Manual

Vector Signal Generator

R&S®SMBV100A

1407.6004K02

ROHDE&SCHWARZ
Test and Measurement

1407.6062.32-04

Dear Customer,

throughout this manual, the Vector Signal Generator R&S® SMBV100A is abbreviated as R&S SMBV.

The firmware of the instrument makes use of the operating system LINUX® and other valuable open source software packages. The most important of them are listed below together with their corresponding open source license. The verbatim license texts are provided on the user documentation CD-ROM (included in delivery).

Package	Link	License
LINUX® Kernel	http://www.linux.org/	GPL 2
gLibc	http://www.gnu.org/software/libc/	LGPL
busybox	http://www.busybox.net/	GPL 2
OpenSSL	http://www.openssl.org/	OpenSSL / SSLeay
XFree86	http://www.xfree86.org/	XFree86
Xitami	http://www.xitami.com	NetSnmp-5.0.8
PHP	http://www.php.net	2.5b6
OpenSSL	http://www.openssl.org	BSD
BOOST Library	http://www.boost.org	Artistic
zlib	http://www.zlib.net	Boost Software, v.1
PC/SC-Lite	http://www.linuxnet.com/	ACE_TAO

The OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/). includes cryptographic software written by Eric Young (eay@cryptsoft.com) and software written by Tim Hudson (tjh@cryptsoft.com).

LINUX® is a trademark of Linus Torvalds.

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

Tabbed Divider Overview

CD-ROM including complete operating manual and compiled online help (provided in the file inside pocket)

Data Sheet

Safety Instructions
Certificate of Quality
Support-Center Address
EC Certificate of Conformity
List of R&S Representatives

User documentation for the Vector Signal Generator R&S SMBV100A

Tabbed Divider

Grouped Safety Messages

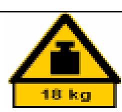
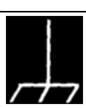
Make sure to read through and observe the following safety instructions!

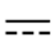
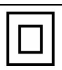
All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standard of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment required for them are designed and tested in accordance with the relevant safety standards. Compliance with these standards is continuously monitored by our quality assurance system. The product described here 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, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for 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 product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Symbols and safety labels

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

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

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 relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories.

Tags and their meaning

DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	NOTICE indicates a property damage message. In the product documentation, the word ATTENTION is used synonymously.

These tags are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the tags described here are always used only in connection with the related product documentation and the related product. The use of tags in connection with unrelated products or documentation can result in misinterpretation and thus contribute to personal injury or material 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:
   prescribed operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, use only in enclosed spaces, max. operation altitude 2000 m above sea level, max. transport altitude 4500 m above sea level.
   A tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.
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 product 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 (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) 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. If products/components are mechanically and/or thermically processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.
6. 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/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.
7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.
8. 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.
9. 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.
10. 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.
11. 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 (corresponding to the 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.
12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, 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.
13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
14. 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.
15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
16. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.
18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
19. 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 license electrician.

20. 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.
21. 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.
22. 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.
23. Rohde & Schwarz products are not protected against penetration of liquids, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.
24. 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.
25. 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.
26. 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.
27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
    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 must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.
29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.
30. 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).
31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.
32. 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.
33. 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 product 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.
34. Prior to cleaning, disconnect the product from the AC supply. Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluent for cellulose lacquers.

Informaciones elementales de seguridad

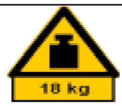
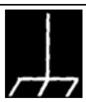
¡Es imprescindible leer y observar las siguientes instrucciones e informaciones de seguridad!

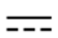
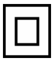
El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestra sección de gestión de la seguridad de calidad controla constantemente que sean cumplidas estas normas. El presente 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 estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o 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 mal uso del producto.

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado dentro de las instrucciones de la correspondiente documentación de producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos profundos y conocimientos básicas del idioma inglés. Por eso se debe tener en cuenta que el producto sólo pueda ser operado por personal especializado o personas minuciosamente instruidas con las capacidades correspondientes. 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. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto y entréguela a usuarios posteriores.

Símbolos y definiciones de seguridad

							
Ver documen-tación de producto	Informaciones para maquinaria con un peso de > 18kg	Peligro de golpe de corriente	¡Advertencia! Superficie caliente	Conexión a conductor protector	Conexión a tierra	Conexión a masa conductora	¡Cuidado! Elementos de construcción con peligro de carga electroestática

					
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

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 el capítulo correspondiente de la documentación de producto y que también son obligatorias de seguir. En las informaciones de seguridad actuales hemos juntado todos los objetos vendidos por el grupo de empresas 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	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
AVISO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
	En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

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:
   como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 m sobre el nivel del mar.
   Se aplicará una tolerancia de ±10% sobre el voltaje nominal y de ±5% sobre la frecuencia nominal.
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 especializado 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 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 níquel). Si se producieran 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.
4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.
5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberán ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.
6. Ciertos productos, como por ejemplo las instalaciones de radiocomunicación RF, 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/usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.
7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.
8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del producto.
9. 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.
10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. 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.
11. 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 asegurar de que el enchufe sea de fácil acceso y nabejo (según la 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 bastidores o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

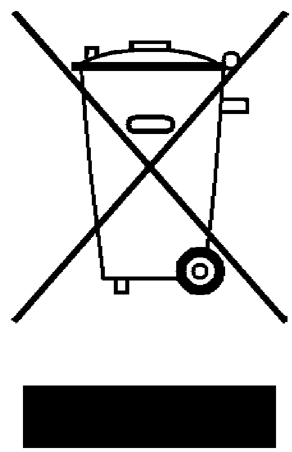
12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.
13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).
14. 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.
15. 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.
16. En las mediciones en circuitos de corriente con una tensión de entrada de U_{eff} > 30 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.).
17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos del estándar IEC950/EN60950.
18. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.
19. 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.
20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.
21. 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 cortocircuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.
22. 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.
23. Los productos R&S no están protegidos contra líquidos 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 para el usuario o de daños en el producto lo cual también puede llevar al peligro de personas.
24. 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.
25. 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.
26. 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.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. 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). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.
28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.
29. El producto puede poseer un peso elevado. Muévalo con cuidado para evitar lesiones en la espalda u otras partes corporales.
30. 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).
31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean observadas. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.
32. 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. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.
33. Dado el caso de que esté integrado un producto de láser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación de producto. De otra manera pondrá en peligro su salud, ya que el rayo láser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo láser.
34. Antes de proceder a la limpieza, desconecte el producto de la red. Realice la limpieza con un paño suave, que no se deshilache. No utilice de ninguna manera agentes limpiadores químicos como, por ejemplo, alcohol, acetona o nitrodiluyente.

Customer Information Regarding Product Disposal

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

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



Product labeling in accordance with EN 50419

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

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

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

ROHDE&SCHWARZ

Certified Quality System

DIN EN ISO 9001 : 2000
DIN EN 9100 : 2003
DIN EN ISO 14001 : 2004

DQS REG. NO 001954 QM 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 14001:2004

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 14001:2004

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 14001:2004

ROHDE&SCHWARZ

1171.0200.11-02.00

Customer Support

Technical support – where and when you need it

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

Up-to-date information and upgrades

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

USA & Canada

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

Tel. from USA 888-test-rsa (888-837-8772) (opt 2)
From outside USA +1 410 910 7800 (opt 2)
Fax +1 410 910 7801

E-mail CustomerSupport@rohde-schwarz.com

East Asia

Monday to Friday (except Singaporean public holidays)
8:30 AM – 6:00 PM Singapore Time (SGT)

Tel. +65 6 513 0488
Fax +65 6 846 1090

E-mail CustomerSupport@rohde-schwarz.com

Rest of the World

Monday to Friday (except German public holidays)
08:00 – 17:00 Central European Time (CET)

Tel. from Europe +49 (0) 180 512 42 42*
From outside Europe +49 89 4129 13776
Fax +49 (0) 89 41 29 637 78

E-mail CustomerSupport@rohde-schwarz.com

* 0.14 €/Min within the German fixed-line telephone network, varying prices for the mobile telephone network and in different countries.

ROHDE&SCHWARZ

1171.0200.22-02.00

Address List

Headquarters, Plants and Subsidiaries

Headquarters

ROHDE&SCHWARZ GmbH & Co. KG
Mühldorfstraße 15 · D-81671 München
P.O.Box 80 14 69 · D-81614 München
Phone +49 (89) 41 29-0
Fax +49 (89) 41 29-121 64
info.rs@rohde-schwarz.com

Plants

ROHDE&SCHWARZ Messgerätebau GmbH
Riedbachstraße 58 · D-87700 Memmingen
P.O.Box 16 52 · D-87686 Memmingen
Phone +49 (83 31) 1 08-0
+49 (83 31) 1 08-1124
info.rsmb@rohde-schwarz.com

ROHDE&SCHWARZ GmbH & Co. KG
Werk Teisnach
Kaikenrieder Straße 27 · D-94244 Teisnach
P.O.Box 11 49 · D-94240 Teisnach
Phone +49 (99 23) 8 50-0
Fax +49 (99 23) 8 50-174
info.rsdts@rohde-schwarz.com

ROHDE&SCHWARZ závod
Vimperk, s.r.o.
Location Spidrova 49
CZ-38501 Vimperk
Phone +420 (388) 45 21 09
Fax +420 (388) 45 21 13

ROHDE&SCHWARZ GmbH & Co. KG
Dienstleistungszentrum Köln
Graf-Zeppelin-Straße 18 · D-51147 Köln
P.O.Box 98 02 60 · D-51130 Köln
Phone +49 (22 03) 49-0
Fax +49 (22 03) 49 51-229
info.rsdc@rohde-schwarz.com
service.rsdc@rohde-schwarz.com

Subsidiaries

R&S BICK Mobilfunk GmbH
Fritz-Hahne-Str. 7 · D-31848 Bad Münder
P.O.Box 20 02 · D-31844 Bad Münder
Phone +49 (50 42) 9 98-0
Fax +49 (50 42) 9 98-105
info.bick@rohde-schwarz.com

ROHDE&SCHWARZ FTK GmbH
Wendenschloßstraße 168, Haus 28
D-12557 Berlin
Phone +49 (30) 658 91-122
Fax +49 (30) 655 50-221
info.ftk@rohde-schwarz.com

ROHDE&SCHWARZ SIT GmbH
Am Studio 3
D-12489 Berlin
Phone +49 (30) 658 84-0
Fax +49 (30) 658 84-183
info.sit@rohde-schwarz.com

R&S Systems GmbH
Graf-Zeppelin-Straße 18
D-51147 Köln
Phone +49 (22 03) 49-5 23 25
Fax +49 (22 03) 49-5 23 36
info.rssys@rohde-schwarz.com

GEDIS GmbH
Sophienblatt 100
D-24114 Kiel
Phone +49 (431) 600 51-0
Fax +49 (431) 600 51-11
sales@gedis-online.de

HAMEG Instruments GmbH
Industriestraße 6
D-63533 Mainhausen
Phone +49 (61 82) 800-0
Fax +49 (61 82) 800-100
info@hameg.de

Locations Worldwide

Please refer to our homepage: www.rohde-schwarz.com

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- Service Locations
- National Websites

CE

Certificate No.: 2008-46

This is to certify that:

Equipment type	Stock No.	Designation
SMBV100A	1407.6004.02	Vector Signal Generator, Base Unit
SMBV-B1	1407.8407.02	Reference Oscillator OCXO
SMBV-B10	1407.8607.02	Baseband Generator
SMBV-B50	1407.8907.02	Baseband Generator
SMBV-B51	1407.9003.02	Baseband Generator
SMBV-B90	1407.9303.02	Phase Coherence
SMBV-B92	1407.9403.02	Hard Disc

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
  (2006/95/EC)
- relating to electromagnetic compatibility
  (2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1 : 2001
EN 61326 : 1997 + A1 : 1998 + A2 : 2001 + A3 : 2003
EN 55011 : 1998 + A1 : 1999 + A2 : 2002, Class B
EN 61000-3-2 : 2000 + A2 : 2005
EN 61000-3-3 : 1995 + A1 : 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 2008

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

Munich, 2008-07-17

Central Quality Management MF-QZ / Radde

Supplement to Operating Manual
R&S Signal Generator

Firmware Version 2.05.200 and higher

The new firmware version for the R&S Signal Generator offers Remote Control via LAN Interface using Telnet protocol as a new functionality that could not be reported yet in the current operating manual.The following description is to provide you with comprehensive information about these new features.

Table of contents

Remote Control via LAN Interface using Telnet protocol

The instrument is equipped with the following interfaces for remote control:

- IEC/IEEE bus interface according to standard IEC 625.1/IEEE 488.2.
- LAN interface: the network card uses 10/100/1000Mbps Ethernet IEEE 802.3u; two protocols are supported:
  - the VXI-11 standard, using VISA
  - a simple telnet protocol, also called "Raw Ethernet".

The connectors are located at the rear of the instrument and permit a connection to a controller for remote control either via GPIB or via a local area network (LAN).
A VISA installation on the controller is a prerequisite for remote control over LAN (when using VXI-11 protocol).

Another alternative way to remote control the instrument is using a simple telnet protocol (port 5025). Unlike using the VXI-11 protocol, no VISA installation is necessary on the remote controller side.

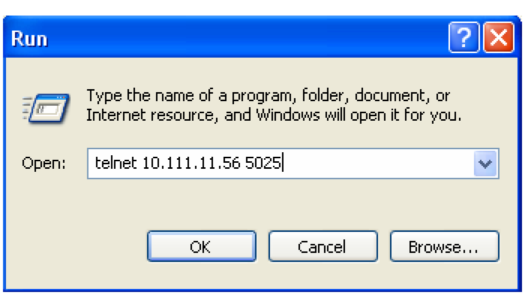
This protocol is sometimes also referred as "socket communication" or "Raw Ethernet mode".

To control the instrument manually, only a Telnet program is required. The Telnet program is part of every operating system.

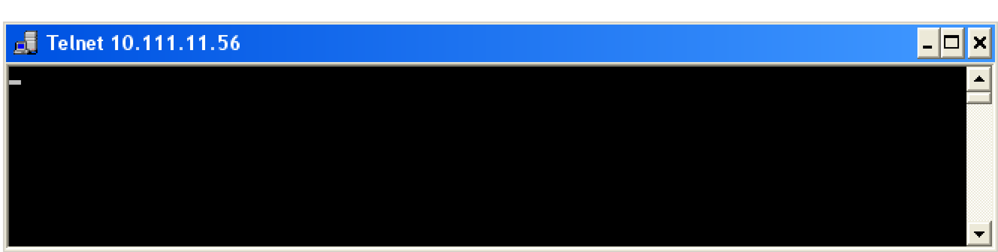
Setting up a Telnet Connection

1. To establish a Telnet connection with an instrument, start the Telnet program, enter the IP address of the R&S Signal Generator and the number of the port configured for remote-control via Telnet.

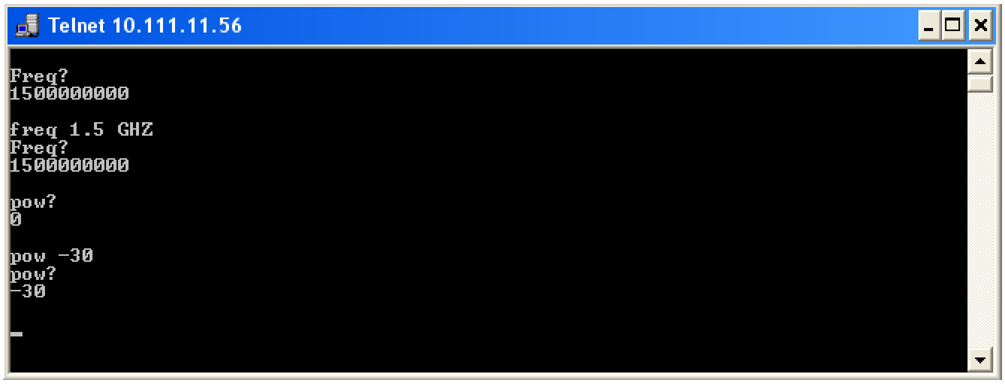
Note:
The R&S Signal Generator uses the port number 5025 for remote connection via Telnet.



The connection to the instrument is set up and remote-control commands can be sent.



2. Even if the cursor is not visible on the screan, enter blind a remote-control command and confirm with Enter.



After the fisrt remote-control command had been send, the R&S Signal Generator is in the REMOTE state, i.e. instrument control from the front panel or via mouse and keyboard is disabled and REMOTE is displayed in the status line.

Program examples

To write a program, only a socket communication must be established. The following program example shows a simple TcpClient class and how to use it.

```
#include <string>
//defines structs for socket handling
#include <netinet/in.h>
using namespace std;
typedef struct sockaddr_in SockAddrStruct;
typedef struct hostent     HostInfoStruct;
class TcpClient
{
  public:
    TcpClient();
    ~TcpClient();
    void connectToServer( string &hostname, int port );
    void disconnect( );
    void transmit( string &txString );
    void receive( string &rxString );
    string getCurrentHostName( ) const;
    int    getCurrentPort( ) const;
  private:
    string           currentHostName;
    int              currentPort;
    int              currentSocketDescr;
    SockAddrStruct   serverAddress;
    HostInfoStruct * currentHostInfo;
    bool             clientIsConnected;
    int              receiveBufferSize;
};


#include <netdb.h>
#include <netinet/in.h>
#include <unistd.h>
#include "TcpClient.h"
TcpClient::TcpClient()
: currentHostName( "" )
, currentPort( 0 )
, currentSocketDescr( 0 )
, serverAddress ( )
, currentHostInfo( NULL )
, clientIsConnected( false )
, receiveBufferSize( 1024 )
{
}
TcpClient::~TcpClient()
{
  currentHostInfo = NULL;
}

void TcpClient::connectToServer( string &hostname, int port )
{
  currentHostInfo = gethostbyname( hostname.c_str( ) );
  if( currentHostInfo == NULL )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("error connecting host\n" );
  }
```

```
  currentHostName = hostname;
  currentPort     = port;
  currentSocketDescr = socket(AF_INET, SOCK_STREAM, 0);
  if( currentSocketDescr == 0 )
  {
    currentHostName   = "";
    currentPort       = 0;
    currentHostInfo   = NULL;
    clientIsConnected = false;
    printf("can't create socket\n" );
  }
  serverAddress.sin_family = currentHostInfo->h_addrtype;
  serverAddress.sin_port   = htons( currentPort );
  memcpy( (char *) &serverAddress.sin_addr.s_addr, currentHostInfo->h_addr_list[0],
currentHostInfo->h_length );
  if( connect( currentSocketDescr, ( struct sockaddr *) &serverAddress, sizeof(
serverAddress ) ) < 0 )
  {
    throw string("can't connect server\n" );
  }
  clientIsConnected = true;
}
void TcpClient::disconnect( )
{
  if( clientIsConnected )
  {
    close( currentSocketDescr );
  }
  currentSocketDescr = 0;
  currentHostName    = "";
  currentPort        = 0;
  currentHostInfo    = NULL;
  clientIsConnected  = false;
}
void TcpClient::transmit( string &txString )
{
  if( !clientIsConnected )
  {
    throw string("connection must be established before any data can be sent\n");
  }
  char * transmitBuffer = new char[txString.length() +1];
  memcpy( transmitBuffer, txString.c_str(), txString.length() );
  transmitBuffer[txString.length()] = '\n'; //newline is needed!
  if( send( currentSocketDescr, transmitBuffer, txString.length() + 1, 0 ) < 0 )
  {
    throw string("can't transmit data\n");
  }
  delete [] transmitBuffer;
}
void TcpClient::receive( string &rxString )
{
  if( !clientIsConnected )
  {
    throw string("connection must be established before any data can be received\n");
  }
  char * receiveBuffer = new char[receiveBufferSize];
  memset( receiveBuffer, 0, receiveBufferSize );
  bool receiving = true;
  while( receiving )
  {
    int receivedByteCount = recv( currentSocketDescr, receiveBuffer,
receiveBufferSize, 0 );
    if( receivedByteCount < 0 )
    {
      throw string("error while receiving data\n");
    }
```

```
    rxString += string( receiveBuffer );
    receiving = ( receivedByteCount == receiveBufferSize );
  }
  delete [] receiveBuffer;
}
string TcpClient::getCurrentHostName( ) const
{
  return currentHostName;
}
int TcpClient::getCurrentPort( ) const
{
  return currentPort;
}

#include <iostream>
#include "TcpClient.h"
void printUsage()
{
  cout<<"usage: EthernetRawCommand <server-ip> [scpi-command]"<<endl;
}
int main( int argc, char *argv[] )
{
  int errorCode         = 0; //no error
  bool useSingleCommand = false;
  string singleCommand  = "";
  string hostname       = "";
  int    port           = 5025;
  string input          = "";
  TcpClient client;
  switch( argc )
  {
    case 3:
      useSingleCommand = true;
      singleCommand    = argv[2];
    case 2:
      hostname         = argv[1];
      break;
    default:
        printUsage();
        return(-1);
  }
  try
  {
    client.connectToServer( hostname, port );
    bool terminate = false;
    while( !terminate )
    {
      char buffer[1024];
      if( useSingleCommand )
      {
        input =  singleCommand; //send string
      }
      else
      {
        cin.getline( buffer, 1024 );
        input = buffer;
        if( input == "end" )
        {
          terminate = true;
        }
      }
      if( !terminate)
      {
        client.transmit( input ); //send string
        int qPos = input.find( "?", 0 );
        //receive string only when needed
```

```
        if( qPos > 0 )
        {
          string rcStr = "";
          client.receive( rcStr );
          cout << rcStr << endl;
        }
      }
      if( useSingleCommand )
      {
        terminate = true;
      }
    }
  }catch( const string errorString )
  {
    cout<<errorString<<endl;
  }
  client.disconnect( );
  return errorCode;
}
```

Supplement to Operating Manual
R&S Signal Generator

Firmware Version 2.05.269 and higher

The R&S Signal Generator uses a tag-oriented format for externally or internally generated waveforms as well as for data and control lists. The new firmware version for the R&S Signal Generator offers additional tags for working with multi segment waveforms as a new functionality that could not be reported yet in the current operating manual. The following description is to provide you with comprehensive information about this new feature.

Table of contents

Supplement to R&S Signal Generator Waveform and List Format

The R&S Signal Generator uses a tag-oriented format for externally or internally generated waveforms as well as for data and control lists. The data can be transmitted via the IEC bus from an external computer to the R&S Signal Generator and vice versa. For these purposes the file is transmitted as a binary data block, using IEC bus command `SOUR:BB:ARB:WAV:DATA`.

Note:
A waveform version number is not necessary due to the flexible, tag-based form.

Tags are self-contained information units. Their general format is:

{Name: Data} or **{Name-Length: Data}**

The colon separates the name part and the data part. The colon can be followed by a space for the sake of legibility.

