive   POSNegative RAD   RADBipolar RADNegative		4.234, 4.235
SENSe5:FUNCTion	ON   OFF		4.210
SENSe6:FUNCTion	OFF   LRMS   DC   PEAK		4.238, 4.239
SENSe7:FUNCTion	ON   OFF		4.224
SOURce:BANDwidth	F30   F100		4.67
SOURce:DIGital:FRAMephase	<nu>		4.27



Command	Parameter	Remarks	Page
SOURce:DIGital:PHASetorefvar	OFF   VALue		4.27
SOURce:DIGital:REFeRence	AONE   AZER		4.26
SOURce:DIGital:SRCMode	ADATa   COMMon   JITTer		4.15, 4.16, 4.17
SOURce:DIGital:SYNC:TO	AINPut   AUXinput INTClock   SINPut SINVinput INT   EXTM   EXTW		4.19, 4.32
SOURce:DIM	DIMA   DIMB		4.67
SOURce:FILTer	OFF   UFIL1   UFIL2 UFIL3   UFIL4   UFIL5 UFIL6   UFIL7   UFIL8 UFIL9   AWE   CARM   CCIU CCIR   CCIT   CMES DEMP17   DCN   DEMP5015 DEMP50   DEMP75   IECT JITT   URUM   WRUM		4.47 to 4.241
SOURce:FREQuency:CH2Stereo	<nu>		4.50
SOURce:FREQuency:DIFFerence	<nu>		4.65
SOURce:FREQuency:MEAN	<nu>		4.65, 4.73
SOURce:FREQuency:REFeRence	<nu>		4.8, 4.30, 4.39
SOURce:FREQuency:SElect	FQFQ   FQPH		4.48
SOURce:FREQuency[1]	<nu>		4.46 to 4.79
SOURce:FREQuency<i>	<nu>		4.53
SOURce:FREQuency2	<nu>		4.62, 4.79
SOURce:FUNCTion:MODE	AM   DEFinedvoltage EQUalvoltage   FM IEC118   IEC268		4.52, 4.64, 4.79
SOURce:FUNCTion[:SHAPE]	ARBitrary   BURSt   DC DFD   DIM   MDIST MODulation   MULTisine POLarity   RANDom S2Pulse   SINusoid STEReo		4.45 to 4.81
SOURce:INTerval	<nu>		4.57, 4.60
SOURce:LOWDistortion	ON   OFF		4.45
SOURce:MULTisine:COUNT	<n>		4.53
SOURce:ONTime	<nu>		4.57, 4.60
SOURce:ONTime:DELaY	<nu>		4.57, 4.60
SOURce:PHASe	<nu>		4.49
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SOURce:RANDom:FREQuency:LOWer	<nu>		4.73
SOURce:RANDom:FREQuency:UPPer	<nu>		4.73
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SOURce:RANDom:SPACing:FREQuency	<nu>		4.52, 4.72
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SOURce:SWEep:DWELl	<nu>		4.93
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SOURce:SWEep:FREQuency:SPACing	LINPoints   LINSteps LOGPoints   LOGSteps		4.96, 4.97
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SOURce:SWEep:FREQuency:STEP	<nu>		4.100
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# 8 Maintenance and Instrument Interfaces

## Introduction - Maintenance and Interfaces

The following chapter contains information on maintaining the audio analyzer and also describes the instrument interfaces.

How to change a module and order spare parts is described in the service manual. The service manual also contains all the ID numbers required for ordering spare parts.

The address of our Support Center and a list of Rohde & Schwarz Service Centers are given at the beginning of this manual.

More detailed information (especially on troubleshooting, repairing the instrument, changing the modules and calibration) can also be found in the service manual.

## Maintenance

The audio analyzer does not require regular maintenance. Maintenance is essentially restricted to cleaning the instrument. It is, however, advisable to check the nominal data from time to time.

## Cleaning the Outside of the Instrument and Storage

The outside of the instrument should be cleaned using a suitable soft, lint-free cloth. It is important to make sure that the instrument vents are not obstructed.