The **Name** identifies the tag. It is always expressed in capital letters.

The **Data** is tag-specific, and in most cases, it is in ASCII plain text.

The **Length** specifies the number of bytes in a WAVEFORM tag or DATA LIST tag (from ':' to '}, ASCII integer)'
Each waveform file must begin with the TYPE tag. The sequence of the remaining tags is arbitrary. For each tag, an indication shows whether it *must* be included in the file concerned (mandatory) or *may* be included (optional).
Unknown tags are not analyzed by the R&S Signal Generator. On the other hand they are left unchanged, are saved without an error message and can be read back again.
R&S AMIQ waveforms can also be loaded on the R&S Signal Generator, where they are converted internally into an R&S Signal Generator waveform.

The following sections first describe the mandatory TYPE tag, which identifies the file and is always located at the start of the file. The rest of the tags used in the R&S Signal Generator are then described in alphabetical order. Most tags are valid for all three file types. If a tag is valid only for a single file type, e.g. only for a waveform, this fact is indicated in the description.

Note:
This chapter lists only the new or modified tags.

{TYPE: magic, xxxxxxxx} (mandatory, must be the first tag in the file)

The *TYPE* tag identifies the file as a valid R&S Signal Generator file. It must be present and must be the first in the waveform. If a file of the same name already exists on the target medium, it is overwritten.

Note:
AMIQ waveforms can also be loaded on the R&S Signal Generator, where they are converted internally into an R&S Signal Generator waveform.

magic 'magic' designates the file type and has the following values:

SMU-WV
The file contains a valid R&S Signal Generator waveform.

SMU-MWV
The file contains a valid R&S Signal Generator multi segment waveform.

SMU-DL
The file contains a valid R&S Signal Generator data list.

SMU-CL
The file contains a valid R&S Signal Generator control list.

xxxxxxxx: 'xxxxxxxx' is an ASCII-coded checksum of the data part of the WAVEFORM tag in the file. This value is always 0 for data lists and control lists.

The checksum for waveforms is used for detecting transmission errors. If the *TYPE* tag contains 0 or a non-numeric value for the checksum, it is ignored.

It is calculated in accordance with the following algorithm, where 'start' is a pointer to the first byte after the '#' character in the WAVEFORM tag and 'length' is the number of bytes between 'start' and the closing curly bracket (excluding the latter; 'length' must be divisible by 4 without a remainder):

```
UINT32 checksum(void *start, UINT32 length)
{
  UINT32 i, result = 0xA50F74FF;
  for(i=0; i < length/4; i++)
    result = result ^ ((UINT32 *)start)[i];
    return(result);
}
```

Example: {TYPE: SMU-WV,106656}

IEC bus query: `":BB:ARB:WAV:TAG? 'TYPE'"`
'queries the content of the 'TYPE' tag.

`Response: "'SMU-WV,106656'"`
'this is a valid waveform.

{CLOCK: frequency} (mandatory for waveforms)

The tag specifies the clock frequency at which the waveform has to be output, in Hz (on multi segment waveforms this tag contains the maximal clock of all segments).

A query of `ARB:CLOCk?` after loading the waveform returns the value set using the CLOCK tag.

This value can subsequently be altered with the aid of the `ARB:CLOCk` command.

Example: {CLOCK: 54000000}

IEC bus query: `":BB:ARB:WAV:TAG? 'CLOCK'"`
'queries the content of the `'CLOCK'` tag.

Response: "`54000000`"
'the clock frequency is set to 54 MHz.

{DATA LIST-Length: #$d_0d_1...d_x...d_{N-1}$…} (mandatory for data lists)

The tag contains the actual bit sequence of the data list in binary format.

Length 'Length' defines the number of bytes in the DATA LIST tag in ASCII Format (for format see WAVEFORM length).

d_x Data bits in binary format (8-bit unsigned characters, MSB first).

Example: DATA LIST-17: #$d_0d_1...d_x...d_{127}$}
16 bytes containing 128 data bits, first bit is the MS bit of the first byte.

{CONTROL LENGTH: ControlLength} (optional / recommended for marker and control lists)

The tag contains the length of the control list in ASCII format. If this tag is not used, the marker and control list length is determined by the highest position used in one of the LIST tags. It is recommended to set this value to be equal to the number of samples in order to keep marker signals and wave data synchronized.

Example: {CONTROL LENGTH: 444}

IEC bus query: "`:BB:ARB:WAV:TAG? 'CONTROL LENGTH'`"
'queries the length of the control list.

Response: "`'444'`"

{LEVEL OFFS: RMSOffset_dB,PeakOffset_dB} (recommended for waveforms)

The tag determines the level of the ARB signal in the waveform file. The offset levels define the offset of rms and peak value relative to the 16-bit full-scale modulation (-32767 to + 32767) = 0 dB.

RMSOffset_dB 'RMSOffset_dB' defines the rms level offset of the signal relative to full-scale ARB signal in the "WAVEFORM" tag. The offset is defined in ASCII float format. The value is always positive. A 3dB value indicates that the rms level of the signal is 3 dBs below the full scale (full scale = max. amplitude of vector of I/Q samples = $|S_{IQ}|$max = sqrt(I^2+Q^2)max = 0 dB)

PeakOffset_dB 'PeakOffset_dB' defines the peak level offset of the signal relative to full scale for the ARB signal in the "WAVEFORM" tag. The offset is defined in ASCII float format. The value usually equals 0 dB as in the majority of cases the I/Q samples (signed 16-bit integer values) are modulated to full scale:
Full scale = 0 dB = max. amplitude of vector of I/Q samples = $|S_{IQ}|$max = sqrt(I^2+Q^2)max = (2^{15})-1 = 32767.

A positive PeakOffset_dB value indicates that a headroom to full scale is provided when generating the waveform. A negative PeakOffset_dB value indicates that overrange is likely for some samples, i.e. clipping might occur.

The crest factor can be calculated from the two values as follows:

crest factor = |PeakOffset_dB - RMSOffset_dB|

Example: {LEVEL OFFS: 3.45,2}

IEC bus query: "`:BB:ARB:WAV:TAG? 'LEVEL OFFS'`"
'queries the content of the `'LEVEL OFFS'` tag of the selected waveform file.

Response: "`'3.45,2'`"
'the level of the waveform is below full scale, clipping will not occur.

{SAMPLES: Samples} (recommended for waveforms)

The tag contains the number of I/Q samples in the waveform in ASCII format.

On multi segment waveforms, this tag contains the total I/Q samples of all segments.

Example: {SAMPLES: 4333}

IEC bus query: `":BB:ARB:WAV:TAG? 'SAMPLES'"`
'queries the content of the 'SAMPLES' tag of the selected waveform file.

Response: `"'4333'"`
'the waveform contains 4333 I/Q samples.

{[TRACE] LIST [#]: Pos_0:Val_0;Pos_1:Val_1;...Pos_x:Val_x;...Pos_{N-1}:Val_{N-1}}
(mandatory for control lists / optional for waveforms)

The tag contains the data for the marker and control signals in the control list or the marker signals of ARB waveforms. To select which of these signals is defined, [TRACE] and the associated number are used. For ARB waveforms it is only meaningful to define marker signals (on ARB multi segment waveforms these tags will be ignored).

[TRACE] [TRACE] specifies the name of the marker or control signal:
You may choose from the following names:
MARKER; BURST; LEVATT; CW MODE; HOP, MAP

[#] [#] specifies the number in the case of control signals and marker signals with the same name. There is a choice between 4 markers and 3 LEVATT signals. Lines LEVATT 1 and 2 are needed for internal purposes and should not be used.

Pos Pos specifies in ASCII format the number of the position in the sequence, with effect from which the binary state of the marker or of the control signal changes from 0 to 1 or from 1 to 0.

Val Val specifies the binary state of the marker or of the control signal{0; 1} from Pos_x to Pos_{x+1} exclusive in ASCII format.

Example: {MARKER LIST 1: 0:0;10:1;20:0;30:1}

IEC bus query: `":BB:DM:CLIS:TAG? 'MARKER LIST 1'"`
'queries the content of the `'MARKER LIST 1'` tag of the selected control list file.

Response: `"'0:0;10:1;20:0;30:1'"`
'the marker setting for samples 0 to 9 = 0 (low), for 10 to 19 = 1 (high) and for 20 to 29 = 0. From sample 30 onward the marker setting = 1.

Example: {LEVATT LIST 1: 0:0;10:1;20:0;30:1}

IEC bus query: `":BB:DM:CLIS:TAG? 'LEVATT LIST 1'"`
'queries the content of the `'LEVATT LIST 1'` tag of the selected control list file.

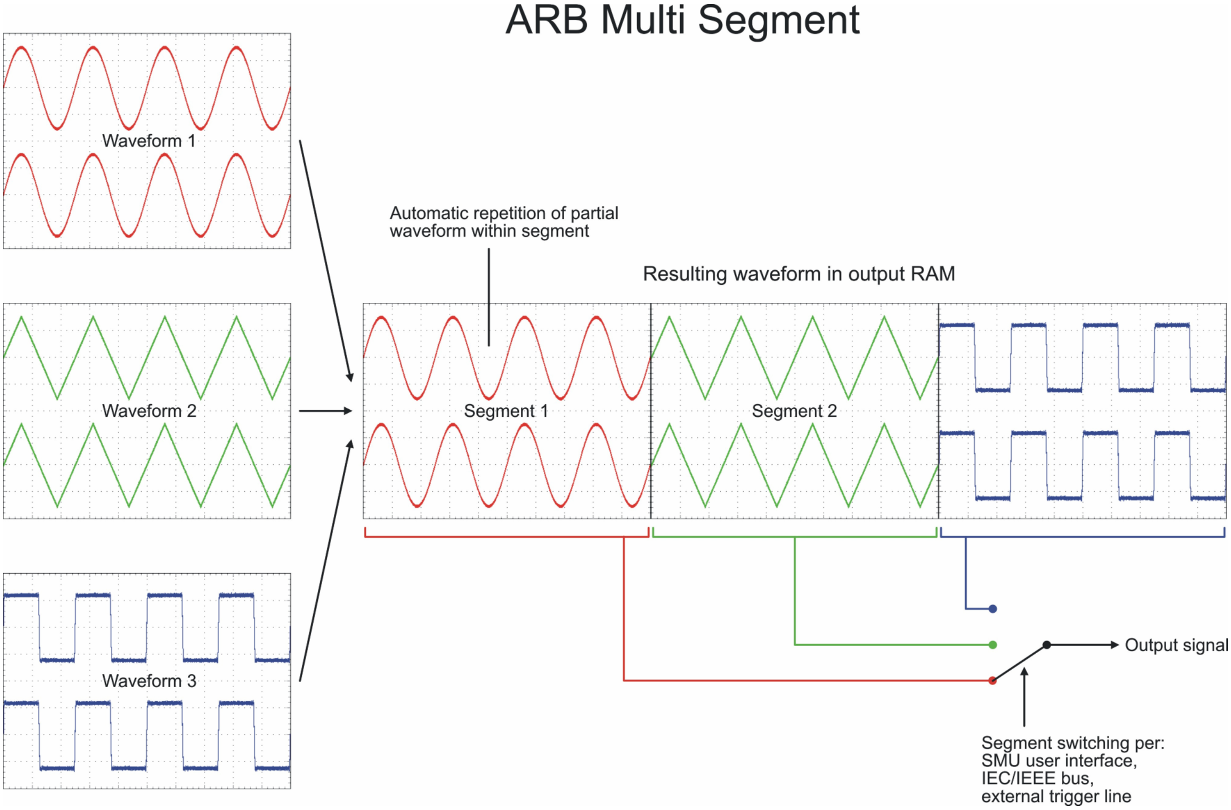
Response: `"'0:0;10:1;20:0;30:1'"`
'level attenuation applies to data values 10 to 19 (high) and from data value 30 onward.

{WAVEFORM-Length: #$I_0Q_0I_1Q_1...I_xQ_x...I_{N-1}Q_{N-1}...$} (mandatory for waveforms)

The tag contains the actual waveform data or multi segment waveform data (I/Q stream)

The TYPE tag decides, whether the waveform file contains a normal waveform or a multi segment waveform.

The following shows the principle of multi segment work mode.



This tag consists of the following:

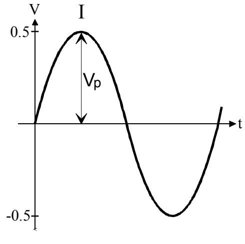
Length 'Length' specifies the number of bytes in a WAVEFORM tag and consists of:

+ Length of "#"	(1 byte)
+ Number of I/Q pairs * 4	(2 bytes per I and 2 bytes per Q value).

I Q IxQx… represents binary data (16-bit signed integer in 2's complement notation) containing the I and Q component alternately and starting with the I component. Each component consists of two bytes, least significant byte (LSB) first.

The values of the two bytes in an I component and a Q component are in the range 0x0 to 0xFFFF (-32767 to +32767). This value is transferred to the D/A converter.

At 50 Ω between the inner and outer conductors of the I and Q outputs, an amplitude Vp of +/-0.5 Volt arises on the I/Q output connectors of the R&S Signal Generator. When a PEP offset is defined (PEP OFFSET tag), the amplitude is correspondingly reduced.



(The illustration also applies to the Q output)

This tag is also used to store multi segment waveforms. The I/Q streams of the individual waveforms are directly concatenated to one collectively waveform I/Q stream.

The number of segments and the start offset and length of the individual segments inside the total waveform I/Q stream is determined by the additional tags MWV_SEGMENT_COUNT, MWV_SEGMENT_START and MWV_SEGMENT_LENGTH. Further MWV_SEGMENT_... tags are also available, i.e. for level and clock information etc.

Example: {WAVEFORM-401:# $I_0,Q_0,I_1,Q_1,I_2,Q_2,...I_{99},Q_{99}$}
(100 I/Q pairs with 4 bytes each are transmitted - none multi segment)

Example (multi segment): {WAVEFORM-1201:
$I_{0,Seg0},Q_{0,Seg0},I_{1,Seg0},Q_{1,Seg0},...I_{99,Seg0},Q_{99,Seg0},I_{0,Seg1},Q_{0,Seg1},I_{1,Seg1},Q_{1,Seg1},...$
$I_{199,Seg1},Q_{199,Seg1}$}
(2 segments: segment 0 with 100 I/Q pairs, segment 1 with 200 I/Q pairs.
Each I/Q pair consist of 2 * 16 bit = 4 bytes)

IEC bus query: The data is transmitted using IEC bus command `BB:ARB:WAVE:DATA`.

{MWV_SEGMENT_COUNT: NumOfSeg} (mandatory for multi segment waveforms)

The tag contains the number of segments in the multi segment waveform in ASCII integer format.

Example: {MWV_SEGMENT_COUNT: 2}
(Multi segment waveform with 2 segments)

IEC bus query: –

{MWV_SEGMENT_LENGTH: $Samples_{Seg0}$, $Samples_{Seg1}$, …, $Samples_{SegN-1}$} (mandatory for multi segment waveforms)

The tag contains a list of I/Q sample lengths for every segment in the multi segment waveform in ASCII integer format.

Example: {MWV_SEGMENT_LENGTH: 100,200}
(2 segments: 100 samples in segment 0 and 200 samples in segment 1.)

IEC bus query: –

{MWV_SEGMENT_START: $SampleStartOffset_{Seg0}$, $SampleStartOffset_{Seg1}$, …, $SampleStartOffset_{SegN-1}$} (mandatory for multi segment waveforms)

The tag contains a list of I/Q sample start offsets for every segment in the multi segment waveform in ASCII integer format.

Example: {MWV_SEGMENT_START: 0,100}
(2 segments with 100 samples in segment 0 and 200 samples in segment 1.
Sample start offset of first segment 0 is 0 samples, start offset of next segment 1 is the sample length of segment 0 = 100 samples.)

IEC bus query: –

{MWV_SEGMENT_CLOCK_MODE: Mode}
(mandatory for multi segment waveforms)

The tag contains a string in ASCII format which supplies the clock rate mode, that was used for calculation of the multi segment output waveform.

The tag CLOCK contains always the highest clock rate of all segments.

The tag MWV_SEGMENT_CLOCK contains the clock rates of the individual segments.

Mode UNCHANGED :

The segments may have different clock rates.
During the multi segment calculation, the clock rates of all individual original waveforms were taken over unchanged in the segments of the multi segment output waveform (no software resampling is done).
If the segments have different clock rates, there are some restrictions on signal output, i.e. switching per external trigger and seamless switching between segments is not possible.
If all segments have already an identical clock rate, this mode is usually set to HIGHEST.

HIGHEST:

All segments have an indentical clock rate, which is the highest clock rate of all original waveforms.
If an individual original waveform has a lower clock rate, an upsampling to the highest clock rate will performed on calculation of the multi segment output waveform.

USER:

All segments have an indentical clock rate, which is given by the user (only upsampling is allowed, no downsampling!)
If an individual original waveform has a lower clock rate, an upsampling to the user clock rate will performed on calculation of the multi segment output waveform.

Example: {MWV_SEGMENT_CLOCK_MODE: UNCHANGED}

{MWV_SEGMENT_CLOCK_MODE: HIGHEST}

{MWV_SEGMENT_CLOCK_MODE: USER}

IEC bus query: –

{MWV_SEGMENT_CLOCK: $Clock_{Seg0}$, $Clock_{Seg1}$, …, $Clock_{SegN-1}$}
(mandatory for multi segment waveforms)

The tag contains a list of clock frequencies for every segment in the multi segment waveform in ASCII floating point format.

Example: {MWV_SEGMENT_CLOCK: 100e6,80e6}

(2 segments: clock of segment 0 is 100 MHz, clock of segment 1 is 80 MHz. Please note: If the segments have different clock frequencies, there are some restrictions on signal output - i.e. seamless switching between segments is only possible, if all segments have the same clock frequency. Software resampling (upsampling) can be used to bring all segments to the same clock.)

IEC bus query: –

{MWV_SEGMENT_LEVEL_OFFS: RMSOffset_dB$_{Seg0}$, PeakOffset_dB$_{Seg0}$, RMSOffset_dB$_{Seg1}$, PeakOffset_dB$_{Seg1}$, …, RMSOffset_dB$_{SegN-1}$, PeakOffset_dB$_{SegN-1}$}
(mandatory for multi segment waveforms)

The tag contains a list of level pairs in ASCII floating point format, one pair for every segment in the multi segment waveform. The first value of a level pair defines the rms offset and the second value the peak offset relative to the 16-bit full scale modulation (-32767; + 32767) = 0 dB. The meaning of one level value pair is the same as in the LEVEL OFFS tag for normal waveforms (see description of LEVEL OFFS tag).

Example: {MWV_SEGMENT_LEVEL_OFFS: 3.0,0.0,6.0,0.0}
(2 segments: Rms level of segment 0 is 3dB below full scale. Rms level of segment 1 ist 6dB below full scale. Peak level of both segments is 0 dB full scale.)

IEC bus query: –

{MWV_SEGMENT_FILES: “FileNameSeg0.wv”, “FileNameSeg1.wv”, …, “FileNameSegN-1.wv”}
(optional for multi segment waveforms)

The tag contains a list of file names for every segment in the multi segment waveform in ASCII format.

Example: {MWV_SEGMENT_FILES: “d:\waveforms\sine.wv”, “d:\waveforms\rect.wv”}

IEC bus query: –

{MWV_SEGMENTx_COMMENT: text}
(optional for multi segment waveforms)

The tag contains a user comment for a specific segment x = [0…NumOfSeg-1] in the multi segment waveform in ASCII format.

Example: {MWV_SEGMENT1_FILES: segment 1 contains a QPSK signal.}

IEC bus query: –

{CONTROL LIST WIDTH4–Length: #$m_0 m_1 … m_x … m_{M-1}$}
(optional for waveforms and multi segment waveforms)

The tag contains a binary marker element stream, which will be given out synchronously to the I/Q sample sequence. One marker element m_x consists of 4 bit, which are assigned to the 4 possible marker lines of the instrument (one bit per marker line). One 4 bit marker elements is needed for every I/Q sample in the WAVEFORM tag - so the number of marker elements M should be equal to the number of I/Q samples. The CONTROL LENGTH tag has to contain the number of all marker elements M.

For standard waveforms the MARKER LIST x tags are a more compact way to define markers, but in principle this CONTROL LIST WIDTH4 format can also be used instead of the MARKER LIST x tags.

For multi segment waveforms, this CONTROL LIST WIDTH4 format is required for marker definition. The binary marker streams of the individual segments are directly concatenated (without any gap) to one collectively marker stream.

Length 'Length' defines the number of bytes in the CONTROL LIST WIDTH4 tag in ASCII Format and consists of the following:

Length = Size of "**#**" (1 byte) + Number of marker elements m_x * (4 bit) / (8 bits/byte)
(rounded up for byte alignment).

m_x Marker element in 4-bit binary format consists of the following bit order:

MS bit 7 Byte							LS bit 0
Marker element m_x (synchronous to I/Q Sample x)				Marker element m_{x+1} (synchronous to I/Q Sample x+1)			
Marker 4	Marker 3	Marker 2	Marker 1	Marker 4	Marker 3	Marker 2	Marker 1

Example: {CONTROL LIST WIDTH4-51: #$m_0m_1…m_x…m_{99}$}
(100 marker elements, each marker element with 4 bits)

IEC bus query: –

Supplement to Operating Manual
R&S SMBV100A Vector Signal Generator

Firmware Version 2.05.269 and higher

The firmware version for the R&S Vector Signal Generator provides some new functionality that could not be reported yet in the current operating manual.
The following description is to provide you with comprehensive information about these features.

Table of contents

Security Settings

Supplement to Connecting the R&S SMBV to a Network (LAN)

The R&S SMBV is equipped with a network interface and can be connected to an Ethernet LAN (local area network).
Provided the appropriate rights have been assigned by the network administrator, the instrument can also be remote-controlled and remote-accessed in the network.
Remote-access means that the user can operate the R&S SMBV from any remote PC in the network using the VNC protocol. For instance, the user can control one or more R&S SMBVs from a desk that is part of a test assembly located in another section of the building.
A VNC client program for Windows operating systems is provided on the R&S SMBV CD-ROM (included in delivery). VNC client programs for other operating systems are available free-of-charge on the internet.

In addition, the instrument also supports two standard methods to access the file system form a remote client:

- FTP (file transfer protocol)
- File sharing according to the SAMBA/SMB (server message block) protocol.

Both methods allow the access to the folder /var/user/share.

For VNC remote-access, FTP and SAMBA file access the user "instrument" is used. The default password is also "instrument".

NOTICE	It is highly recommended to change the default user and security passwords in the menu **Setup->Security** before connecting the instrument to the network (see section *"Security - Setup-Protection"*).

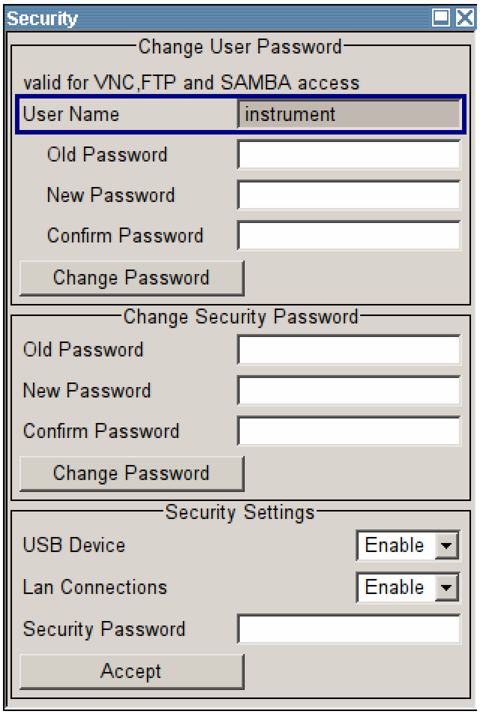
Remote-control of the instrument via the LAN interface is described in Chapter 5 of the Operating Manual, section "Remote Control via LAN Interface".
The configuration of the R&S SMBV for networking is performed in the **Environment** section of the **Setup** menu.

Security - Setup-Protection

The **Security...** menu provides access to the passwords and mass storage security settings. To open this menu, use the SETUP or MENU key under **Protection**.

The menu is divided into the password sections and the security settings section. In the password section, the passwords for securing a controlled access to the instrument are defined and changed. In the security section, the remote interfaces are enabled and disabled.

A change of passwords for the operating system and security password requires the entry of the old and new password and the conformation of the new password. All settings are only accepted after the **Change Password** button is pressed.



User Name - Security

Indicates the user name used for access to the Linux operating system and valid for VNC, FTP and SAMBA access.

The user name and password are required for remote access to the instrument via VNC, FTP or SAMBA.

Remote-control commands: `n.a.`

Old Password (User Password) - Security

Enters the currently used user password. The default password is "instrument".

Note:
It is highly recommended to change the default user password before connecting the instrument to the network.

Remote-control commands: n.a.

New Password (User Password) - Security

Enters the new password.

Remote-control commands: n.a.

Confirm Password (User Password) - Security

Enters the new password for conformation.

The new password is only valid after the **Change Password** button is pressed.

Remote-control commands: n.a.

Change Password (User Password) - Security

Changes the password accordingly.

Remote-control command: n.a.

Old Password (Security Password) - Security

Enters the currently used security password. The default password is '123456'.

Note:
It is highly recommended to change the default security password before connecting the instrument to the network.

Remote-control commands: n.a.

New Password (Security Password) - Security

Enters the new security password.

The security password may contain decimal characters only.

Remote-control commands: n.a.

Confirm Password (Security Password) - Security

Enters the new password for conformation.

The new password is only valid after the **Change Password** button is pressed.

Remote-control commands: n.a.

Change Password (Security Password) - Security

Changes the password accordingly.

Remote-control command: n.a.

USB Device - Security

Enables/disables the USB interfaces.

The instrument does not recognize any device connected to the USB interface when the interface is disabled.

The setting requires the entry of the security password and is only accepted after the **Accept** button is pressed.

Remote-control commands: n.a.

LAN Connection - Security

Enables/disables the LAN interfaces.

It is not possible to access the instrument via LAN while the LAN Connection is disabled. An enabled LAN Connection is a prerequisite for the remote control of the instrument via VNC, FTP or SAMBA.

The setting requires the entry of the security password and is only accepted after the **Accept** button is pressed.

Remote-control commands: n.a.

Security Password - Security

Enters the security password that is required to enable or to disable the LAN or USB interface. Default is '123456'.

Note:
It is highly recommended to change the default security password before connecting the instrument to the network.

All settings are only accepted after the **Accept** button is pressed.

Remote-control commands: n.a.

Accept - Security

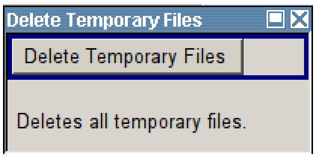
Accepts a new entry or selection and changes the settings accordingly.

Remote-control command: n.a.

Delete Temporary Files

Delete Temporary Files - Setup-System

To maintain sufficient amount of free disc space on the internal flash memory, the R&S SMBV provides a convenient way to delete the temporary files from the directory /var/smbv/unicod.



Delete Temporary Files - Setup

Execute this function to delete the temporary files from the directory /var/smbv/unicod.

The content of this directory are temporary files such as the wavefiles (*.wv) of all ARB standards. Deleting the temporary files maintains sufficient amount of free disc space on the internal flash memory.

Another way to achieve more free disc space on the internal flash memory is to execute the **Factory Preset** function.

Remote-control command:
`SYST:FIL:TEMP:DEL`

Remote-Control Command

SYSTem:FILes:TEMPorary:DELete

The command deletes the temporary files from the directory /var/smbv/unicod.

The content of this directory are temporary files such as the wavefiles (*.wv) of all ARB standards. Deleting the temporary files maintains sufficient amount of free disc space on the internal flash memory.

Another way to achieve more free disc space on the internal flash memory is to execute the `SYST:FPReset` command.

The command triggers an event and therefore has no *RST value and no query form.

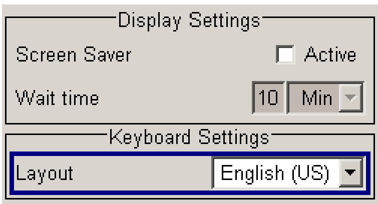
Example: `SYST:FIL:TEMP:DEL`
the content of the folder /var/smbv/unicod is deleted.

*RST value	Resolution	SCPI
-	-	Compliant

Keybord Settings

Supplement to Display/Keyboard Settings - Setup-Environment

In the **Display/Keyboard Settings** menu the power-save mode and external keyboard settings are made. It is opened using the SETUP or MENU key under **Environment**.



Layout - Setup

Selects the keyboard layout for the selected keyboard language.

The assignment of some keys depends on the selected layout and language.

Remote-control command:
`KBO:LAY US`
`KBO:LANG US`

Remote-Control Commands

The KBOard system contains the commands to set the external keyboard.

Command	Parameters	Default unit	Remark
KBOard:LANGuage	US | DE		
KBOard:LAYout	US | DE		

KBOard:LANGuage US | DE

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Example: `KBO:LANG US`
selects keyboard language American English.

*RST value	Resolution	SCPI
US	-	Device-specific

KBOard:LAYout US | DE

This command selects the keyboard layout for the selected keyboard language. The assignment of some keys depends on the selected layout and language.

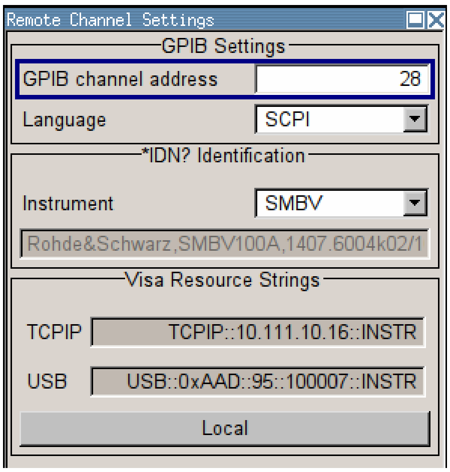
Example: `KBO:LAY US`
activates American keyboard layout

*RST value	Resolution	SCPI
US	-	Device-specific

Remote Emulation Modes

Supplement to GPIB/Ethernet - Setup-Remote

The **Remote Channel Settings** menu provides access to the GPIB and Ethernet settings. The **Remote Channel Settings** menu is opened using the SETUP or MENU key under **Remote**.



Language - Remote Channel Settings

Selects the remote control command set.

The R&S SMBV can also be remote controlled via the command set of several other generators, e.g. HP8657 generator or R&S SML.

Selection of R&S SML for instance allows to easily replace the R&S SML by an R&S SMBV in existing test setups.

Please check for the corresponding Application Note at the download area of the product site on the Internet. The Application Note is also provided on the user documentation CD-ROM (included in delivery).

As any other parameter, the remote control command set can also be changed remotely by means of the SCPI command `SYST:LANG`. However, this remote control command is enabled only in the instrument's specific SCPI command set, i.e. it is possible to change the command set remotely from the original one (`SYST:LANG SCPI`) to the command set to be emulated but not vice versa.

Note:

While working in a emulation mode, the R&S SMBV specific command set is disabled, i.e. the SCPI command `SYST:LANG` will be discarded.

Remote-control command:
`SYST:LANG?`

*IDN? Identification - Remote Channel Settings

Selects if the instruments identifies itself as R&S SMBV or otherwise, e.g. as R&S SML generator, when queried with common command *IDN?.

If a language other than SCPI is selected, the identification string for the selected generator is preset.

In addition, a user defined identification string can be entered, e.g. to provide individual identification for each generator, e.g. 'MY_R&S_SMBV1'.

Note:
While working in a emulation mode, the R&S SMBV specific command set is disabled, i.e. the SCPI commands `SYST:IDEN` and `SYST:IRES` will be discarded.

Remote-control command:
`SYST:IDEN USER`
`SYST:IRES 'MY_R&S_SMBV1'`

Remote-Control Command

SYSTem:IDENtification ORIGinal | USER

The command selects if the instruments identifies itself as R&S SMx or for example as R&S SML generator when queried with common command *IDN?.

A user defined identification string can be defined in addition.

Note:
While working in a emulation mode, the R&S SMBV specific command set is disabled, i.e. the SCPI command `SYST:IDEN` will be discarded.

Example: `SYST:IDEN USER`
'selects the identification string of the R&S SML

*RST value	Resolution	Options	SCPI
ORIGinal	-	-	-

SYSTem:LANGuage?

Queries the remote control command set.

The R&S SMBV can also be remote controlled via the command set of several other generators, e.g. HP8657 generator.

Please check for the corresponding Application Note at the download area of the product site on the Internet. The Application Note is also provided on the user documentation CD-ROM (included in delivery).

Note:
While working in a emulation mode, the R&S SMBV specific command set is disabled, i.e. the SCPI command `SYST:LANG` will be discarded.

The command is a query and therefore has no *RST value.

Example: `SYST:LANG?`

Response: `SCPI`
the SCPI command set is used

*RST value	Resolution	Options	SCPI
-	-		Device specific

SYSTem:IRESponse <string>

The command defines the identification string for selection user-defined (`SYST:IDEN USER`).

Note:
While working in a emulation mode, the R&S SMBV specific command set is disabled, i.e. the SCPI command `SYST:IRES` will be discarded.

Example: `SYST:IDEN USER`
selects an user-defined identification

`SYST:IRES "Test Device"`
defines the identification string 'test device'

`*IDN?`

Response: 'test device'

*RST value	Resolution	Options	SCPI
-	-	-	-

Configuration of the External Input Impedance for Analog Modulations

Configuration of the input impedance of the external modulation source fed via the EXT MOD input is provided for the Amplitude, Phase and Frequency Modulations.

Supplement to Amplitude, Phase and Frequency Modulation Menu

External Input Impendence

(Source External only)

Selects the impedance for external feed via the EXT MOD input.

Selection 600 Ohm and high (>100 kOhm) is available.

Note:
This setting affects all analog modulations which use the external modulation source.

Remote-control command:
`SOUR:INP:MOD:IMP HIGH`

Remote-Control Command

[SOURce:]INPut:MODext:IMPedance HIGH | G600

The command sets the impedance of the EXT MOD input.

This setting affects all analog modulations which use the external modulation source.

Parameters:

HIGH
> 100 k0hm to ground

G600
600 0hm to ground

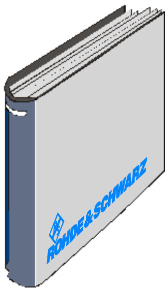
Example: `INP:MOD:IMP HIGH`
the EXT MOD input is set to > 100 kOhm to ground.

*RST value	Resolution	SCPI
600	-	Device-specific

Contents of User Documentation for the Vector Signal Generator R&S SMBV100A

The user documentation describes the Vector Signal Generator R&S SMBV100A and all options. It includes a printed Quick Start Guide and a CD-ROM with the complete operating and service manual in printable pdf-format.
The R&S SMBV is equipped with a context-sensitive online help that offers a help page for each instrument function.

Quick Start Guide



The present quick start guide describes everything that is needed to put the instrument into operation and to get familiar with the generator. The quick start guide gives an introduction to remote control and manual control via external monitor, mouse and keyboard.

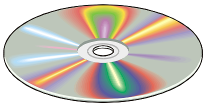
The quick start guide is subdivided into the data sheet, 3 chapters and index:

The data sheet	informs about specifications and characteristics of the instrument.
Chapter 1	Describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the instrument into operation.
Chapter 2	Gives an introduction the operating concept and typical applications of the R&S SMBV.
Chapter 3	Describes key operating modes, the structure of the graphical interface and the principles of manual control.
Index	Contains an index of the quick start guide.

Help System

The help system is embedded in the instrument, offering quick, context-sensitive reference to the information needed for operation and programming. The help contains the complete user documentation for the R&S Signal Generator including the contents of the present quick start guide.
The help files (*.chm) are also available on the CD-ROM and can be used as a standalone help.

Documentation CD-ROM

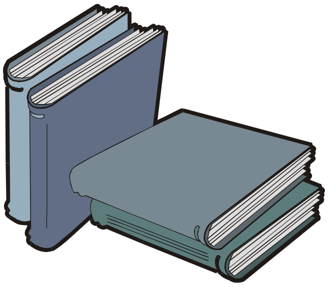


The CD-ROM provides the complete user documentation for the Signal Generator:

- The online help system (*.chm).
- The complete operating manual and service manual in printable form (*.pdf).
- The data sheet (brochure and specifications) in printable form.
- Links to different useful sites in the R&S internet.

Note: *Please use the ADOBE® Acrobat® Reader for PDF files and the browser Internet Explorer® ≥ 4.0 for the HTML help.*

Optional Documentation



The printed version of the operating and service manual provides the contents of the quick start manual plus the complete reference and the service information for the Signal Generator. This manual can be ordered as an option (stock no. 1407.6062.32 (English - A4 format) or 1407.6062.39 (English - letter format)); see ordering information in the data sheet.

Note: *The CD-ROM contains the *.pdf version of the manuals.*

Operating Manual

The operating manual contains comprehensive information about the instrument functions and remote control, in addition to the chapters of the quick start guide. It includes information about maintenance of the instrument and about error detection listing the error messages which may be output by the instrument. It is subdivided into 10 chapters:

The data sheet informs about specifications and characteristics of the instrument.

Chapter 1 Describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the instrument into operation.

Chapter 2 Gives an introduction to the operating concept and typical applications of the R&S SMBV.

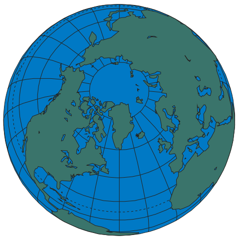
Chapter 3 Describes key operating modes, the structure of the graphical interface and the principles of manual control.

Chapter 4	Forms a reference for manual control of the R&S SMBV and contains a detailed description of all instrument functions and their application. The chapter also lists the remote control command corresponding to each instrument function.
Chapter 5	Describes the basics for programming the R&S SMBV, command processing and the status reporting system.
Chapter 6	Lists all the remote-control commands defined for the instrument.
Chapter 7	-
Chapter 8	Describes preventive maintenance and the characteristics of the instrument's interfaces.
Chapter 9	Gives the status messages and a list of error messages that the R&S SMBV may generate.
Index	Contains an index of the operating manual.
Annex	Lists the remote-control commands in alphabetical order. Contains the description of the Digital Standards supported by the R&S SMBV.

Service Manual Instrument

The service manual - instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for the maintenance of R&S SMBV by exchanging modules. In addition it describes how to perform a firmware update and how to install options.

Internet Site



The Rohde & Schwarz internet site: http://www2.rohde-schwarz.com/product/smbv100A.html provides the most up to date information on the R&S SMBV. Additonally firmware updates including the associated release notes, instrument drivers current data sheets and application notes are provided for download on the internet site.

The current operating manual at a time is available as printable PDF file in the download area.

Contents - Chapter 1 "Putting into Operation"

1Putting into Operation

Introduction - Putting into Operation

Chapter 1,"Putting into Operation" explains the control elements and connectors of the Vector Signal Generator R&S SMBV with the aid of the front and rear views and describes how to put the instrument into operation. It also describes the connection of peripherals such as keyboard or mouse. A detailed description of the device interfaces is given in Chapter 8, "Maintenance and Remote Control Interfaces". Specifications of interfaces can be seen in the data sheet.

Chapter 2, "Getting Started" gives an overview of generator functions and introduces the operating concept. Detailed operating instructions and an overview of menus follow in chapter 3, "Manual Operation".

Menus and instrument functions including the associated remote control commands are described in detail in chapter 4, "Instrument Functions", basics of remote control of the instrument in chapter 5, "Remote Control - Basics" and commands for remote control in the respective chapter 6, "Remote Control - Commands". chapter 9, "Error Messages" contains a list of possible status and error messages.

Legend for Front Panel View

This section gives an overview of control elements and connectors on the front panel of the R&S SMBV. Each element/connector is briefly described and a reference is given to the chapters containing detailed information.

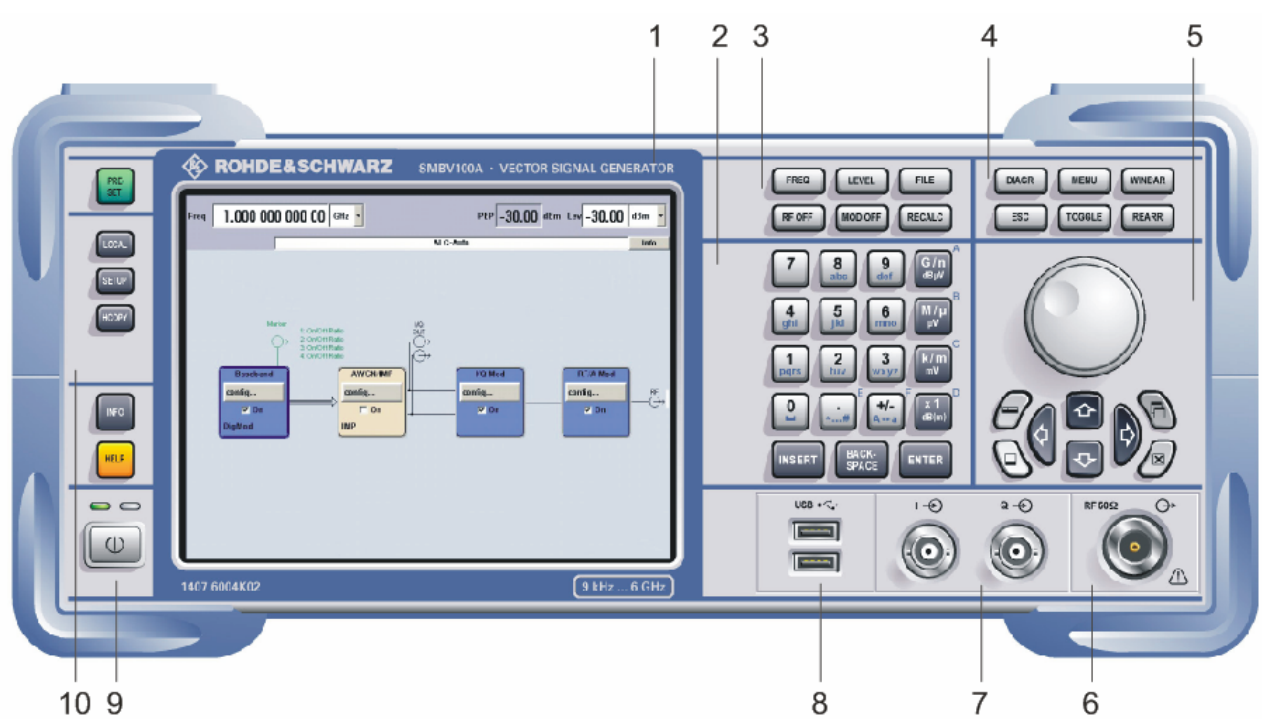
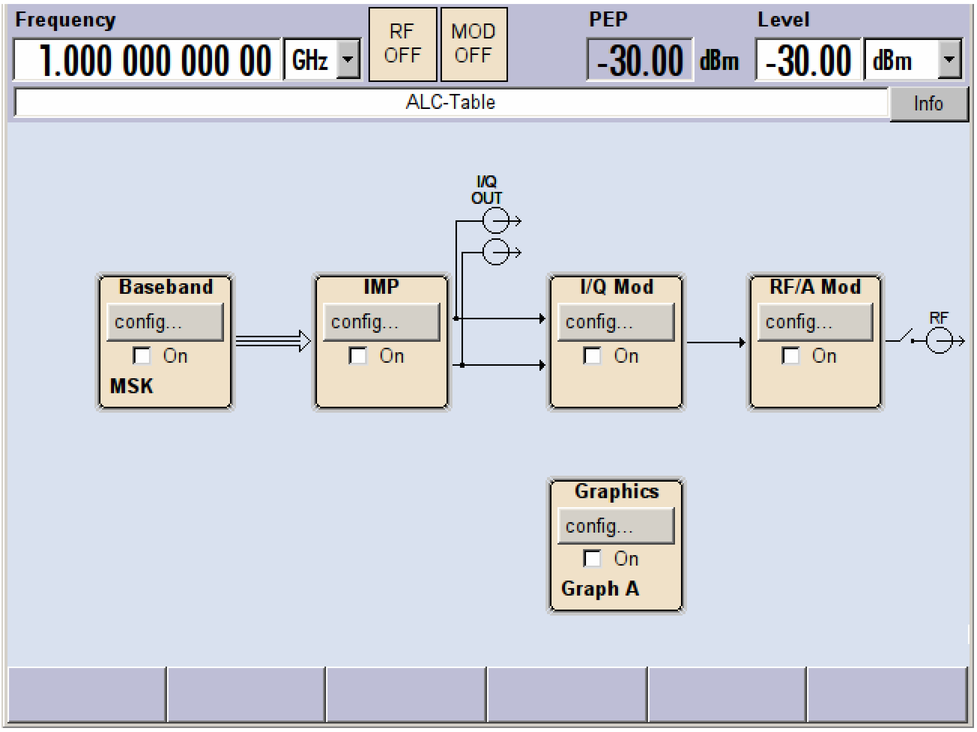


Figure 1-1 Front panel view

1 Display



The display shows all main settings and states of the signal generator (see also chapter 3, section Display, on page 3.7).

The display is divided into three sections:

- the **Status bar** with the main system parameters, frquency and level display section and an info line.
- the **Block diagram** with the current configuration.
- the **Winbar** with labelled buttons for menu display.