---

**Caution:**

*Never use solvents such as thinners, acetone or similar, as these substances will damage plastic components and the labelling on the front panel.*

---

The storage temperature range for the audio analyzer is specified in the data sheet. The instrument must be protected against dust if it is to be stored for a long period.

When transporting or shipping the instrument, it is advisable to use the original packing material (especially the two protective covers for the front and rear panel).

## Changing the AC Supply Fuse



---

**Caution:**

*Only fuses of the type IEC 127-T4.0H/250V should be used.*

---

Changing the AC supply fuses:

- Make sure that the power cable is disconnected.
- Open the flap covering the voltage selector using a small screwdriver (or similar).
- Remove the cylinder labelled with the nominal voltages. Remove both fuses and fit new ones. Reinsert the cylinder so that the value visible through the hole in the cover flap is the same nominal voltage as before.
- Close the flap.

---

**Note:**

*The Audio Analyzer R&S UPV is operated with the same fuses for all of the specified nominal AC supply voltages.*

---

## Instrument Interfaces

The following section describes the remote-control interfaces of the audio analyzer and the pin assignment of the monitor socket. The other interfaces are described in Chapter 1 in the sections "[Front Panel](#)" and "[Rear Panel](#)".

### IEC/IEEE-Bus Interface (IEC 625 / IEEE 488)

As standard, the instrument is equipped with an IEC/IEEE-bus connector. The connector socket (conforming to IEEE 488) is at the rear of the instrument. The interface can be used to connect a controller to allow remote control of the instrument. A shielded cable is used for connection.

#### Features of the IEC/IEEE-bus interface

- 8-bit parallel data transfer
- Bidirectional data transfer
- Three-wire handshake
- High data transfer rate
- Up to 15 instruments can be connected
- Maximum length of connecting cables 15 m (single connection 2 m)
- Wired-Or operation with parallel connection of several instruments

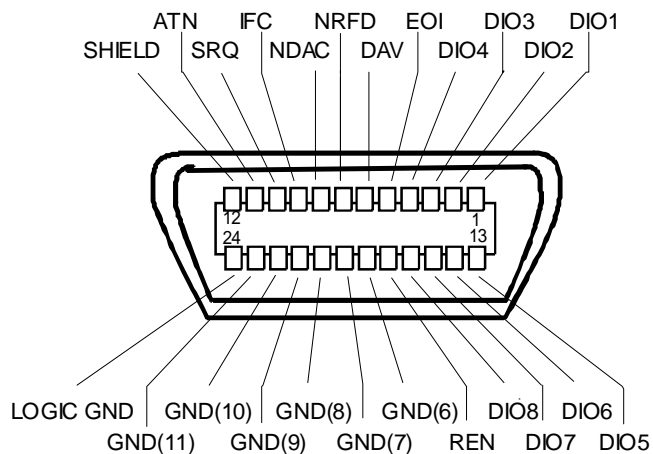


Figure 8-1 Pin assignment of IEC/IEEE-bus interface

## IEC/IEEE-bus lines

### 1. Data bus with 8 lines DIO 1...DIO 8

Data is transferred parallel by bit and serial by byte in ASCII/ISO code. DIO1 is the bit with the lowest value and DIO8 the bit with the highest value.

### 2. Control bus with 5 lines

<b>IFC</b> (Interface Clear)	Active LOW resets the interfaces of the connected instruments to their initial setting.
<b>ATN</b> (Attention)	Active LOW signals the transmission of interface messages. Active HIGH signals the transmission of instrument messages.
<b>SRQ</b> (Service Request)	Active LOW allows the connected instrument to send a service request to the controller.
<b>REN</b> (Remote Enable)	Active LOW allows switchover to remote-control mode.
<b>EOI</b> (End or Identify)	This has two functions in conjunction with ATN: ATN = HIGH Active LOW indicates the end of data transfer. ATN = LOW Active LOW triggers a parallel poll.

### 3. Handshake bus with three lines

<b>DAV</b> (Data Valid)	Active LOW signals a valid data byte on the data bus.
<b>NRFD</b> (Not Ready For Data)	Active LOW signals that one of the connected instruments is not ready to receive data.
<b>NDAC</b> (Not Data Accepted)	Active LOW while the connected instrument is receiving the data on the data bus.



## IEC/IEEE-bus interface functions

Instruments which can be remote-controlled via the IEC/IEEE bus can be provided with various interface functions. The table below lists the interface functions which apply to the audio analyzer.

Table 8-1 Interface functions

Control character	Interface functions
SH1	Source handshake, full capability
AH1	Acceptor handshake, full capability
L4	Listener function, full capability, unaddressing by MTA
T6	Talker function, full capability, capability of responding to serial query, unaddressing by MLA
SR1	Service request function, full capability
PP1	Parallel poll function, full capability
RL1	Remote/local switchover function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability
C0	No controller function

## IEC/IEEE-bus interface messages

Interface messages are transferred to the instrument on the data lines, whereby the "attention" control line ("ATN") is active (LOW). They are used for communication between the process controller and the instrument and can only be sent by a process controller which has the controller functionality at the IEC/IEEE bus.

### Universal commands

The universal commands are in the code range 0x10 to 0x1F. They act on all instruments connected to the bus without previous addressing.

Table 8-2 Universal commands

Command	VISUAL BASIC command	Effect on instrument
DCL (Device Clear)	IBCMD (controller%, CHR\$(20))	Terminates processing of the commands that have just been received, and sets the command-processing software to a defined initial state. Does not change the instrument setup.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to their initial setting.
LLO (Local Lockout)	IBCMD (controller%, CHR\$(17))	The manual LOCAL switchover function is disabled.
SPE (Serial Poll Enable)	IBCMD (controller%, CHR\$(24))	Ready for serial polling.
SPD (Serial Poll Disable)	IBCMD (controller%, CHR\$(25))	End of serial polling.
PPU (Parallel Poll Unconfigure)	IBCMD (controller%, CHR\$(21))	End of parallel polling query status.

### Addressed commands

The addressed commands are in the code range 0x00 to 0x0F. They only act on instruments which are addressed as listeners.

Table 8-3 Addressed commands

Command	VISUAL BASIC command	Effect on instrument
SDC (Selected Device Clear)	IBCLR (device%)	Terminates processing of the commands that have just been received, and sets the command-processing software to a defined initial state. Does not change the instrument setup.
GET (Group Execute Trigger)	IBTRG (device%)	Initiates a measurement or a sweep.
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual operation).
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configure instrument for parallel polling. The VISUAL BASIC command also executes PPE / PPD.

## Ethernet Interface (LAN)

As standard, the instrument is equipped with an Ethernet interface. The connector socket is at the rear of the instrument. Network administrators with the appropriate rights can transfer files across the network and use network resources such as network directories or printers. The instrument can also be remote-controlled and manually operated in the network. A commercially available RJ45 cable is used for connection.

The network card operates with 100-MHz-Ethernet IEEE 802.3u. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP provides connection-mode communication where the sequence of the exchanged messages is retained and interrupted connections are detected. Furthermore, messages cannot be lost if this protocol is used.

Connection of the R&S UPV is described in Chapter 1 in the section "[Connection to the Network](#)" and remote control via Ethernet is described in Chapter 5 in the section "[Remote Control via LAN Interface](#)". The architecture of a LAN remote-control connection is described in greater detail below.

Remote control of the instrument via a network is based on these standardized protocols which comply with the OSI reference model (see the figure below).

Application	SCPI	SCPI [3]
Presentation	XDR (VXI-11)	RFC 1014 [1,2]
Session	ONC-RPC	RFC 1057
Transport	TCP / UDP	RFC 793
Network	IP	RFC 791
Data Link	Ethernet/802.3	8802-3
Physical	802.3/10BASE-T	8802-3

Figure 8-2 Example of LAN remote control in compliance with OSI reference model

Based on TCP/UDP, the messages are exchanged between the controller and the instrument by means of Open Network Computing (ONC) Remote Procedure Calls (RPC). With XDR, the permitted RPC messages are known as the VXI-11 standard. Messages are exchanged between the controller and the instrument based on this standard. The messages are identical to the SCPI commands. They can be divided into four groups: program messages (control commands to the instrument), response messages (values returned by the instrument), service request (spontaneous requests by the instrument) and low-level control messages (interface messages).