Status bar

The Staus bar frequency and level display section with info line shows:

- Frequency and level settings containing offset and peak envelope power (PEP)
- Status messages
- Brief error messages (detailed information for a message can be called with the [INFO] key)

(see also chapter 3, section Display, on page 3.7).

Block Diagram

The **block diagram** shows the current configuration and the signal flow in the generator with the aid of function blocks containing an on/off switch. Clicking the function block opens a list of associated setting menus. Active menus, info windows and graphs are displayed on top of the block diagram. The block diagram can be displayed in the foreground anytime with the [DIAGRAM] key.

(see also chapter 3, section Display, on page 3.7).

Winbar

In addition the **Winbar** can be called with the WINBAR key. The **Winbar** indicates open menus by a labelled button. When a button is clicked using the rotary knob, the associated menu is displayed either in the foreground or minimized in the Winbar. Pressing the WINBAR key toggels between the active menus.

(see also chapter 3, section Display, on page 3.7).

2 Keypad for data entry

Numeric and alphanumeric keys

0...9

Entry of numeric values

.

Entry of decimal point

+/–

Entry of sign

abc

Entry of letters

–

Entry of a space

***... #**

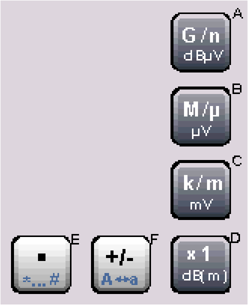
Entry of special characters

A ↔ a

Switchover between uppercase and lowercase letters

See chapter 3, section Setting Parameters, on page 3.16.

A, B, C, D, E, F



A, B, C, D, E, F

Entry of hexadecimal values. The letters assigned to the keys are automatically active when an entry field with a hexadecimal value is active.

See chapter 3, section Setting Parameters, on page 3.16.

Insert, Back Space, Enter

INSERT

Toggels between insert and overwrite mode.

BACKSPACE

Deletes the character to the left of the cursor.

ENTER

- Calls the next menu level.
- Activates the editing mode for highlighted numeric and alphanumeric parameters.
- Terminates a data entry; the new value is set. In case of numeric parameters, the unit indicated next to the value in the menu applies.
- Switches highlighted status parameters on and off (on/off state).
- Confirms (OK) and closes message windows.

See chapter 3, section Setting Parameters, on page 3.16.

Unit Keys

The unit keys can either select a unit and thus determine the absolute value, or change the unit, i.e. trigger a recalculation without changing the absolute value. Their function depends on the time at which they are pressed during parameter entry:

Selecting the unit

If a unit key is pressed immediately after a numeric value has been entered, it terminates the entry and determines the multiplication factor for the respective basic unit (e.g. the k/m key determines the unit kHz after frequency entry).
If a level value is entered, the unit keys are directly labelled with the units they select. The level entry must be active in this case, e.g. by pressing the LEVEL key.

Changing the unit

If a numeric entry is terminated with ENTER (e.g. by clicking the rotary knob) and not with a unit key, the unit displayed in the unit field of the parameter in the menu is assigned. If the unit key is pressed later, the unit is changed but not the value. The value is recalculated to suit the new unit (e.g. the display changes from 1000 to 1 when the Hz is changed to kHz). The new unit is then indicated in the value field of the menu.

See chapter 3, section "Selecting a Unit - Setting Parameters".

Assignment

G/n	dBµV	giga/nano, dBµV for RF levels, dBu for LF levels
M/µ	µV	mega/micro, µV for levels
k/m	mV	kilo/milli, mV for levels
x1	dB(m)	basic unit dBm for levels dB for level offset and level step width same function as ENTER key for unit-free values

3 Keys for setting parameters

See chapter 3, "Setting Parameters" on page 3.16, and chapter 4,section "RF Signal and Analog Mod - A Mod-RF A"

FREQ

Activates frequency entry.

RF OFF

Switches the RF signal an and off.
RF OFF is displayed in the header next to the **Frequency** field.

LEVEL

Activates level entry.

MOD OFF

Switches the modulations on and off.
MOD OFF is displayed in the info line of the header next to the **Level** field.

FILE

Activates the menu for storing or loading files.

RECALC

Starts the recalculation of instrument settings. If time-consuming calculations are required, the active modulation is automatically switched off and the calculation is interrupted to allow the user to make further settings. Calculation is restarted by a keystroke and the modulation is switched on again after the calculation is completed.

4 Keys for settings and navigation in the display

DIAGRAM

Brings the block diagram to the foreground. Active menus are minimized. Active menus are indicated by the buttons in the winbar bar.

ESC

Calls the next higher selection level. This opens up the following functions:

- Closes the active menu if the cursor is in the top-level menu (parameter selection).
  If settings in this menu require acknowledgement by means of an **Accept** button, a query is displayed asking whether the changes made should be cancelled.
- Switches between different entry fields of a menu.
- Quits the editing mode and restores the previous value. This function is only available in the editing mode, i.e. only before an entry is confirmed or selected with Enter.
- Cancels queries in message windows.
- Shifts the entry cursor from the frequency or level display to the previously active menu, or to the previously highlighted block in the block diagram if no menu is active.

MENU

Calls the menu tree.

TOGGLE

- Switches highlighted elements or a function block on and off.
- Switches between two or more settings, e.g. items of selection lists. At the end of a list, the cursor is set on the first entry again.

REARR

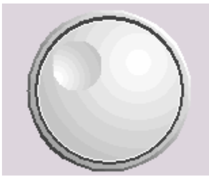
Adjusts the size of the active menu to use the whole hight of the dislay.

WINBAR

Toggles between the active menus.

See chapter 3, section "Setting Parameters", on page 3.16.

5 Rotary Knob, arrow keys and keys for setting the display



Rotary knob

- Varies the value at a cursor position. For frequency and level entry, a fixed step width can be set and activated for the variation.
- Moves the entry cursor in the block diagram or menu.
- Moves the cursor in tables and selection lists.
- Clicking on the rotary knob (= Enter). terminates entries. In this case the entry mode is terminated and the value set.

See chapter 3, section "Setting Parameters", on page 3.16.

Arrow keys

- Vary the entry value.
- Highlight a selected list item in the editing mode.
- Highlight parameters in menus and tables (up/down).

- Move the cursor in the entry fields (editing mode).
- Highlight parameters in menus and tables (left/right).

CLOSE

Calls the next higher selection level. This opens up the following functions:

- Closes the active menu if the cursor is in the top-level menu (parameter selection).
- Switches between different entry fields of a menu.
- Quits the editing mode and restores the previous value. This function is only available in the editing mode, i.e. only before an entry is confirmed or selected with Enter.
- Cancels queries in message windows.
- Shifts the entry cursor from the frequency or level display to the previously active menu, or to the previously highlighted block in the block diagram if no menu is active.

See chapter 3, section "Setting Parameters", on page 3.16.

HIDE

Minimizes the active open menu. The associated button in the Winbar remains visible.

REARR

Has the same function as the REARR key, i.e. adjusts the size of the active menu to use the whole hight of the dislay.

WINBAR

Has the same function as the WINBAR key, i.e. toggles between the active menus.

6 RF output

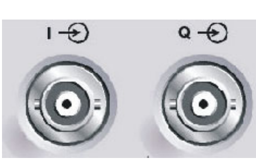
Output for RF signal.

See data sheet and chapter 4, section "RF Signal"

NOTICE **Maximum Input Levels**

Do not overload the RF output. The maximum permissible back-feed is specified in the data sheet.

7 Analog Input and output



I

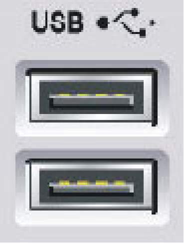
Input for external analog modulation signal in case of I/Q modulation.

Q

Input for external analog modulation signal in case of I/Q modulation.

See data sheet and chapter 4, sections "Data and Signal Sources in Baseband", "Baseband Input Settings Menu".

8 Female USB connectors type A



USB (universal serial bus) interfaces of type A (host USB).

- Connection of peripherals such as mouse or keyboard
- Connection of memory stick for file transmission
- Firmware update

Note:

Another USB interface type A (host USB) and a USB interface type B (device USB for data transmissionand remote control) are available on the rear panel.

See chapter 1, section "Connecting an External Keyboard and Mouse" and chapter 8, section "USB Connection (USB and USB IN)".

9 Switch

The on/off switch switches the instrument from the standby mode to the operating state provided the power switch on the instrument rear is switched on.

- The yellow LED (right) is on in the standby mode.
- The green LED (left) is on when the instrument is ready for operation.

See chapter 1, section "Switching On", on page 1.21.

CAUTION

Danger of shock hazard!

The instrument is still power supplied while it is in standby mode.

10 Keys for general instrument settings

PRESET

Sets the instrument to a defined state.

LOCAL

Switches from REMOTE control to LOCAL (manual) control.

SETUP

Opens the setup menu for configuring presetting.

HCOPY

Opens the print menu for configuring and starting printing.

INFO

Activates the display of status messages, error messages and warnings.

HELP

Activates the context-sensitive help display.

See chapter 4, section "General Instrument Settings"

Legend for Rear Panel View

This section gives an overview of connectors on the rear panel of the R&S SMBV. Each connector is briefly described and a reference is given to the chapters containing detailed information. For technical data of the connectors refer to the data sheet.

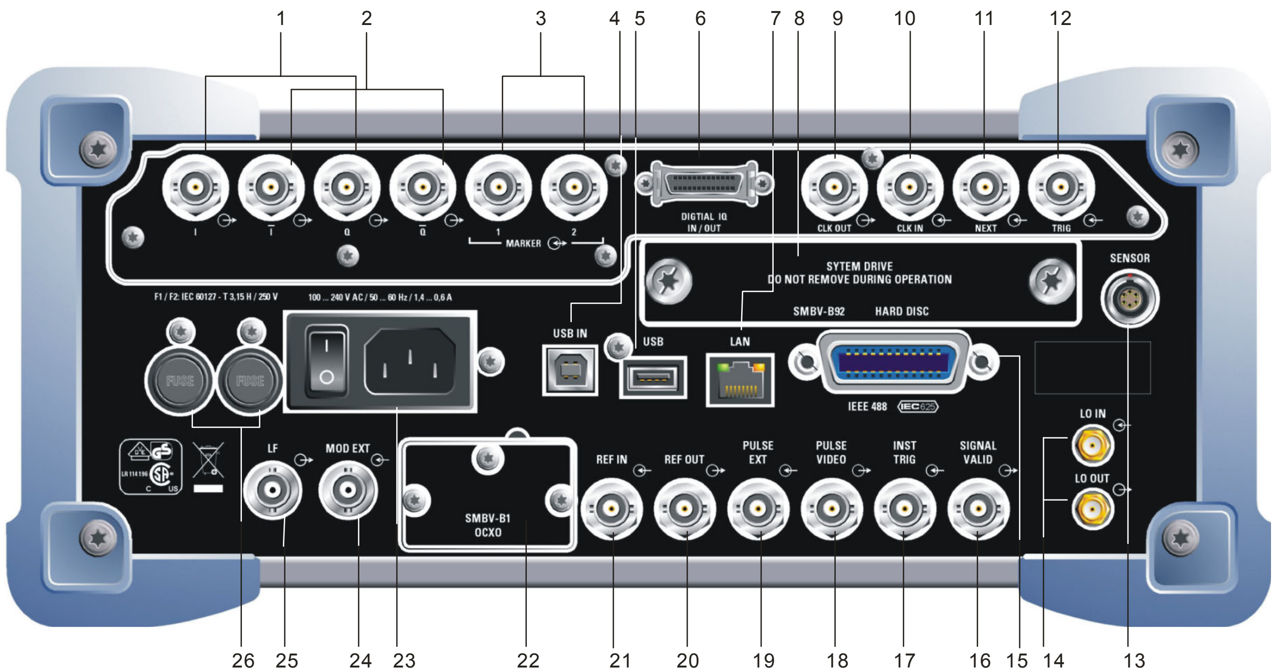
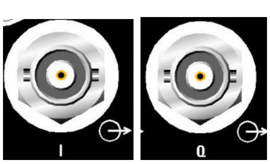


Figure 1-2 Front panel view

1 I/Q signal output

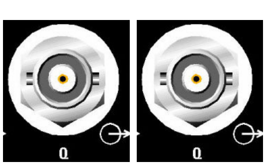


I OUT / Q OUT

Direct output or Differential (non-inverting) output for analog I/Q signal.

See data sheet and chapter 4, section "Impairment of Digital I/Q Signal".

2 Differential I/Q signal output

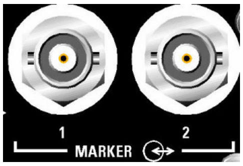


I OUT BAR / Q OUT BAR

Differential (inverting) output for analog I/Q signal).

See data sheet and chapter 4, section "Differential Outputs".

3 Marker inputs



MARKER 1, 2

Outputs 1 and 2 for triggering and control of external devices with user-definable marker signals.

See data sheet and chapter 4, section "Global Trigger/Clock/Input Settings – Setup - Environment".

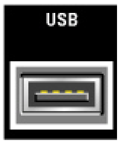
4 USB interface type B

USB IN

USB (universal serial bus) interface of type B (device) for remote control of signal generator.

See chapter 8, section "USB Connection (USB and USB IN)".

5 USB connectors type A



USB.

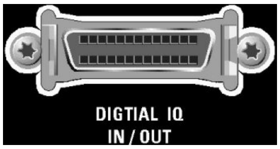
USB (universal serial bus) interfaces of type A (host).

- Connection of peripherals such as mouse and keyboard
- Connection of memory stick for firmware update

Note:
Further USB interfaces of type A are on the front panel.

See chapter 1, section "Connecting an External Keyboard and Mouse" and chapter 8, section "USB Connection (USB and USB IN)".

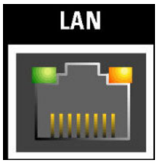
6 Digital interface IQ input and output



Digital IQ IN/OUT

Connector for the input/output of a digital I/Q signal from/to an R&S EX-IQ-Box.
The cable used for the connection between the R&S SMBV and the R&S EX-IQ-Box is provided with the R&S EX-IQ-Box delivery.

7 LAN interface



LAN - Ethernet interface

Ethernet interface
- Remote control of signal generator
- Remote access to graphical user interface of signal generator.

See data sheet and chapter 1, section "Connecting the R&S SMBV to a Network (LAN), on page 1.26", chapter 8, section "LAN Connector" and chapter 5, section "Remote Control via LAN Interface".

8 Hard disc

Removable hard disk.

With respect to security concerns the hard disk can be removed from the instrument, but it is bound to the specific R&S SMBV100A. Therefore it cannot be changed between different instruments.

NOTICE **Risk of instrument damage and data loss!**
During operation the instrument is accessing the hard disk. Removing the hard disk while operating will lead to data loss or even instrument damage.

Do not remove the hard disk during operation.

9 Clock signal output

CLOCK OUT

Output for internal (symbol) clock signal. While working in synchronous master-slave mode, the system clock is output on this connector.

See data sheet and chapter 4, section "Data and Signal Sources in Baseband" and "Digital Modulation".

10 Clock signal input

CLOCK IN

Input for the external (symbol) clock signal for synchronizing the external data signal and working in synchronous master-slave mode.

See data sheet and chapter 4, section "Data and Signal Sources in Baseband" and "Digital Modulation".

11 Next

NEXT

This trigger input indicates the next (i.e. the 2nd, 3rd, 4th, ...) segment of a multi segment waveform, which can be a compound of e.g. a sine, a rectangular, and a sawtooth signal.

See data sheet and chapter 4, section "Arbitrary Waveform Generator ARB"

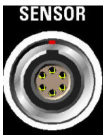
12 Trigger input

TRIGGER

Input for external triggering of digital modulations, standards, ARB and the external trigger in synchronous master-slave mode.

See data sheet and chapter 4, section "Global Trigger/Clock/Input Settings - Setup - Environment".

13 Connector for sensor

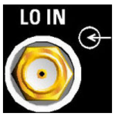


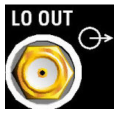
Connector for R&S NRP-Zxx sensors.

With the aid of the **User Correction** function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables.
The power sensors are connected by inserting the male connector. To disconnect hold the connector by its sleeve. Pulling on the sensor cable will not release the sensor connector.

See data sheet and chapter 4, section "Power Sensors".

14 Input and output local oscillator





LO IN

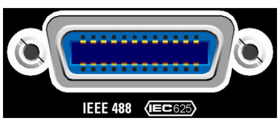
Input for external LO signals.

LO OUT

Output for internal LO signals.

See data sheet and chapter 4, section "Local Oscillator - LO Coupling"

15 IEC/IEEE-bus connector

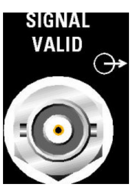


IEC 625/IEEE 488

IEC-bus (IEEE 488) interface for remote control of the R&S SMBV.

See data sheet and chapter 8, section "IEC/IEEE Bus Interface".

16 Signal Valid



SIGNAL VALID

Output of valid signal. This signal marks the valid signal times (valid level and frequency indication). The signal is generated automatically.

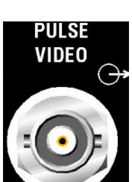
17 Instrument triggering

INST TRIG

Input for external trigger for sweeps and list mode.

See data sheet and chapter 4, sections "List Mode - List", and "Sweep Mode".

18 Output of pulse and video signal

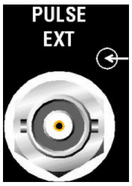


PULSE VIDEO

Output of internal pulse generator signal or external pulse signal fed in via the PULSE EXT connector (video signal).

See chapter 4, section "Pulse Modulation".

19 Input of external pulse signal

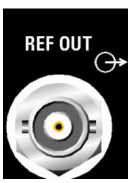


PULSE EXT

Input of external pulse signal or input of external trigger/gate signal for internal pulse generator.

See chapter 4, section "Pulse Modulation".

20 Reference signal output

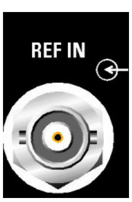


REF OUT

Output of internal 10 MHz reference signal.

See data sheet and chapter 4, section "RF Reference Frequency - Reference Oscillator".

21 Reference signal input



REF IN

Input for external 10 MHz reference signal.

See data sheet and chapter 4, section "RF Reference Frequency - Reference Oscillator".

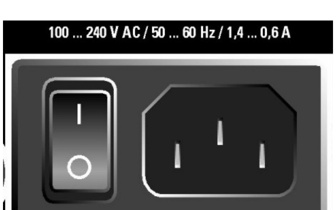
22 Oven-controlled reference oscillator (option R&S SMBV-B1)

OCXO

This option (option R&S SMBV-B1) generates a very precise 10 MHz reference signal. It needs some minutes of warm-up time to reach its nominal frequency.

See data sheet.

23 AC supply



AC supply connector.

When the R&S SMBV is connected to the AC supply, it automatically sets itself to the correct range for the applied voltage (range: see type label). There is no need to set the voltage manually or change fuses.

See chapter 1, section "Connecting the R&S SMBV to the AC Supply" and data sheet.

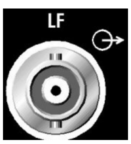
24 Input for external analog modulation signal

EXT MOD

Input for external analog modulation signals (amplitude, frequency and phase modulation).

See data sheet and chapter 4, section "Modulation Sources".

25 LF output

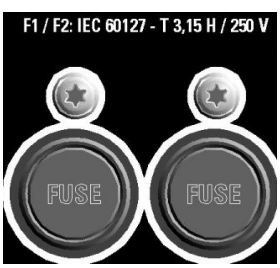


LF

Output for internal modulation generator signal.

See chapter 4, section "LF Generator and LF Output - LF Output" and data sheet.

26 Fuses



Fuses

The R&S SMBV is fully fused by two fuses IEC127-T3.15H/250 V.

See chapter 1, section *"Power Fuses"* and data sheet

Putting into Operation

The following section describes the procedure for putting the instrument into operation. It contains general safety instructions for instrument operation.
The installation of options and the firmware update are described in chapter 4 of the Service Manual (supplied with the instrument on the CD-ROM).

Unpacking the Instrument

- Remove the instrument from its packaging and check the equipment for completeness using the delivery note and the accessory lists for the separate items.
- First, pull off the polyethylene protection pads from the instrument's rear feet and then carefully remove the pads from the instrument handles at the front.
- Pull off the corrugated cardboard cover that protects the rear of the instrument.
- Carefully unthread the corrugated cardboard cover at the front that protects the instrument handles and remove it.
- 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 order to prevent control elements and connectors from being damaged in case the instrument is to be transported or shipped at a later date.

Setting up the Instrument or Installing it in a 19" Rack

The instrument is designed for indoors use. It can either be set up independently or mounted in a 19" rack. A rack adapter (refer to data sheet for Order No.) is required for installation in a 19" rack. The mounting instructions are supplied with the adapter. With options R&S SMBV-B81 (Rear Panel Connectors, factory-fitted) the front panel inputs are relocated to the rear panel.

NOTICE **Risk of overheating!**

To less airflow for cooling may cause overheating of the instrument.
Prior to putting the instrument into operation always check for space between the ventilation holes and the rack casing to get sufficient air supply in the rack

Safety Instructions

General Precautions

NOTICE

Instrument damage caused by disregarding the following precautions!

Any non-compliance with the following precautions may cause damage to the instrument. Prior to putting the instrument into operation, check the following:

- The covers of the housing are in place and screwed on.
- Vents are not obstructed. 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 signal levels at the inputs do not exceed permissible limits.
- The outputs of the instrument are not overloaded or incorrectly connected. This particularly applies to the maximum permissible back-feed at the outputs, which is specified in the data sheet
- 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.

Also observe the instructions in the following sections and the general safety instructions at the beginning of this manual.

Protection against Electrostatics

Risk of instrument damage caused by electrostatic discharge!

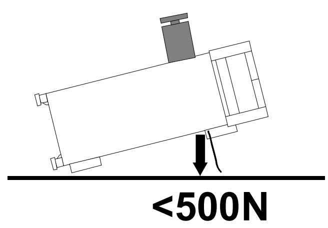
To avoid damaging the electronic components of the EUT due to electrostatic discharge produced by contact, the use of appropriate protective measures is recommended.

Setting up the Instrument

CAUTION

Safe operation with support feet!

- Stacked **instruments** may slip off.
  Secure stacked instruments against slipping (e.g. by locking the feet to the top of the front-panel frame).
  The feet must be fully folded in or folded out. Only then a stable position of the instrument and reliable operation can be ensured. The uniform pressure on the folded-out feet must not exceed 500 N (weight of instrument and of equipment stacked on top).
- When the instrument with expanded feet, the feet might collapse and fold in.
  Do not shift the instrument with the feet out.



EMC Safety Precautions

To avoid electromagnetic interference, only suitable, shielded signal and control cables must be used (see recommended extras).

Cleaning the Outside and Storing

What is necessary is essentially the cleaning of the instrument.