A VXI-11 connection between a controller and an instrument is based on three channels: core, abort and interrupt channel. The instrument is controlled mainly via the core channel (program, response and low-level control messages). The abort channel is used for immediate termination of the core channel, and the interrupt channel transports spontaneous service requests from the instrument. The actual connection setup is complex. Further details can be found in the VXI-11 specification ('TCP/IP Instrument Protocol Specification VXI-11, Revision 1.0 VMEbus Extensions for Instrumentation, VXIbus' and 'TCP/IP-IEEE 488.2 Instrument Interface Specification VXI-11.3, Draft 0.3 VMEbus Extensions for Instrumentation, VXIbus').

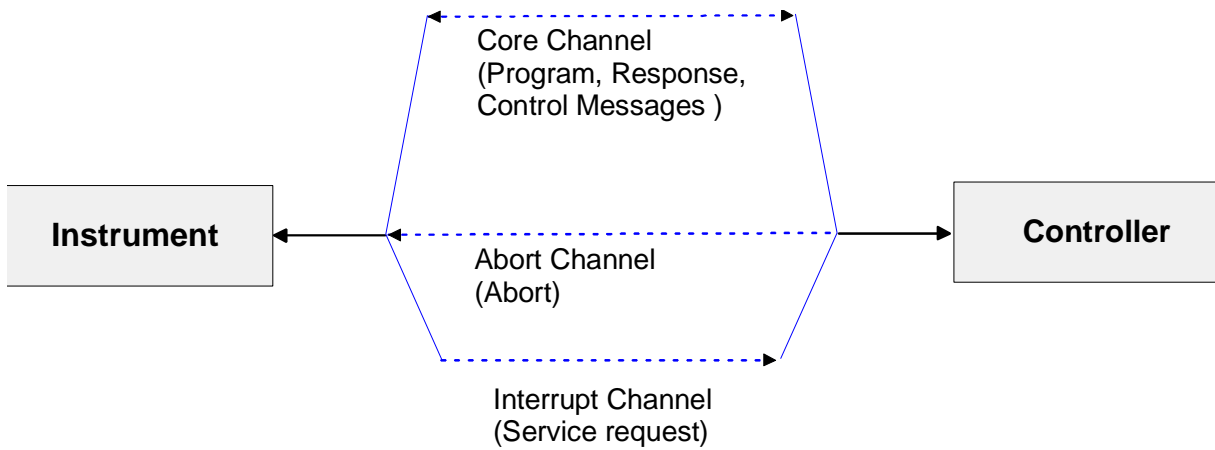


Figure 8-3 Channels between instrument and controller with VXI-11

The number of controllers which can access an instrument is virtually unlimited in the network. In the instrument, a clear distinction is made between the individual controllers. This distinction is continued down to one controller at application level, i.e. two applications on a PC are regarded as two different controllers by an instrument.

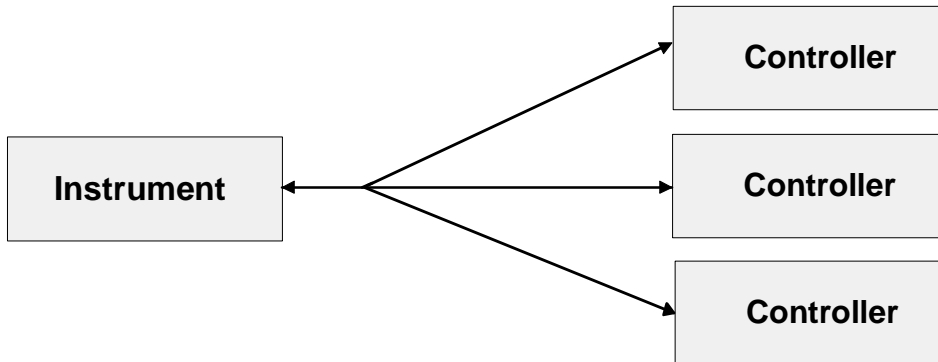
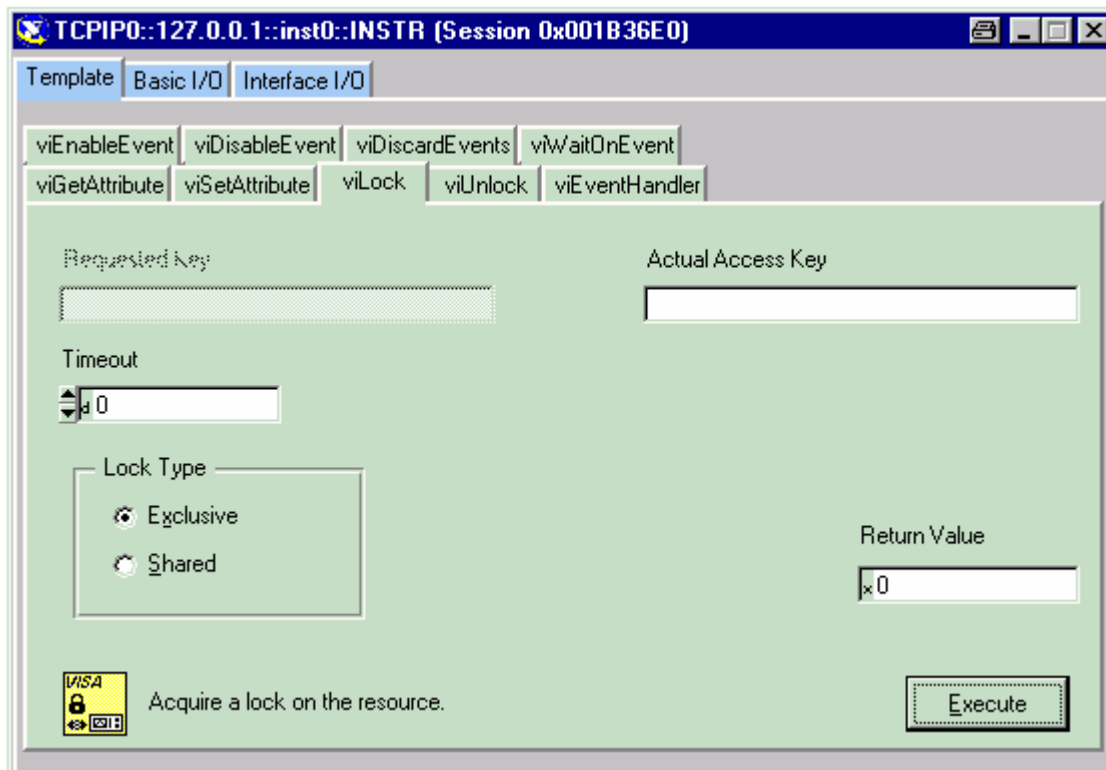


Figure 8-4 Remote control via LAN with several controllers

The controllers can lock and unlock the instrument to permit exclusive access. As a result, it is possible to control access from several controllers.

In the program 'Measurement & Automation Control', this setting is made in the **Template** panel.



## VXI-11 interface messages

With Ethernet connections, the interface messages are referred to as low-level control messages. They can be used to emulate the interface messages of the IEC/IEEE bus.

Table 8-4 VXI-11 interface messages

Command	Effect on instrument
&ABO (Abort)	Terminates processing of the commands that have just been received.
&DCL (Device Clear)	Terminates processing of the commands that have just been received, and sets the command-processing software to a defined initial state. Does not change the instrument setup.
&GTL (Go to Local)	Transition to the "Local" state (manual operation).
&GTR (Go to Remote)	Transition to the "Remote" state (remote control).
&GET (Group Execute Trigger)	Initiates a measurement or a sweep.
&LLO (Local Lockout)	The manual LOCAL switchover function is disabled.
&POL (Serial Poll)	A serial poll is executed.
&NREN (Not Remote Enable)	The manual LOCAL switchover function is enabled.

## RS-232-C Interface (COM)

As standard, the instrument has an RS-232-C interface. The connector socket is at the rear of the instrument. The interface can be used to connect a controller to allow remote control of the instrument. A shielded cable is used for connection.