NOTICE

Instrument damage caused by cleaning agents!

Prior to cleaning, disconnect the product from the AC supply.

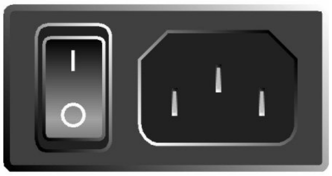
Cleaning agents contain substances that may damage the instrument, e.g. solvent-containing cleaning agents may damage the front panel labeling or plastic parts.

Never use chemical cleaning agents such as solvents (e.g. diluent for lacquers, thinners, acetone, alcohol, etc), or acids, bases, or other substances.
Use a soft, non-linting cloth to suitably clean the outside of the instrument.

Connecting the R&S SMBV to the AC Supply

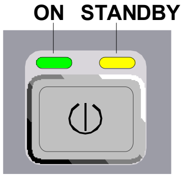
The R&S SMBV is automatically matched to the applied AC voltage (see rear panel). There is no need to set the voltage manually or change fuses. The AC supply connector is at the rear of the unit (see below).

Switching On



- Connect the signal generator to the AC supply by means of the supplied power cable.
  Since the instrument is designed in line with protection class EN61010-1, it may only be connected to an earthing contact type connector.
- Press the main power switch at the rear of the instrument to position I.
- After power-up the instrument is either ready for operation (STANDBY) or in operating mode, depending on the position of the ON/STANDBY switch on the instrument front (see below).

Note:
The power switch may remain on for any period of time. Switching off is required only if the instrument should be completely isolated from the AC supply.



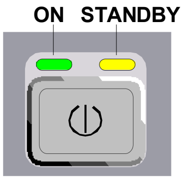
- Press the ON/STANDBY switch on the front panel; the green LED must be on.
- The instrument is ready for operation. All modules in the instrument are supplied with power.

Start Display and Booting the R&S SMBV

After instrument switch-on, the Linux operating system boots first and then the instrument firmware. During booting of the instrument firmware, a selftest is performed. After booting is completed, the block diagram of the signal generator is displayed and the instrument is ready to be operated. The settings that were active before the last switch-off are established unless another start setting has explicitly been selected in the **File** menu.

Note:
If the software stops unexpectedly, the instrument can be rebooted by pressing the STANDBY key for approx. 5 s.

Switching Off

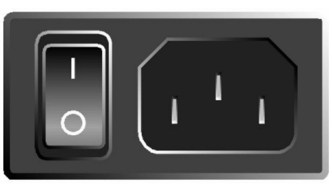


- Press the **ON/STANDBY** switch on the front panel.
- The R&S SMBV stores the current setting before it shuts down the Linux operating system. Then the AC supply is switched to the **standby** mode.
- Only the AC supply is powered.
- The yellow LED must be on.

CAUTION

Danger of shock hazard!
The instrument is still power-supplied while it is in standby mode.

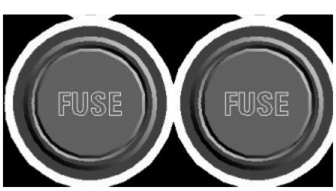
Do the following only if the instrument is completely disconnected from the AC supply:



- Press the main power switch at the rear of the instrument to position **0**. None of the front-panel LEDs should be on.

Note:
*It is recommended to switch the instrument to **standby mode** before completely disconnecting it from the AC supply. If the power switch is set to 0 before the instrument is switched to the standby mode, all current settings are lost.*

Power Fuses



The R&S SMBV is fully fused by two fuses IEC127-T3.15H/250 V. The fuses are accommodated in the fuse holders next to the power connector. Use only fuses of the mentioned type.

CAUTION

Danger of shock hazard!
Before replacing the fuses, disconnect the power cord from the R&S SMBV.

Function Check

The signal generator automatically monitors the main functions when the instrument is switched on and continuously during operation.
If a fault is detected, ERROR is displayed in the info line together with a brief error description.
For in-depth identification of the error, press the INFO key. In response, a description of the error(s) is displayed (see chapter 9, "Error Messages").
Besides automatic monitoring of instrument functions, other capabilities in the R&S SMBV ensure correct functioning of the vector signal generator.

- **Internal Adjustments**
  Adjustments can be performed in the **Setup-System-Internal Adjustments** menu. Thus optimal modulation performance can be obtained, for instance.
- **Selftests**
  If required, selftests can be performed. See also chapter 4, section "Selftests - Setup-Test" in the instrument's Service Manual.
- **Test points**
  Internal test points can be queried by the user and the results can be displayed. See chapter 4, section "Test Point... - Setup-Test".

Default Settings

The PRESET key calls up a defined instrument setup. All parameters and switching states are preset, including those of inactive operating modes. The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed, e.g. IEC/IEEE bus address or reference oscillator source settings.

Note:
*Resetting the instrument to the factory state is possible in the **Factory Preset - Setup Settings** menu of the menu.*

Remote-control command：
`*RST`
In addition, only those settings associated with the menu can be reset directly in the individual menus, e.g. all digital modulation settings in the **Custom Digital Mod** menu. These settings are identical to those which are called up using the PRESET key.
When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched on. An exeption is the state of the RF output. The state of the RF output power-on state can be set to be always off in the **EMF** menu of the RF block.
User-defined instrument states can be stored and called up in the **File** menu.
The following table gives an overview of the presets for the most important generator settings. The other presets can be found in the preset tables of the individual dialogs and the information accompanying the IEC/IEEE-bus commands.
The list below the table shows the settings that are not affected by the PRESET key.

Table 1-1 Preset state - important generator settings

Settings	**Preset Value**
RF frequency	1 GHz
RF level	RF output switched off
Offsets	0
Modulations	Switched off
Uninterrupted level setting	Switch off; level attenuator mode: AUTO
Internal level control	Level ALC: AUTO
User correction	Level Ucor: OFF
LF output	Switched off
Sweep	Switched off
List mode	Switched off

Settings that are not affected by the PRESET key:
- Reference frequency settings (Ref Oscillator menu)
- Power on settings (Level/EMF menu)
- Network settings (Setup menu)
- IEC/IEEE-bus address (Setup menu)
- *IDN? identification (Setup menu)
- Password and settings protected by passwords (Setup menu)
- Start/Stop Gui Update (Setup menu)
- Display and keyboard settings (Setup menu).

Linux Operating System

NOTICE	**Possible impairment of the functioning of the instrument** The instrument is equipped with the Linux operating system. It is thus possible to install commercial off-the-shelf (COTS) software in the instrument. The use and installation of COTS software may impair the instrument function. For this reason, we recommend that you only execute programs tested by Rohde&Schwarz with regard to their compatibility with the instrument software. The drivers and programs used in the instrument under Linux have been adapted to the test instrument. Existing instrument software must only be modified with update software released by Rohde & Schwarz.

The signal generator is equipped with the Linux operating system (please note statement at the back of the title page). The configuration of the operating system is optimally adapted to signal generator functions in the factory. Changes in the system setup are only required when peripherals like keyboard are installed or in the event that the network configuration does not comply with the default settings (see sections *"Connecting the R&S SMBV to a Network (LAN)"*).
After power-up of the signal generator, the operating system boots and the instrument firmware is started automatically. The operating system cannot be accessed. All necessary system settings can be made in the **Environment** section of the **Setup** menu.
The R&S SMBV provides an internal flash memory and a hard disk (R&S SMBV-B92). Both, the internal flash card and tha hard disk can be used to store data but the firmaware is always hold on the internal flash card. However, data transfer is only possible via a memory stick connected to a USB interface. The memory stick, the hard disk and the flash memory are accessed via the **File Manager**.

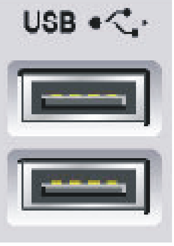
Screen saver:

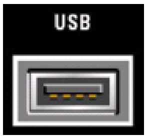
A screen saver is activated by default in the R&S SMBV. The display is shut off when no entries via front panel, external mouse or external keyboard are made for a period of time. The screen saver prolongs the life time of the display.
The screen saver can be switched off and on and the time period can be set in the **Environment** section of the **Setup** menu.

NOTICE	The **Environment** section also provides access to the passwords for securing a controlled access to the instrument. The default user password is "root". It is highly recommended to change this password (see section "General Instrument Settings - Security - Setup Environment").

Connecting an External Keyboard and Mouse

A commercial, external keyboard and mouse with USB interface can be connected to the R&S SMBV. A keyboard simplifies entry of list items, comments, file names, etc. A mouse simplifies control of the block diagram and of associated menus.
The keyboard and the mouse are connected to a USB interface, type A, on front or rear panel of the instrument.





(front panel) (rear panel)

The keyboard and mouse are recognized automatically when it is connected. The US keyboard assignment is the default setting. The keyboard assignment and special settings such as the refresh rate can be changed in the **Environment** section of the **Setup** menu.

Connecting the R&S SMBV to a Network (LAN)

The R&S SMBV is equipped with a network interface and can be connected to an Ethernet LAN (local area network).
Provided the appropriate rights have been assigned by the network administrator, the instrument can also be remote-controlled and remote-accessed in the network.
Remote-access means that the user can operate the R&S SMBV from any remote PC in the network using the VNC protocol. For instance, the user can control one or more R&S SMBVs from a desk that is part of a test assembly located in another section of the building.
A VNC client program for Windows operating systems is provided on the R&S SMBV CD-ROM (included in delivery). VNC client programs for other operating systems are available free-of-charge on the internet.

In addition, the instrument also supports two standard methods to access the file system form a remote client:

- FTP (file transfer protocol)
- File sharing according to the SAMBA/SMB (server message block) protocol.

Both methods allow the access to the folder /var/user/share.

For VNC remote-access, FTP and SAMBA file access the user "instrument" is used. The default password is also "instrument".

NOTICE It is highly recommended to change the default user and security passwords in the menu **Setup->Security** before connecting the instrument to the network (see section "Security - Setup Protection").

Remote-control of the instrument via the LAN interface is described in Chapter 5, section "Remote Control via LAN Interface".
The configuration of the R&S SMBV for networking is performed in the **Environment** section of the **Setup** menu.

Connection to the Network

NOTICE

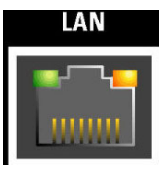
Risk of network errors!

Connecting errors may affect the entire network.

We recommend coordinating the connection of the instrument to the network with the network administrator.

Do not connect or disconnect the network cable until the instrument is **switched off** (standby). Only then the network connection can be reliably detected and impairments to instrument operation can be avoided.

LAN interface



(rear panel)

Connection

The instrument is connected to the LAN with the aid of a commercial RJ-45 cable suitable for a 10/100Mbps connection attached to the LAN interface at the rear of the instrument.
Connect the instrument to the LAN interface on the rear panel of the instrument.

Note:
The LAN interface is described in chapter 8, section "Maintenance and Interfaces".

Configuring the R&S SMBV for Network Operation

The network interface functions with 10/100Mbps Ethernet IEEE 802.3u. The TCP/IP network protocol and the associated network services are preconfigured.
For data exchange in a LAN, each connected PC or instrument must be accessible via an IP address or via an unambiguous computer name. In the **Environment-Network Settings** section of the **Setup** menu, three modes of assigning the IP address or computer name can be selected. The correct mode selection depends on the setup of the network.

Networks using DHCP

The R&S SMBV is preconfigured for networks using DHCP (dynamic host configuration protocol). In these networks, an available IP address is automatically assigned to the R&S SMBV. The R&S SMBV provides an unambiguous computer name in the network via the DHCP request. The DHCP server in the network must consider this name and pass it to the DNS server in order to ensure that the R&S SMBV can be addressed in the network.
Each R&S SMBV is assigned an individual computer name in the factory. This name can be queried and changed in **Environment-Network Settings** section of the **Setup** menu. The mode setting is Auto (DHCP).

Networks using fixed IP addresses

In networks using fixed IP addresses, the addresses are mostly assigned by the network administrator. A fixed IP address must be entered in the **Environment-Network Settings** section of the **Setup** menu (see "Identifying the R&S SMBV in the Network" below). The mode setting is Static.

Point-to-Point Connection

To build a simple network – just a LAN connection between the R&S SMBV and a controller without integration into a larger network – an IP address has to be assigned to the R&S SMBV and the controller. For such purposes, the IP addresses 192.168.xxx.yyy are available .The value range for xxx and yyy is 1...254, the value for the subnet mask is always 255.255.255.0. The gateway IP address must also be provided, however, it is without relevance. The mode setting is **Peer To Peer**.

Example:

On the PC:

1. Open the TCP/IP settings tab (network connection in the control panel)
2. Set fixed IP address (= deactivate DHCP)
3. Select IP address 192.168.0.1
4. Select subnet mask 255.255.255.0

On the signal generator:

1. Open the network setting panel in the Setup menu
2. Select IP address 192.168.0.2
3. Select subnet mask 255.255.255.0
4. Activate the setting

For this type of connection, a commercial cross-over RJ-45 cable is used.

Identifying the R&S SMBV in the Network

1. Open the **Setup** menu by pressing the Setup key
2. Click **Network Settings** menu in the **Environment** section.
3. Select the IP address mode and enter the network data in the respective fields of the menu. The data is provided by the network administrator. The Computer name is indicated in the **Hostname** field. The name can be changed.

Remote Access via an External Controller

The R&S SMBV can be remote-accessed from an external PC via a network link. This allows convenient operation of the vector signal generator from the desktop although the instrument is integrated in a rack somewhere else.

Remote access in contrast to **remote control** does not use remote-control commands but the regular user interface displayed using separate software which is installed on the external PC. The instrument can thus be manually operated from the PC as on the unit itself.

There are different ways to establish a remote access connection to the signal generator. The simplest way to remote access the signal generator is to use a Web browser, such as Windows Internet Explorer or Mozilla Firefox for instance. Alternatively a remote access via Ultra@VNC can be used. Precondition for remote access is a connection between signal generator and PC via a LAN network.
While using a remote access via Ultra@VNC, the VNC client software for setting up the connection is included in the Linux/Unix operating system per default. For Windows operating system, the free-of-charge software **Ultr@VNC** is provided on the R&S SMBV CD-ROM. VNC client programs for other operating systems are available free-of-charge on the internet.

After the connection is established, the signal generator screen with the block diagram is displayed on the external PC and the R&S SMBV can be manually remote-accessed from the external PC. The individual functions are operated using the mouse and keyboard. Specific instrument functions can be executed using specific key combinations on the keyboard or a front panel key emulation that can be operated with the mouse (see chapter 3, section "Legend of Front-Panel Controls", on page 3.43).
Installation of the software **Ultr@VNC** and establishing the connection between external PC and signal generator for Windows operating system is described in the following. Remote access via an external controller with Linux/Unix operating system is performed accordingly.

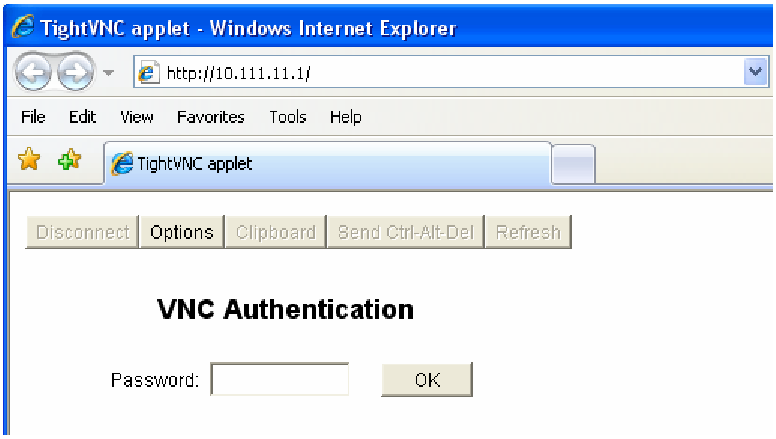
Using a Web Browser for Remote Access

Remote access via Web Browser to the signal generator is possible under the following conditions:

- The external PC with Linux/Unix or Windows operating system (Windows 95 or higher) is equipped with a LAN interface which is configured for the network.
- The signal generator and the PC are linked via a LAN.
- A Point-to-Point connection is established between the signal generator and the PC.
- Java Runtime Environment JRE has to be installed on the PC.
- A user-specific password for the **VNC** connection is defined on the R&S SMBV. The default password is "instrument"; it can be changed in the **Environment-Security** section of the **Setup** menu.

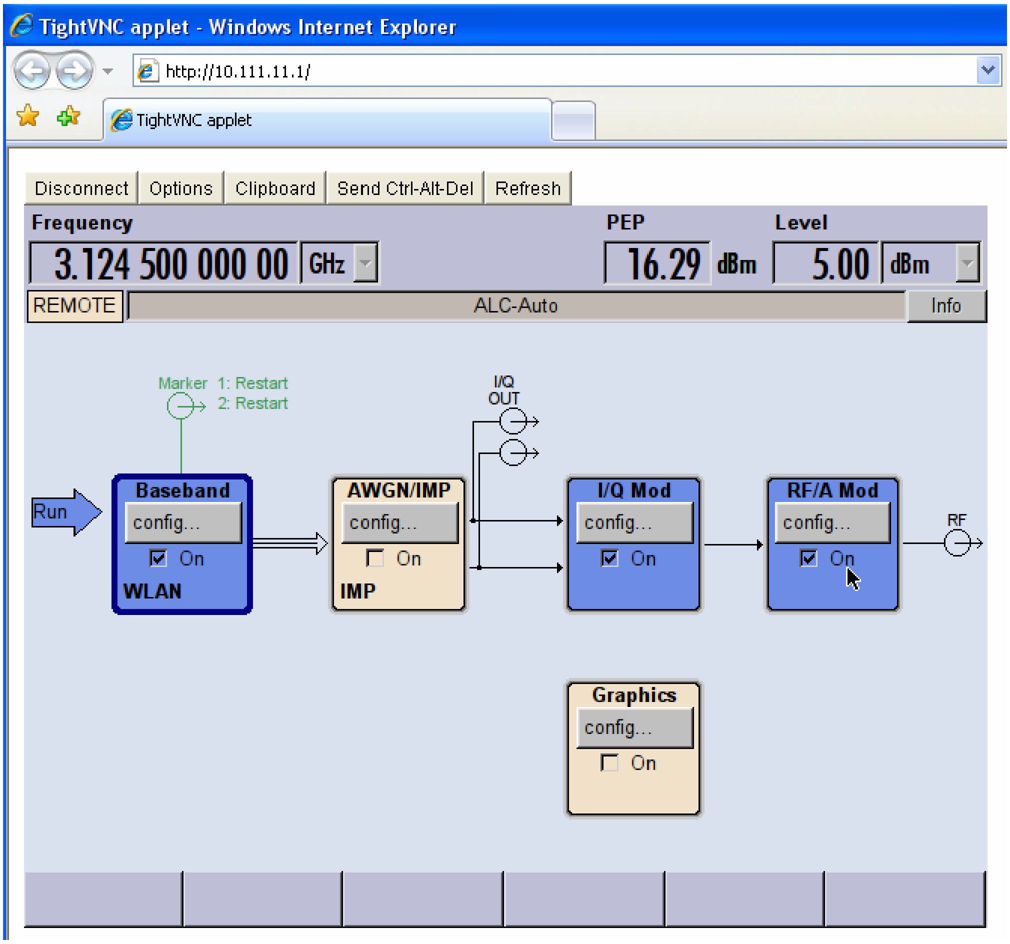
The instrument can be remote-accessed via any Web browser, like Windows Internet Explorer or Mozilla Firefox for instance.

1. Type the instruments' IP address in the address field of the Web browser on your PC, e.g. http://10.111.11.1
   The "VNC Authentication" screen appears.



2. Enter the password and select OK.
   The default password is "instrument".

After the connection is established, the current signal generator screen with the block diagram is displayed and the R&S SMBV can be remote-accessed from the external PC.



Configuration for Remote Access via Ultr@VNC

The instrument is operated with the aid of the program **Ultr@VNC**. It is available as a free-of-charge download on the internet for operating system Window XP (http://www.uvnc.com/download/index.html) and on the R&S SMBV CD-ROM.
Remote access of the signal generator is possible under the following conditions:

- The external PC with Linux/Unix or Windows operating system (Windows 95 or higher) is equipped with a LAN interface which is configured for the network.
- The signal generator and PC are linked via a LAN.
- A user-specific password for the **VNC** connection is defined on the R&S SMBV. The default password is "instrument"; it can be changed in the **Environment-Security** section of the **Setup** menu.
- The **Ultr@VNC Viewer** software is installed on the external PC (or any other VNC client)
  R&S SMBV IP address and the user-specific password for the **VNC** connection are entered in the **VNC Viewer** panel.

NOTICE	**Risk of unauthorized access!** After enabling the VNC connection, any user on the network who knows the password and IP address of the vector signal generator can access this R&S SMBV. Even after cutting it, the connection is still enabled and the R&S SMBV can be accessed any time. To disable the connection, the **VNC program on the R&S SMBV must be uninstalled or the VNC server service disabled**. To enhance security, also communication on the network via Ultr@VNC program should be disabled in the firewall.

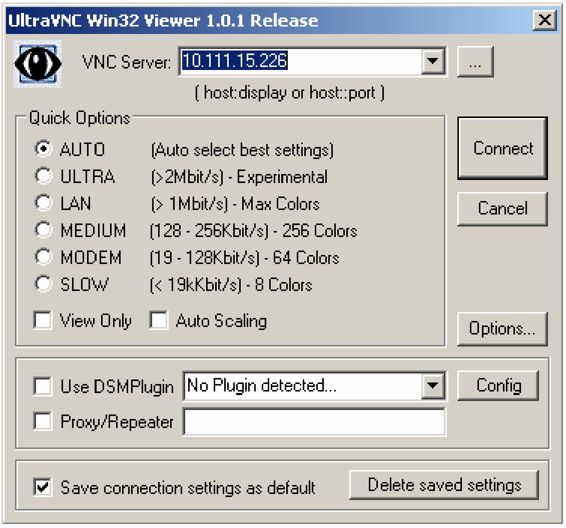
Install VNC Viewer and Establish VNC Connection on the Windows PC

The **Ultr@VNC** program is available on the R&S SMBV CD-ROM delivered with the instrumet. The **Ultr@VNC** program is also available on the Internet as a free-of-charge download.

Following the instructions on the Internet, the program can be copied onto the external Windows PC. Only the program component **VNC Viewer** is required.