### Features of the interface

- Serial data transfer in asynchronous mode
- Bidirectional data transfer via two separate lines
- Selectable transfer speed from 110 to 19200 Baud
- Logic signal level '0' from +3 V to +15 V
- Logic signal level '1' from -15 V to -3 V
- External device (controller) can be connected

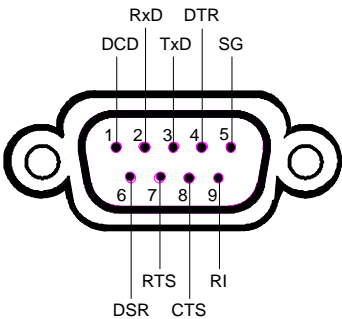


Figure 8-5 Pin assignment of RS-232-C interface

## Signal lines

### **DCD** (Data Carrier Detector)

*Not used in the instrument.*

Input (log. '0' = active); this signal tells the data terminal that the modem is receiving valid signals with adequate level from the remote station. DCD is used to disable the receiver in the data terminal and thus prevent incorrect data from being read in if the modem cannot interpret the signals from the remote station.

### **RxD** (Receive Data)

Data line; transfer direction: remote station to instrument.

### **TxD** (Transmit Data)

Data line; transfer direction: instrument to remote station.

### **DTR** (Data Terminal Ready)

Output (log. '0' = active); the instrument uses DTR to announce that it is ready to receive data.

### **GND**

Interface ground, connected to the instrument ground.

### **DSR** (Data Set Ready)

Input (log. '0' = active); DSR tells the instrument that the remote station is ready to receive data.

### **RTS** (Request To Send)

Output (log. '0' = active); RTS tells the remote station that the instrument is ready for data transfer. The RTS line remains active for as long as the serial interface is active.

### **CTS** (Clear To Send)

Input (log. '0' = active); CTS tells the instrument that the remote station is ready to receive data.

### **RI** (Ring Indicator)

*Not used by the instrument.*

Input; a modem uses RI to announce that a remote station wants to set up a connection with the modem.

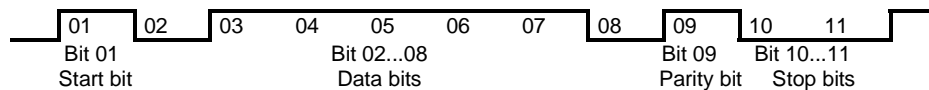
## Transfer parameters

To ensure error-free and correct data transfer, the set transfer parameters must be identical for both the instrument and the controller.

<b>Transfer speed (baud rate)</b>	8 different baud rates can be set in the instrument: 110, 300, 600, 1200, 2400, 4800, 9600, 19200.
<b>Data bits</b>	Data is transferred in 7 or 8-bit ASCII code. The LSB (Least Significant Bit) is the first bit to be transferred.
<b>Start bit</b>	Each data byte begins with a start bit. The falling edge of the start bit signals the beginning of the data byte.
<b>Parity bit</b>	A parity bit can also be transferred to provide error protection. There are three parity settings: none, even and odd. Additionally, the parity bit can be set to logic '0' or logic '1'.
<b>Stop bits</b>	Transfer of a data byte can be ended with 1, 1.5 or 2 stop bits.

**Example:**

Transfer of the letter 'A' (41 Hex) in 7-bit ASCII code, with even parity and two stop bits:





## Handshake

### Software handshake

With the software handshake, data transfer is controlled by the two control characters XON / XOFF:

The instrument signals that it is ready to receive data using the control character XON. If the input buffer is full, it sends the character XOFF to the controller via the interface. The controller then stops data output until it receives XON again from the instrument. In the same way, the controller informs the instrument that it is ready to receive data.

### Cable for local computer link for software handshake

With the software handshake, the instrument is connected to a controller by crossing the data lines. The wiring diagram below applies to a controller with 9-pin or 25-pin connection.