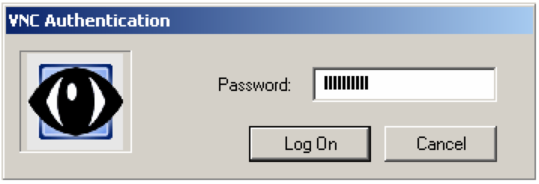
Note:
*The **VNC Viewer** program is included in the download for the installation of the Ultr@VNC program on the signal generator if **Full installation** was selected in the **Select Componen**t panel. In this case, the program ultr@vncviewer.exe can be copied to the Windows PC.*

1. Install **VNC Viewer** program component on the PC.
2. Start **VNC Viewer** program component on the PC.



3. Enter IP address of R&S SMBV in input line **VNC Server.**
4. Initialize the connection by pressing the **Connect** button.

   A message requesting the password appears.



5. Enter the **VNC** password defined in the **Default Local System Properties** panel of the **Ultr@VNC** program of R&S SMBV.

   The default password is "instrument".

   The connection is established when the **Log On** button is pressed.

After the connection is established, the current signal generator screen with the block diagram is displayed and the R&S SMBV can be remote-accessed from the external PC. The individual functions are operated using the mouse and keyboard. Specific instrument functions can be executed using specific key combinations on the keyboard (see table in chapter 3, section "Legend of Front-Panel Controls", on page 3.43).
Direct control on the R&S SMBV is possible while remote access is established; it can be performed alternately with the remote access.

Close Remote Access Connection via Ultr@VNC

The connection can be closed on the external PC by closing the VNC Viewer program.
Closing the connection does not disable it. It can be established again any time.

Contents - Chapter 2 "Getting Started"

2 Getting Started

Introduction - Getting Started

The main field of application of the R&S SMBV is the generation of digitally modulated signals. The R&S SMBV uses I/Q (vector) modulation. Digital data streams are converted to an I/Q baseband signal. The baseband signal is then D/A-converted and modulated onto the desired RF carrier frequency with the aid of an I/Q modulator.

The R&S SMBV provides an entirely digital baseband section for generating I/Q signals and an RF section with I/Q modulator.

The architecture of the R&S SMBV and the signal flow are shown in a block diagram on the R&S SMBV user interface. In the diagram, signal processing is performed from left to right (left: baseband signal generation, extreme right: RF output). The block diagram in the figure below shows a fully equipped R&S SMBV.

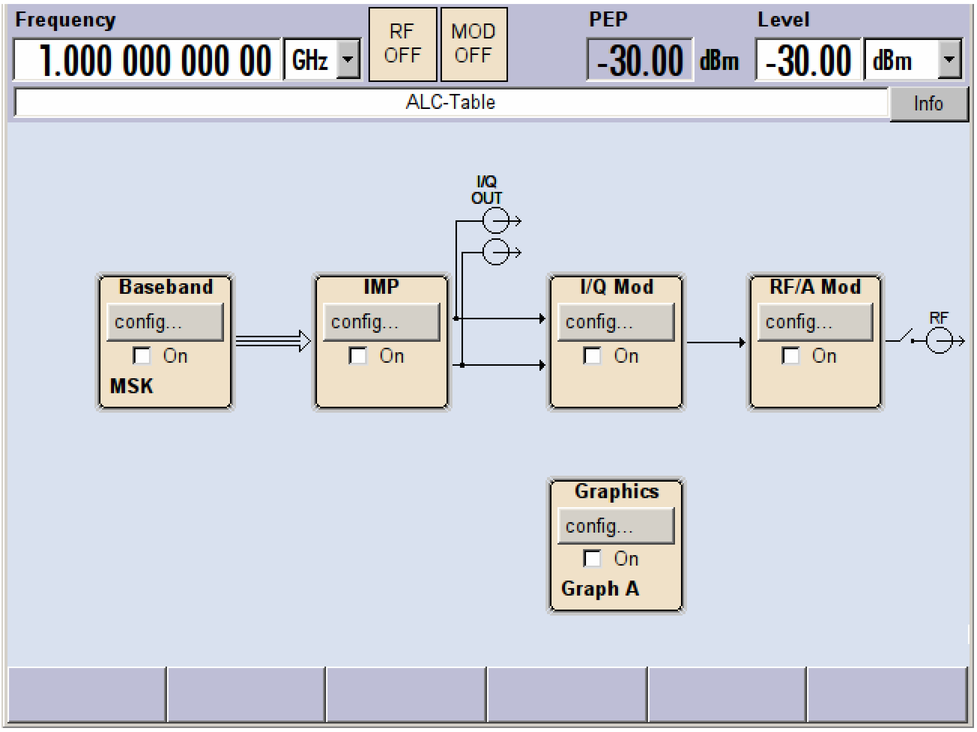


Fig. 2-1 Block diagram of a fully equipped R&S SMBV

In the R&S SMBV, a digitally modulated signal can be generated in several ways:

1. The I/Q signal is generated internally in the R&S SMBV. In this case the instrument must be equipped with a baseband generator (option R&S SMBV-B10 or B50/B51 ARB only).

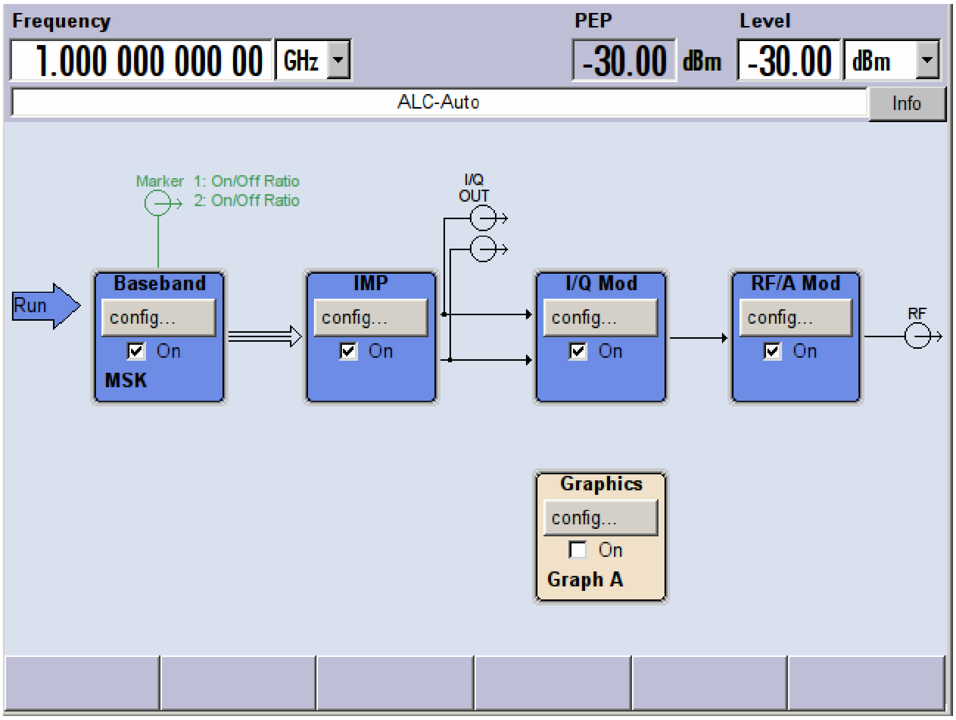


Fig. 2-2 Operation of R&S SMBV I/Q modulator with I/Q signals from the internal baseband section

2. An external analog I/Q signal is directly applied to the I/Q modulator of the R&S SMBV (Analog Wideband I/Q operation). In this mode, the entire bandwidth of the I/Q modulator can be utilized. The various capabilities of the baseband section (AWGN, addition of signals, etc) are disabled, however.

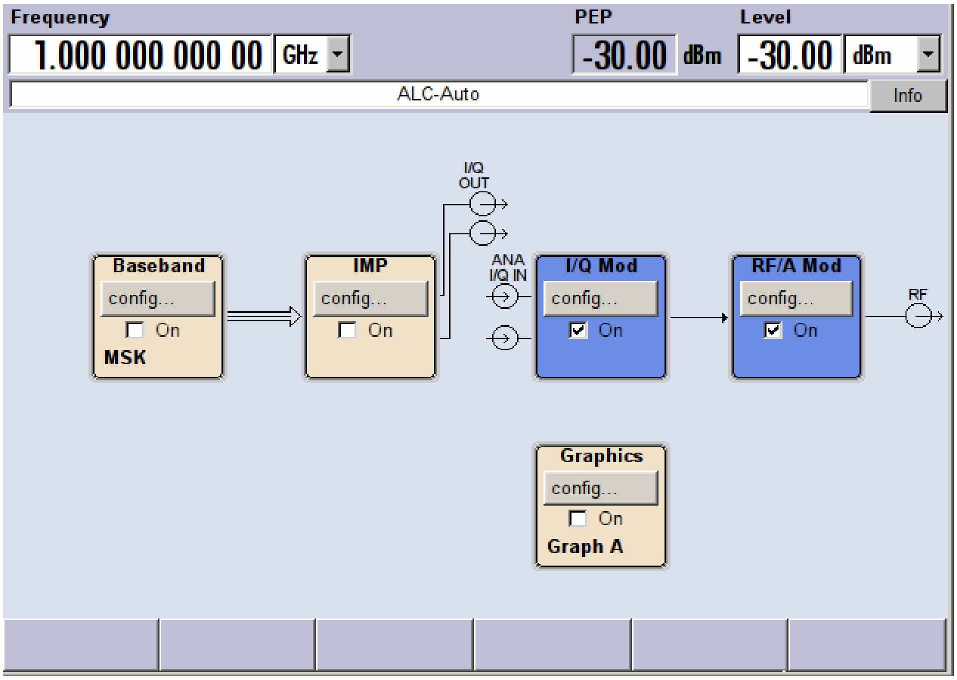


Fig. 2-3 Operation of R&S SMBV I/Q modulator with external analog I/Q signals directly applied to the I/Q modulator

Baseband Section of R&S SMBV

The baseband section of the R&S SMBV is fully digital and contains the hardware for generating and processing I/Q signals.

Baseband generator (option R&S SMBV-B10): The generator produces baseband signals. It contains modules for real time signal generation and an arbitrary waveform generator (ARB). Option R&S SMBV-B10 contains real time Custom Digital Modulation and ARB. Software options providing various digital standards are offered in addition. Option R&S SMBV-K40, for instance, generates signals to GSM/EDGE standard, option R&S SMBV-K42 signals to 3GPP FDD standard. For more detailed information on available options, refer to the R&S SMBV data sheet and the R&S SMBV Configuration guide (available at R&S SMBV homepage on the internet).

At the end of the baseband path, the digital signal isconverted to an analog I/Q signal. The analog I/Q signal is fed to the I/Q modulator of the RF path. The baseband module also routes signals to the analog I/Q outputs. This module is absolutely required for coupling out the baseband signal from the baseband section.
The baseband module also offers digital I/Q impairment functions. The I/Q signal can be deliberately corrupted, e.g. for testing the receiver quality.

Additional White Gaussian Noise (option R&S SMBV-K62):Additive white noise, which may be required for instance for measurements on mobile radio base stations, can be produced with the AWGN software option (R&S SMBV-K62).

RF Section of R&S SMBV

An RF path is configured by installing a frequency option that comprises all required modules. One of the following options can be installed:

R&S SMBV-B103	9 kHz to 3.2 GHz
R&S SMBV-B106	9 kHz to 6 GHz

Note:
One of these options must be installed.

For more detailed information on options, refer to the R&S SMBV data sheet and the R&S SMBV Configuration Guide (available on the R&S SMBV Homepage on the Internet; http://www.smbv100a.rohde-schwarz.com).

Description of Individual Diagram Blocks

Available Blocks

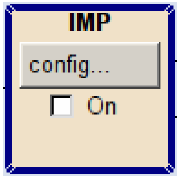
Block	Function of block	Status display in the block	Effect of TOGGLE key
Baseband	Baseband source is configured and activated	Selected modulation	Switches the selected modulation (digital standard, digital modulation or ARB) on or off.
AWGN/IMP	Additive white Gaussian noise production and digital impairments are activated	Active functions of block	Switches the active functions of the block on or off. The functions (AWGN, impairments or both) are activated in the respective menus.
Graphics	Graphical display is selected and activated	Status of graphical display	Opens or closes the graphics window.
I/Q Mod	I/Q modulator is configured, I/Q impairments are selected and activated	Analog I/Q impairments, I/Q swap	Switches the I/Q modulator on or off.
RF/A Mod	RF signal, analog modulations, list mode and sweeps are configured and activated	Active analog modulation modes	Switches the RF signal on or off.

Blocks of the Baseband Section

Baseband block

In this block, the (first) baseband source is configured and activated. The block is displayed only if a baseband generator (option R&S SMBV-B10/B50/B51, Baseband Generator and ARB) is available in the instrument. Depending on the installed software options, various digital standards, user-configured digital real time modulation or the built-in waveform generator (ARB) can be selected. The selected modulation is displayed in the block. The TOGGLE key switches the selected system on or off.

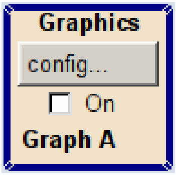
AWGN/IMP block



This block is displayed only if a baseband generator (R&S SMBV-B10/B50/B51) is installed. In this block (digital) I/Q impairments can be set. With the aid of the software for AWGN generation (option R&S SMBV-K62), an (additive) noise signal can be produced.

AWGN and impairments can be activated independently of each other in the appropriate menus. The settings are displayed in the block. The entire block can be activated or deactivated with the TOGGLE key. If the block is deactivated, the signal passes through the block unchanged.
In addition, the differential I/Q output is configured in this block.

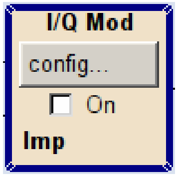
Graphics block



With this block, the baseband signal can be graphically displayed in real time. The block is displayed only if a baseband generator (R&S SMBV-B10/B50/B51) is installed.

Blocks of the RF Section

I/Q Mod block

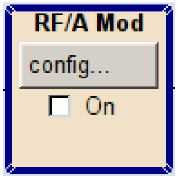


The I/Q modulator is configured in this block. Also the Analog Wideband I/Q mode can be selected here, which allows external I/Q signals to be directly applied to the I/Q modulator, i.e. not via the baseband section. If no baseband module is installed, I/Q modulation is possible only in the Analog Wideband I/Q mode. I and Q components can be swapped (I/Q Swap). (Analog) I/Q impairments can be set in addition. Unlike the impairments in the AWGN/IMP block, impairments in the I/Q Mod block also affect the externally applied signals in the Analog Wideband I/Q mode.

The status display in the block shows whether I/Q impairments and/or I/Q swap is active. I/Q modulation is switched on or off with the TOGGLE key.

***Note**:*
An I/Q modulator provided in the R&S SMBV is automatically activated when a connected baseband source is switched on. The I/Q modulator can also be separately switched on and off (select the I/Q Mod block and press the TOGGLE key). This permits the following configuration to be obtained with a R&S SMBV.
The baseband source generates an I/Q signal that is output via the analog I/Q output. At the same time, the RF section generates an unmodulated carrier.

RF/A Mod block



In this block, the RF parameters and the analog modulation modes are set.

The active analog modulation modes are displayed in the block. The TOGGLE key switches the RF signal on and off. When the signal is switched off, the switch before the RF output symbol is open.

RF settings include:

- Frequency and reference frequency
- Level settings, if required
- Attenuator settings, if required.
- Frequency and level sweep
- Pulse Generator
- List Mode settings. In this mode, extremely fast frequency and level settings can be made.

Note:
Numeric values for frequency and level are entered best and quickest with the aid of the FREQ and LEVEL keys.

Available analog modulation modes:

- Amplitude modulation
- Frequency modulation
- Phase modulation
- Pulse modulation (option R&S SMBV-K22)

Note:
For modulation modes that can be simultaneously used, refer to the R&S SMBV data sheet.

Example of Setup

A central element of the R&S SMBV display is the block diagram that illustrates the signal flow. Each block represents an important section of signal generation. Thus the user always knows the position at which a parameter has an effect in the signal flow. The main settings of a block are indicated in the block. The interconnection of employed inputs and outputs is also shown. The user is thus always informed about the connection of inputs and outputs in the signal flow and where they can be configured.

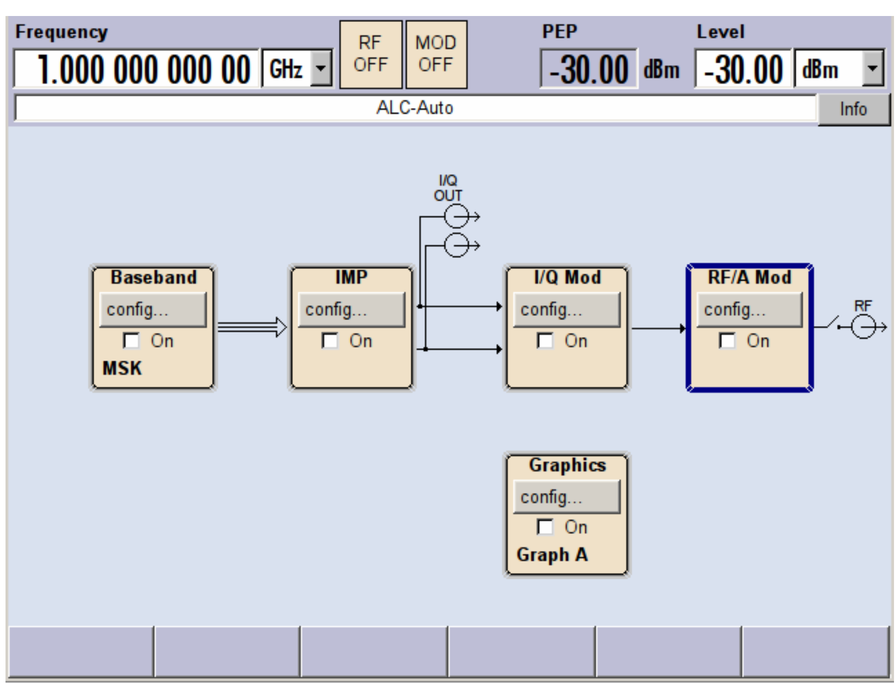
A window is opened for each menu where parameters can be set. When the window is opened, an entry is made in the Winbar below the display. All open menus are of equal priority (not modal) and can be accessed any time.

The R&S SMBV can be entirely operated from the front panel. Peripherals such as mouse or keyboard can be connected but are not essential.
With the aid of the rotary knob, the user can navigate in the block diagram and the dialogs. The cursor is moved line by line through the block diagram or dialog. Turning the button clockwise advances the cursor. The selected block can be activated or deactivated with the TOGGLE key. Active blocks are highlighted by a colored background.

In the example, a simple QPSK-modulated signal is configured and displayed. Proceed as described below:
1. Activate default (preset) state.
2. Select and activate digital modulation.
3. Set frequency and level and activate RF signal.
4. Select graphics display of I/Q signal.

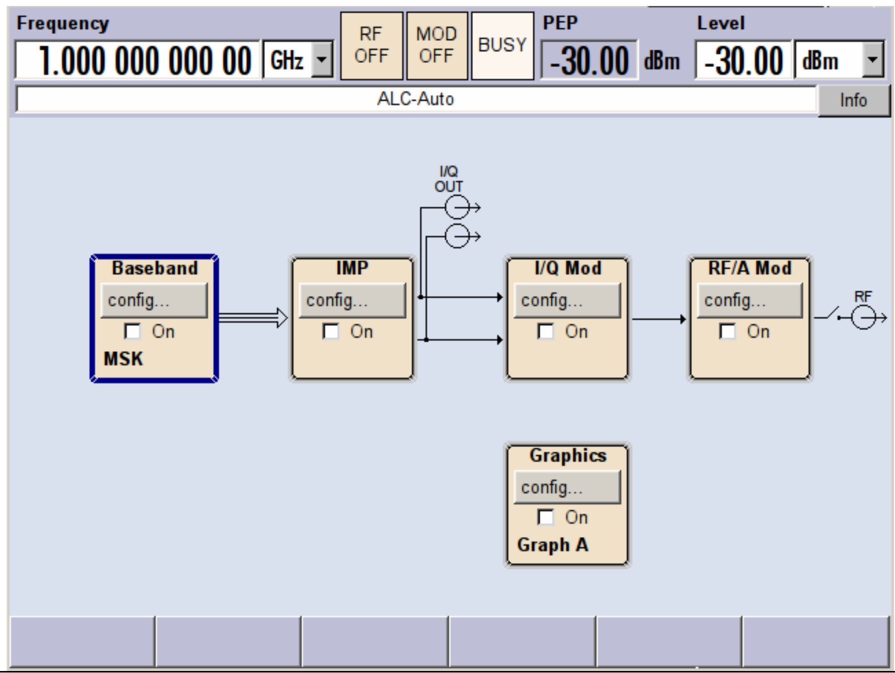
Step 1: Activate default (preset) state

Set a defined instrument state by pressing the PRESET key.

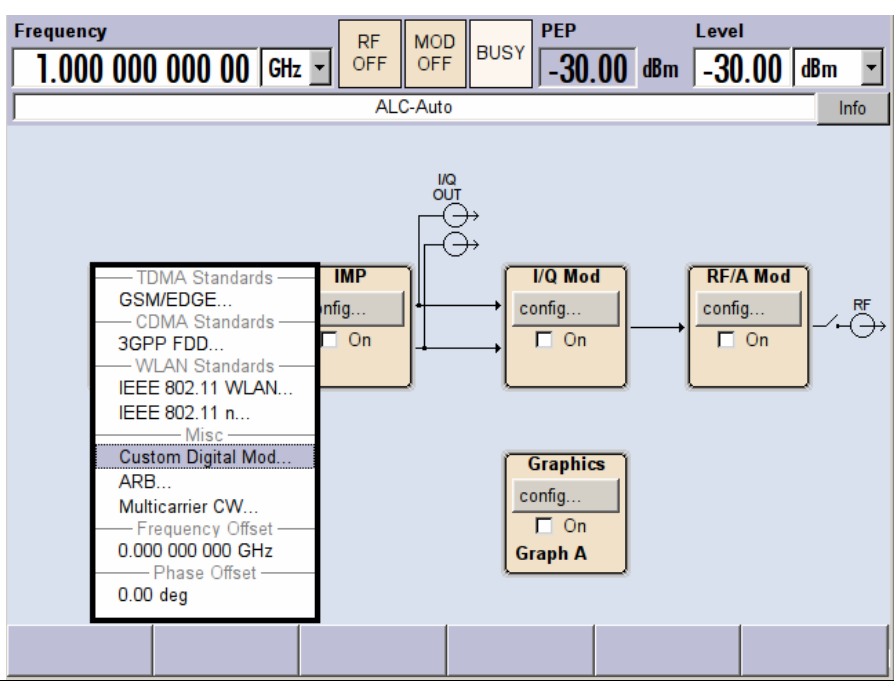


Step 2: Select and activate digital modulation

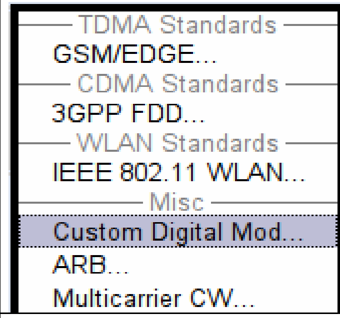
Select the Baseband block by turning the rotary knob.

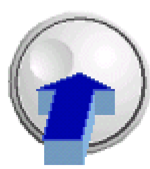


Press the rotary knob to open the menu where the digital modulation can be selected (different modulation modes are available depending on the options installed).

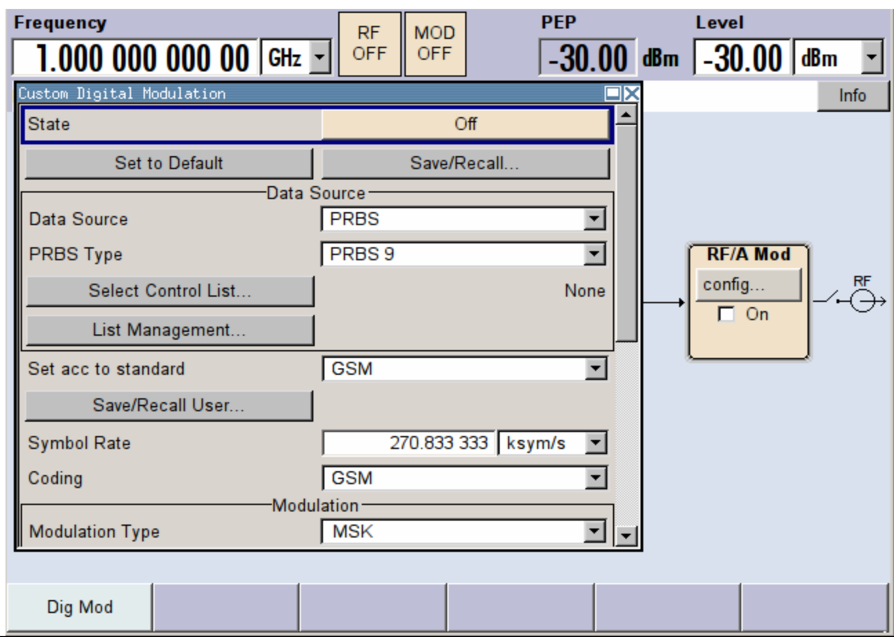


Highlight **Custom Digital Mod...** by turning the rotary knob.

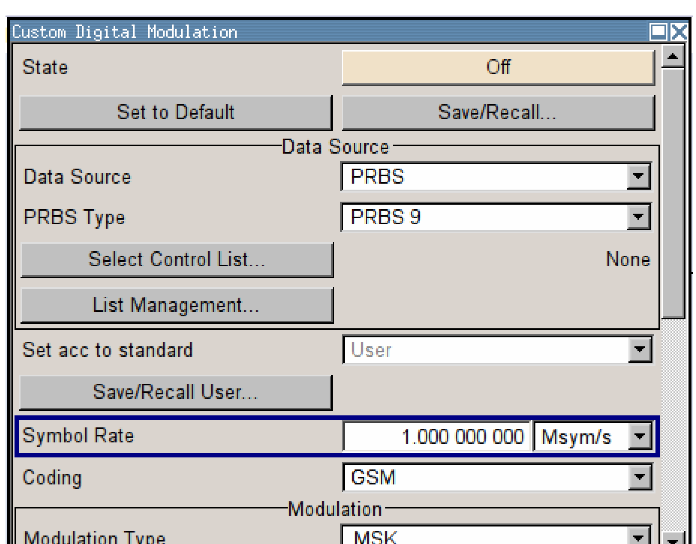




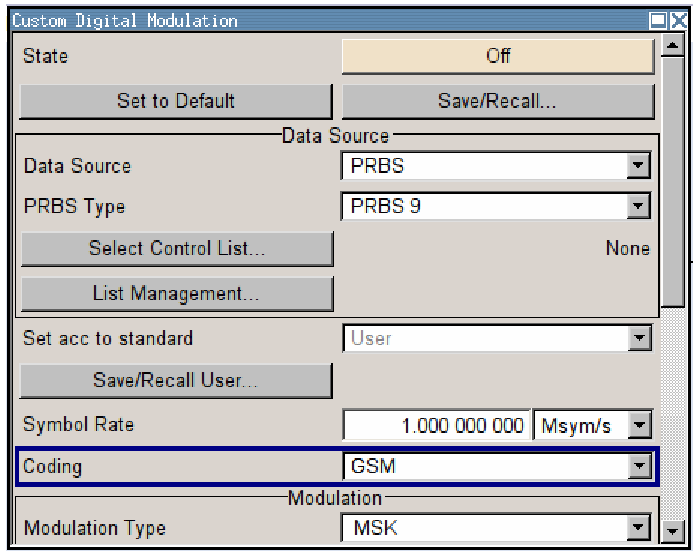
Press the rotary knob to open the **Custom Dig. Mod.** menu.

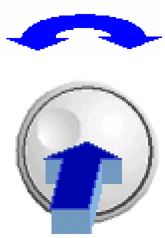


Select the **Symbol Rate** parameter by turning the rotary knob, and then enter the desired symbol rate with the aid of the numeric keypad and the unit keys.

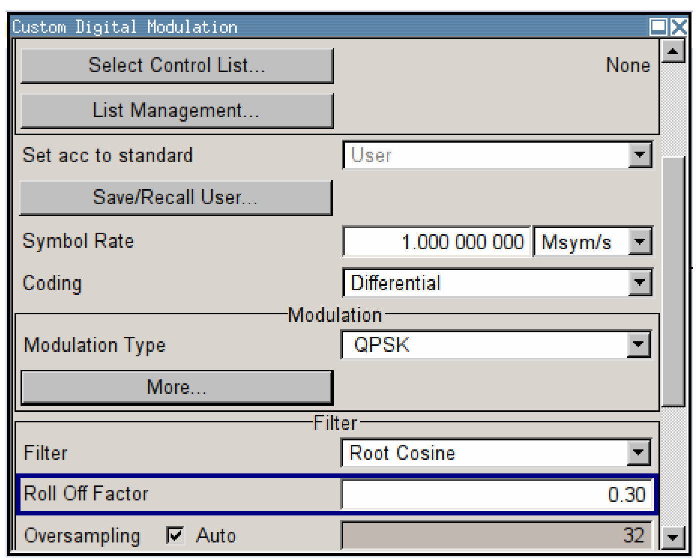


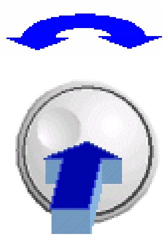
Select the **Coding** parameter by turning the rotary knob. Press the button to open the selection list. Select **Off** by turning the rotary knob and press it to activate the selected item.



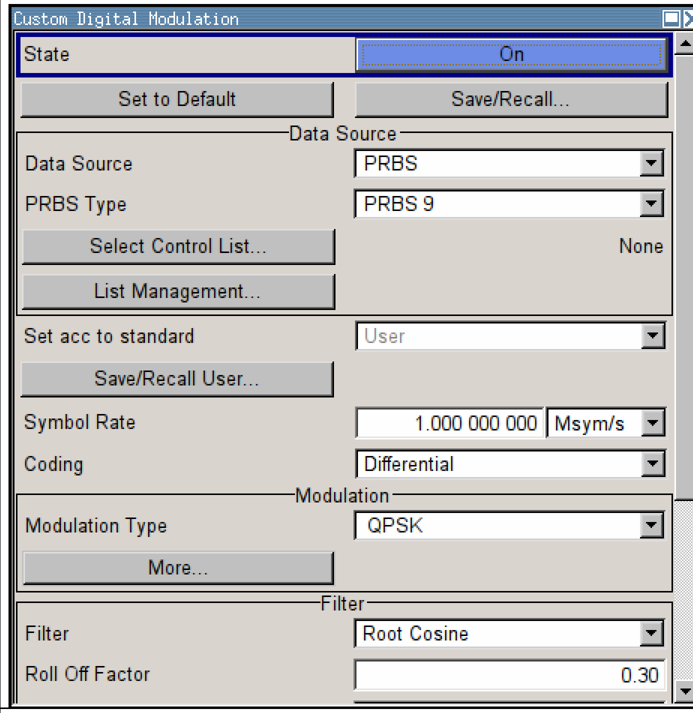


Set **Modulation Type QPSK** and **Filter Root Cosine** with **Roll Off Factor 0.3** in the same way using the rotary knob.

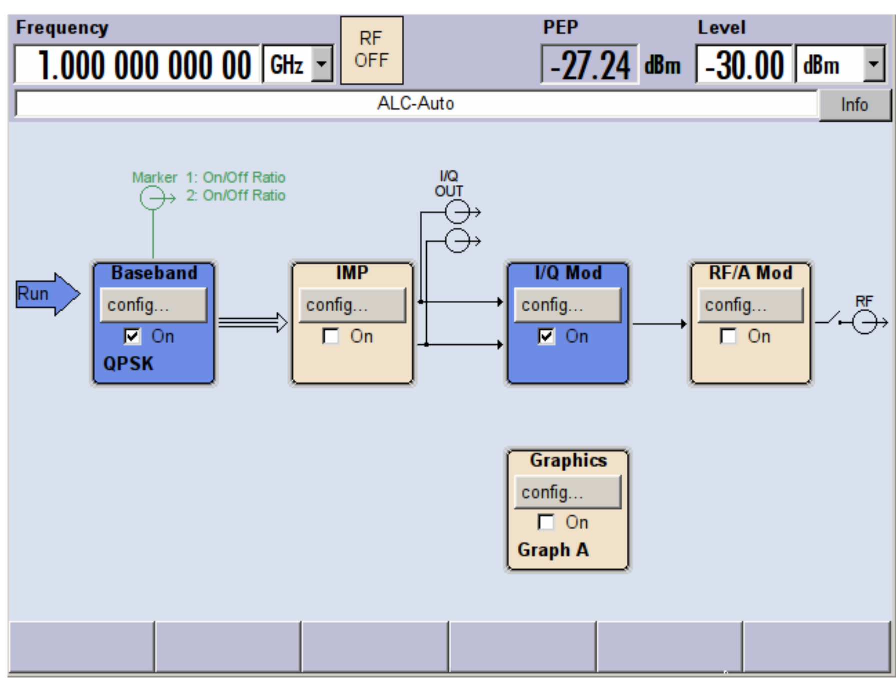




Finally, switch on digital modulation by selecting **State On**.



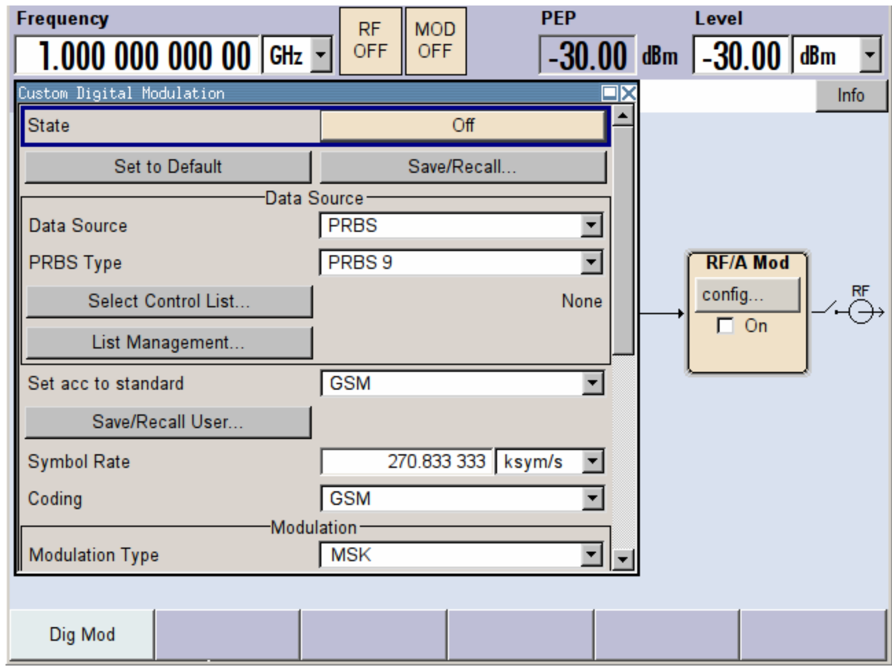
Press the [DIAGRAM] key to display the complete block diagram.



To indicate the active state, the **Baseband** block is displayed in blue. The **I/Q Mod** block is automatically activated. The **RF/A Mod** is not yet active, which means that no RF signal is output.
The entry in the Winbar indicates that the Custom Dig. Mod. menu is still open in the background.

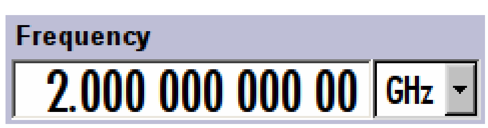
The menu can be displayed in the foreground by selecting the windbar button with the rotary knob or by toggeling the active menus with the WINBAR key.

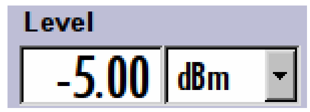
Press the HIDE key to minimize the menu again.



Step 3: Set frequency and level and activate RF signal

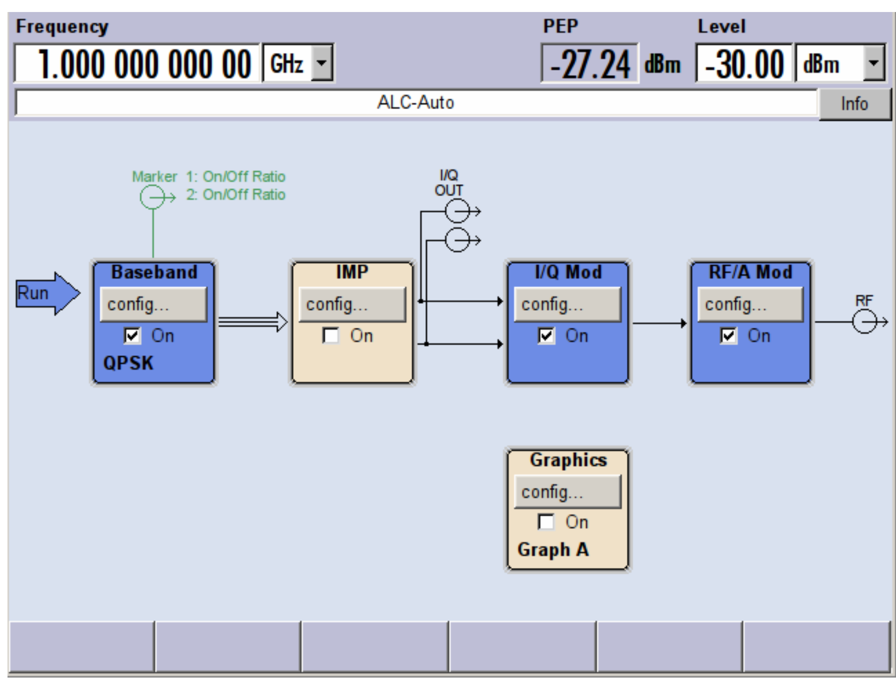
Press the FREQ key to activate the editing mode for frequency entry. The frequency entry field in the header section of the display is highlighted.
Enter the frequency using the numeric keypad and terminate the entry by pressing a unit key.





Enter the level in the same way after pressing the LEVEL key.

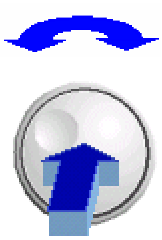
Press the DIAGRAM key to display the complete block diagram.



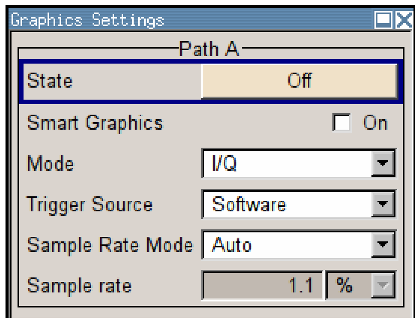
Select the RF/A Mod block by turning the rotary knob and activate it by pressing the TOGGLE key.

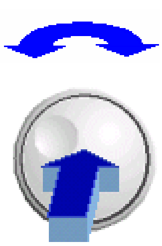
The QPSK modulation signal is now present at the RF output.

Step 4: Select graphics display of I/Q signal

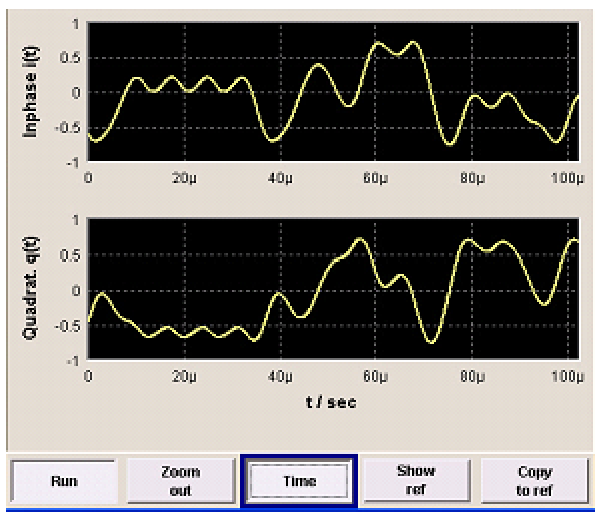


Select the Graphics block and open the respective menu by turning the rotary knob.





Activate display of the I/Q diagram by selecting **State On** with the rotary knob.



Contents - Chapter 3 "Manual Operation"

3 Manual Operation

Introduction - Manual Operation

The Vector Signal Generator R&S SMBV can be operated intuitively either via the interactive block diagram or via a menu tree. All menus are in the form of windows that can be operated in the same way. Rotary knob, keys or alternatively a mouse, allow direct and therefore convenient access to entries and settings. The clear-cut display shows the current signal generator state . Graphs, spectra, vector diagrams, etc, can be called for a visual check of the output signal. Numerous help functions support the user in signal configuration.

The following chapter describes manual operation of the signal generator. This includes a description of screenshots, operation of menus and the block diagram and the setting of parameters. An overview of menus and functions can be found at the end of this chapter.

Operating Concept

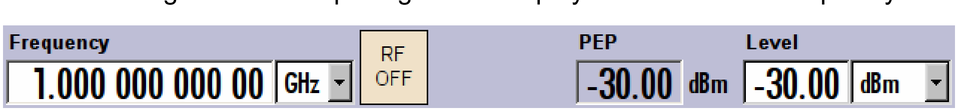
The operating concept of the R&S SMBV enables the user to make settings as intuitively as possible and at the same time gives a permanent overview of characteristics of the generated signal and of the current instrument state. Numerous on-line help functions support user settings.

The block diagram is the core of the operating concept.

A large graphics display showing the current configuration and the signal flow in the form of a block diagram is the core of the operating concept of the Vector Signal Generator R&S SMBV. The block diagram gives an overview of signal configuration, and the graphical elements can be accessed for operation. The desired element is selected by means of the rotary knob and the associated setting function is called by clicking this button. Required menus and graphs are displayed on the block diagram which is displayed again in the foreground whenever the DIAGR key is pressed.

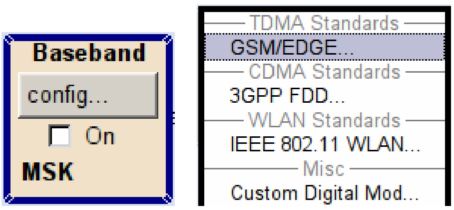
Permanent display of frequency and level of the RF output signal

The main characteristics of the RF signal, frequency and level, are permanently displayed in the header section of the screen and can be directly set in the display fields after the FREQ or LEVEL key is pressed. Status messages for the output signal are displayed in addition to frequency and level.

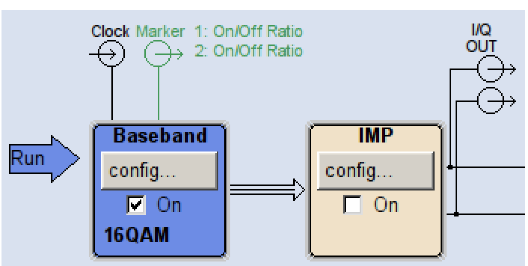


Operation via the graphics interface

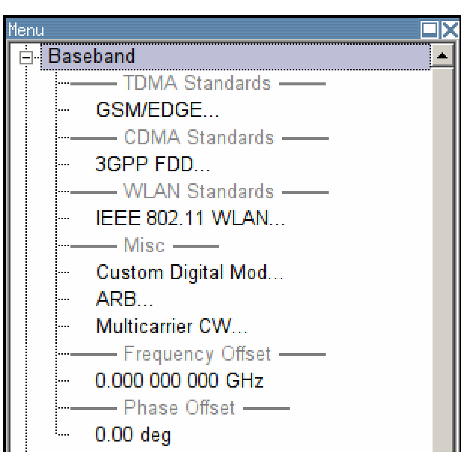
Menus are assigned to the specific function blocks in the block diagram. The function blocks represent elements of signal generation, e.g. the baseband block which contains all menus required for baseband signal configuration. In this block all digital standards and the digital modulation can be selected. Function blocks displayed with a blue frame can be directly switched on and off by means of the [TOGGLE] key. In the example, digital modulation can be activated in this way. The menus of the highlighted function blocks can be called by clicking the rotary knob or by pressing the [ENTER] key.



The signal flow between the function blocks and the employed inputs and outputs are also shown.

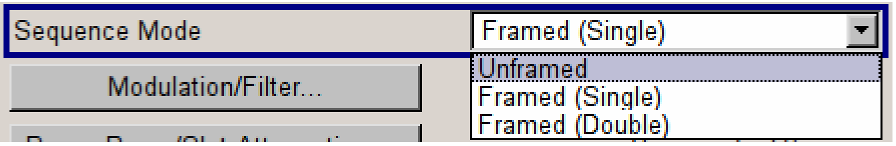


The menu tree can be opened and closed with the [MENU] key. The menu tree is organized in the same way as the directories under Linux. The function blocks correspond to the first directory level, the menus to subdirectories.



Operation corresponds to the Linux concept

To offer the user a familiar environment, operation is very similar to operation of Linux user interfaces. All menus and tables are made up of known elements, e.g. selection lists,



check boxes,

or entry fields.

A blue frame indicates that the selected item is active. In the highlighted element, entries can be made.