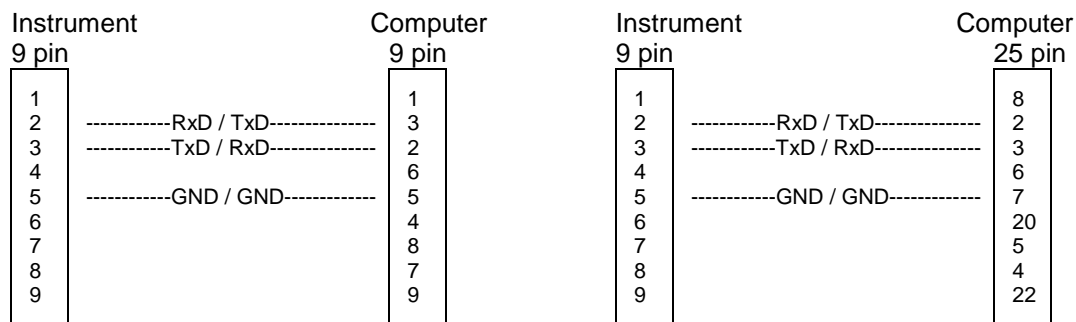


Figure 8-6 Wiring of data lines for software handshake

### Hardware handshake

With the hardware handshake, the instrument signals that it is ready to receive data via the lines DTR and RTS. A logic '0' on both lines means 'ready' and a logic '1' means 'not ready'. The RTS line is always active (logic '0') provided that the serial interface is switched on. The DTR line thus controls the R&S UPV's readiness to receive data.

The instrument is informed of the remote station's readiness to receive data via the lines CTS and DSR. A logic '0' on both lines activates the output of data and a logic '1' on both lines stops the output of data by the instrument. Data is output via the TxD line.

**Cable for local computer link for hardware handshake**

The instrument is connected to a controller using a "null modem" cable. With this cable, the data, control and signalling lines must be crossed. The wiring diagram below applies to a controller with 9-pin or 25-pin connection.

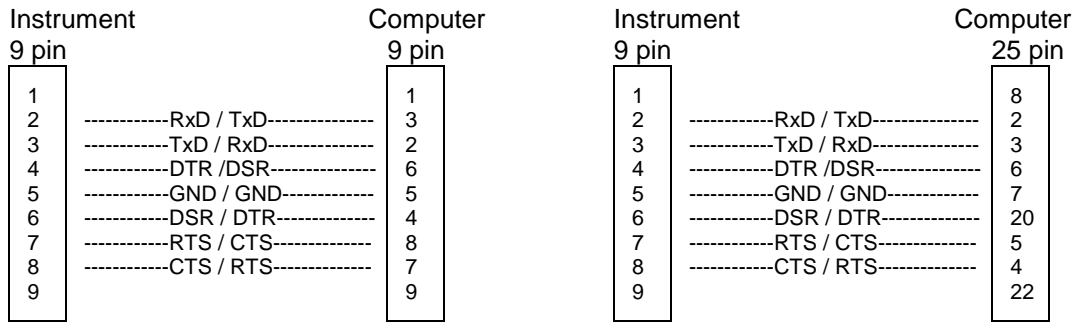


Figure 8-7 Wiring of data, control and signalling lines for hardware handshake

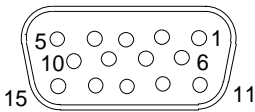
**USB Connectors (USB)**

As standard, the instrument has four USB interfaces (Universal Serial Bus) of type A (Master USB); they form a link with the internal processor. They can be used to connect peripherals such as a mouse and keyboard or to connect a USB stick for transferring files. Two of the USB interfaces are on the front of the instrument and two are on the rear of the instrument.



### Monitor Connector (MONITOR)

The 15-pin connector MONITOR on the rear of the instrument allows a VGA monitor to be connected.



Pin	Signal	Pin	Signal	Pin	Signal
1	Red (output)	6	GND	11	(NC)
2	Green (output)	7	GND	12	(NC)
3	Blue (output)	8	GND	13	HSYNC (output)
4	(NC)	9	GND	14	VSYNC (output)
5	GND	10	GND	15	(NC)

Figure 8-9 Assignment of MONITOR connector

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