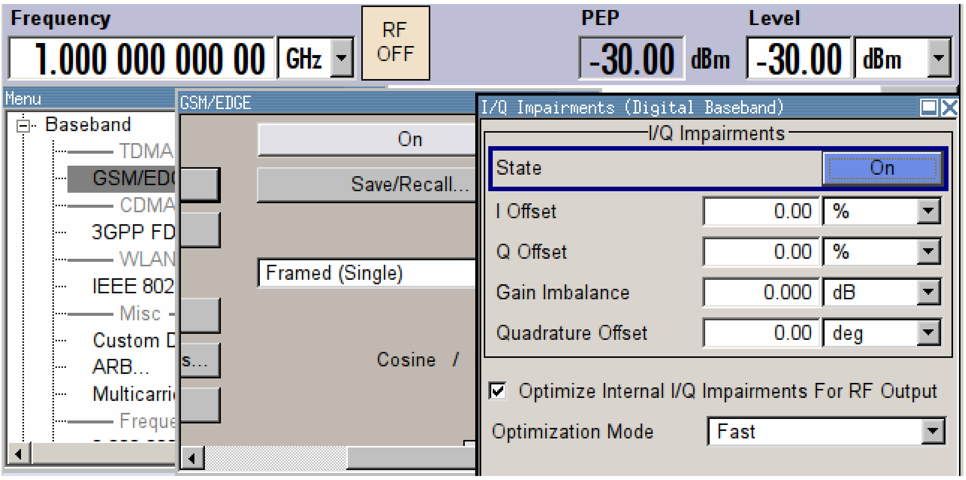
Most of the settings can be easily made with the rotary knob

Operation is possible via front-panel keys, an external keyboard and the mouse. Most of the settings can be made with the rotary knob:

- Turning the rotary knob shifts the entry focus to the desired element.
- Clicking the rotary knob activates the selected entry field.
  Depending on the parameter, the submenu is now called, the numeric value varied, the list entry selected or the check box activated or deactivated.
- If a value is entered, the entry is stored by another click on the rotary knob and the editing mode is exited.

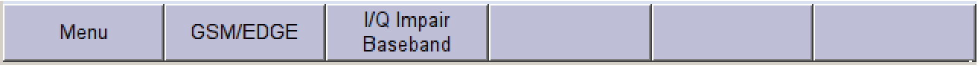
Clear settings with the aid of independent submenus

A separate menu is opened for each menu and submenu. The menus can be operated independently of each other, i.e. none of the menus requires that settings in other menus be completed before it can be closed. This ensures flexible operation at all times.



The Winbar gives an overview of menus and simplifies their access.

The menus are displayed on top of the block diagram but they can be "hidden", i.e. displayed in the form of a button in the Winbar at the lower end of the screen (HIDE key). They can be displayed again in full size by a keystroke (REARR key). This makes room on the screen for other displays that may be required but the setting menus can thus be accessed any time.

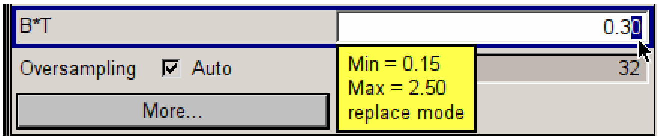


The keys are assigned simple functions

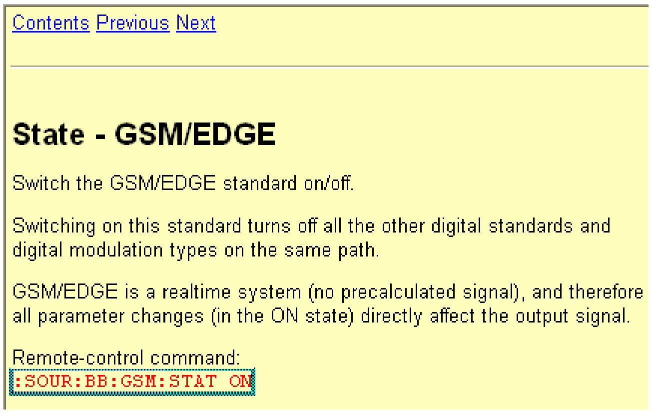
Most keys on the front panel of the R&S SMBV directly perform a simple function. Since a great number of settings can thus be made by a keystroke, operation is easy. For instance, the CLOSE key closes the active menu; with the RF OFF key the RF output signal can be switched on or off.
An exception are keys that call a menu such as the MENU key which opens the complete menu tree of the R&S SMBV, the SETUP key which opens the menus for general instrument settings or the FILE, key which opens the menu for file management.

Help functions support the user

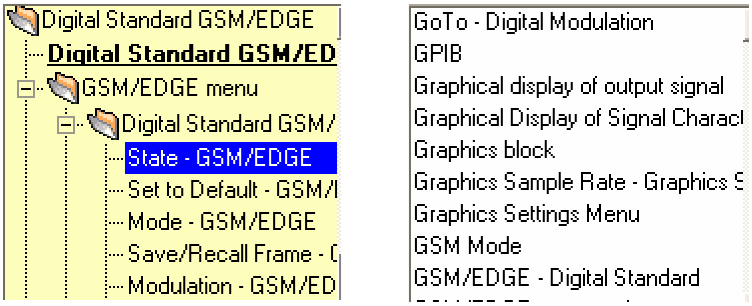
Numerous help functions support the user in signal configuration.
The valid setting range can be displayed for each numeric parameter. This requires a short wait after activation of the entry field. The range is then displayed automatically after a few seconds. If the entered value is outside the permissible range, the next permissible value is automatically set and a message is output (see below).



Context-sensitive help for each parameter can be called with the HELP or F1 key:

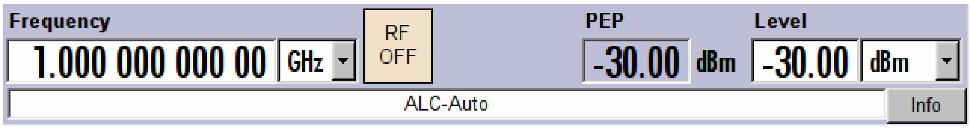


Each help page is part of a comprehensive online help function which can be called by means of an index, a content tree or the Previous / **Next** buttons.



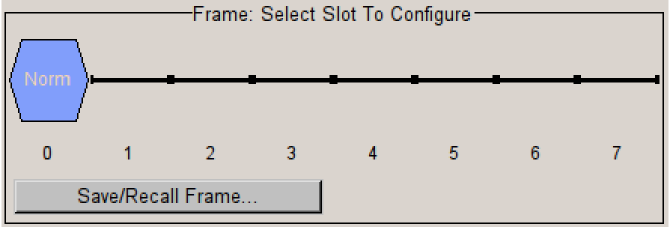
Messages indicate the current instrument state

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. With the aid of the INFO key, help pages can be called for most of the messages. They provide background information on the message and indicate operating steps that may be required. All messages are explained in the online help which can be called with the HELP key.



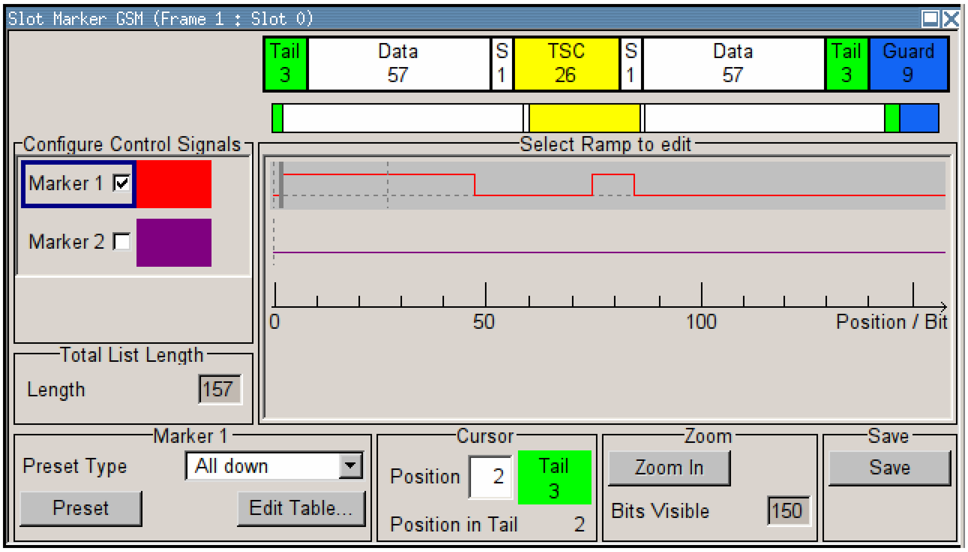
Graphical display of data structure

The structure of the baseband signal is graphically displayed in the respective menus; the individual signal elements can be graphically selected for processing.



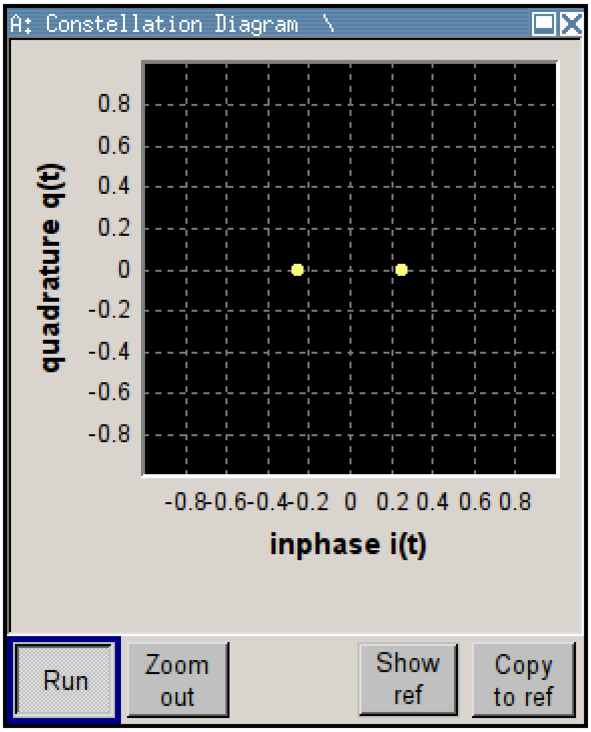
Definition of control signals with the aid of a graphics editor

Control signals are also graphically configured.



Graphical display of output signal in a diagram

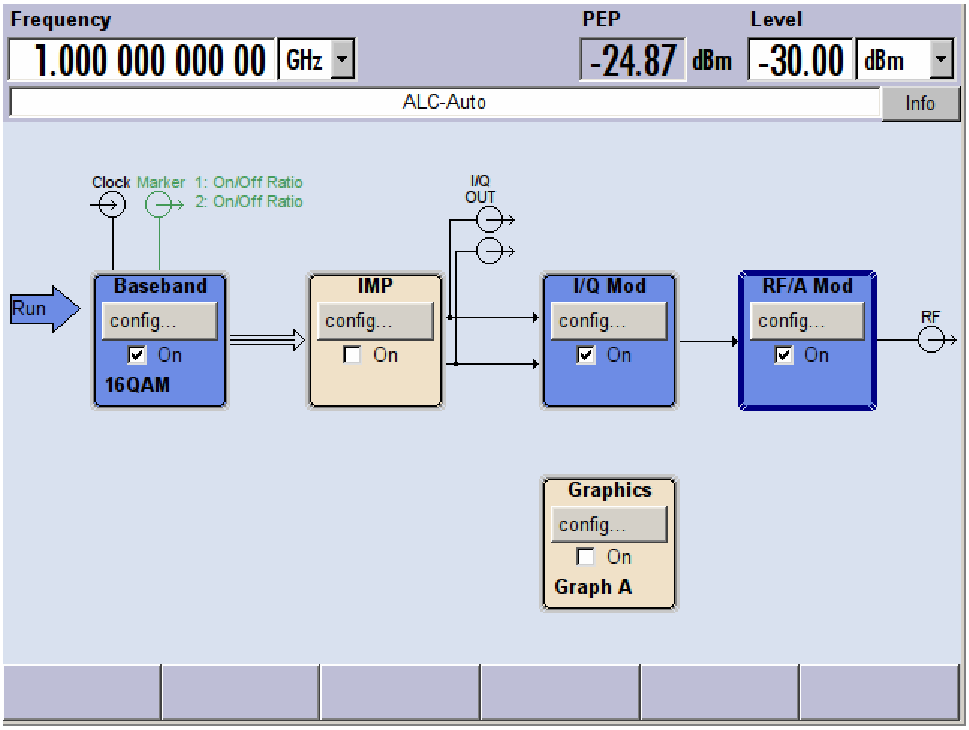
The output signal can be graphically displayed in a number of diagrams. This allows a fast check of signal characteristics. Zoom functions and the insertion of a reference trace permit in-depth evaluation without an external analyzer being required.



Display

The display shows the current signal generator state and offers graphical elements for direct operation. It is divided into three sections:

- The frequency and level display with info line indicates the main output signal parameters and reports the current state with status, error and warning messages.
- The block diagram shows the instrument configuration, the signal characteristic as well as the inputs and outputs used and permits interactive operation via graphics elements. Active menus and graphs are displayed on top of the block diagram.
- Winbar with labelled buttons for menu display.



Frequency and Level Setting - Display

Frequency/level settings and a few status messages (see below) are displayed in the header field of the screen. The display may vary depending on the instrument's operating mode:

- In the sweep mode, the current frequency or level of the output signal is displayed.
- In the list mode, neither the current frequency nor level is displayed, the indication is dimmed. The status message **ListMode** is displayed in the info line.
- If user correction is active, the status message **UCorr** is displayed in the info line.
- In the case of digital or analog modulation, **Freq** indicates the frequency, **PEP** the peak envelope power and **Level** the average level.

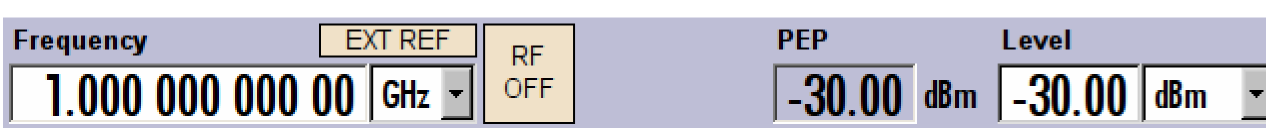
It should be noted that the signal at the RF output may differ from the indicated value by a set offset (frequency or level) (see chapter 4, sections "RF Frequency - Frequency - Phase", "RF Phase - Frequency - Phase" and "RF Level/EMF - Level - EMF").

Status Information and Messages - Display

The status information and messages are displayed in the header section of the screen. The messages differ with respect to their importance (errors, warnings, info) and the time of their appearance (brief and permanent messages). They require different treatment by the user. Further information on all messages can be called in the info window (see section "Info Window - Display", page 3.9).
Chapter 9, "Error Messages" includes an overview of all status information and messages as well as instructions for error elimination.

Status Information

The status information gives the user an overview of the main operating states and settings of the R&S SMBV. The states are indicated for information only and do not necessitate any action by the user. Status information is displayed between or above the frequency and level fields, at the left of the info line or in the info line itself.



Messages

Messages indicate errors in the instrument. They are displayed in the info line in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

Volatile messages

Volatile messages report automatic settings in the instrument (e.g. switching off of incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.
Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

Remote-control command:
`SYST:ERR? or SYST:ERR:ALL?`

Permanent messages

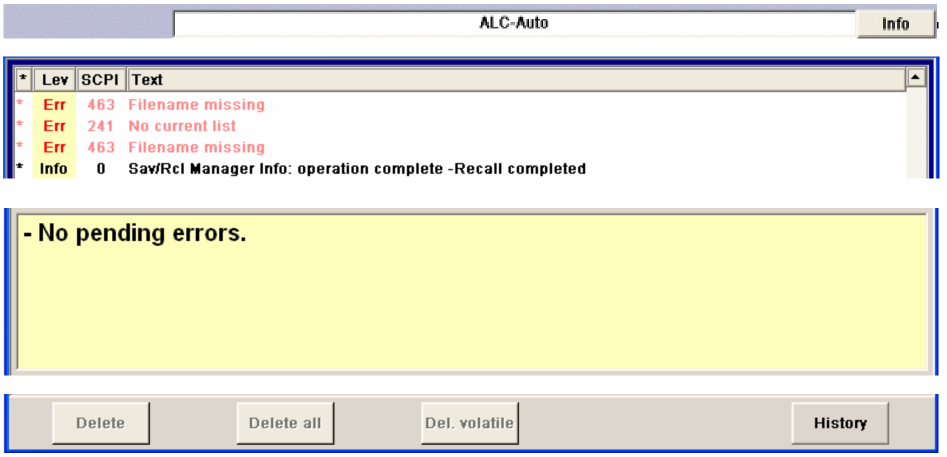
Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent message must be eliminated before correct instrument operation can be ensured.
The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

Remote-control command:
`SYST:SERR?`

Info Window - Display

A few operating states and the current message are displayed in the info line (see chapter 9 "Error Messages").

The info window with a list of current permanent messages and a detailed description of each message can be opened with the INFO key.
The upper section of the info window contains a list of all current permanent messages in the order of their occurrence, i.e. the most recent message is displayed first. In the lower section of the window, additional information on the highlighted message is displayed.
A history of all messages that have occurred since instrument switch-on can be called with the **History** button. The most recent message is displayed first.



Info line

List of current messages with short message text.

Detailed description for highlighted message

The messages are color-coded according to their level. Device-specific messages are red, info and remote control error are black. The level is also indicated in the **Lev** column (Err, Sys or Info). Column **SCPI** indicates the SCPI error code.
With the aid of the buttons, error messages can be cleared and a history of all messages called.

Delete

Clears the highlighted message. This button is available only if the history of the messages is displayed.

Remote-control command:
(see below)

Delete all

Clears all messages.
This button is available only if the history of the messages is displayed.

Remote-control command: n.a

Sel. volatile

Clears all volatile messages. This button is available only if the history of the messages is displayed.

Remote-control command:
`SYST:ERR:ALL?`

(Each time a `SYSTem:ERRor:ALL?` query is sent, the error queue is returned and at the same time cleared).

History

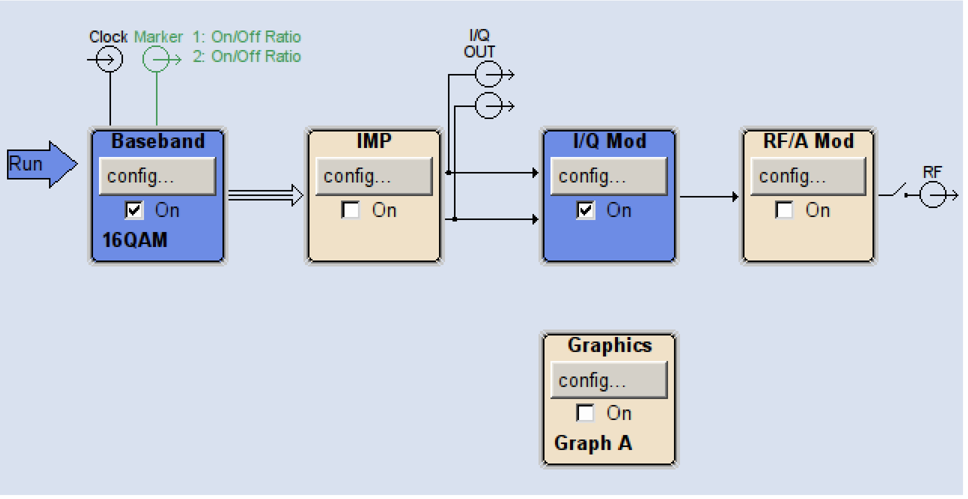
Calls the list of all messages that have occurred since instrument switch-on. The most recent messages are displayed at the top of the list. When the button is pressed again, the list of current messages is displayed.

Remote-control command:
`SYST:ERR? or STAT:QUE?`

(Each time a `SYSTem:ERRor?` or `:STATus:QUEue?` query is sent, the oldest entry in the error queue is returned and at the same time cleared in the list).

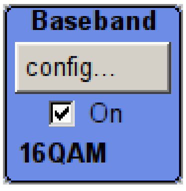
Block Diagram - Display

The block diagram shows provided options, signal configuration and the currently selected signal flow of the generator with inputs and outputs used. Signal generation can be completely operated from the block diagram. The highlighted function block can be directly switched on and off with the TOGGLE key. Clicking the rotary knob (= Enter) opens the associated setting menu.



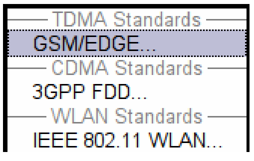
Function Blocks in the Block Diagram

Each block represents a function of signal generation. The function is indicated in the headline of the block, e.g. **Baseband.** In this block, the digital modulation signal, the digital standards, arbitrary waveform generation and multicarrier CW are set, for instance.



In the check box, the respective function can be quickly activated/ deactivated with the TOGGLE key. After activation, the block is displayed in blue.
Status information is displayed below the check box. It is different for the different blocks. In the baseband block, the selected modulation and associated additional information, e.g. the number of channels, are indicated.

Clicking the rotary knob (front panel) or the **config...** button (mouse) opens the associated setting menu. In all function blocks where the signal flow can be influenced, the top menu level for setting **signal routing** parameters is offered.

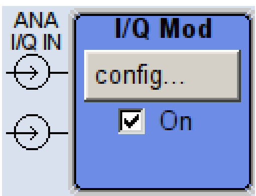


Signal Flow and Input/Output Symbols in the Block Diagram

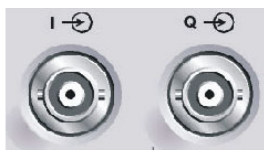
The input/output symbols in the block diagram show the currently used inputs and outputs of the signal generator. Unused inputs and outputs are not shown. The lines indicate the signal flow.

Symbols and labels refer to the corresponding inputs and outputs on the front and rear panel of the signal generator. The direction - input or output - is indicated by an arrow.

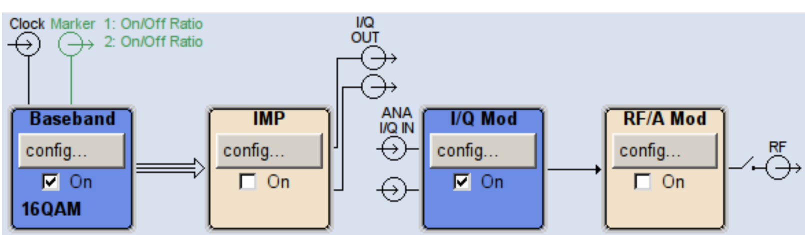
Example:



The symbols indicate the inputs for the analog I and Q signal on the instrument front panel.



The marker characteristics are listed next to the marker symbol of the active markers.
Symbols and lines are displayed in different colors depending on their function.

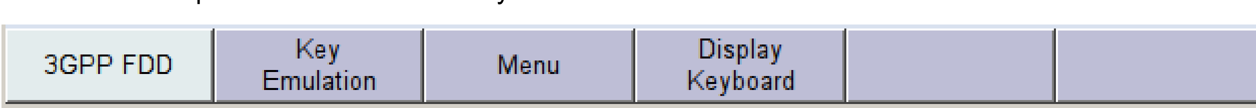


- The baseband signal is indicated by a three line arrow, the I- and Q-components of the signal by a single-line arrow.
- Black is used for the generated signal.
- Green is used for control signals.

The signal flow is configured in the individual menus. User interfaces are configured in the [Setup]-**Environment - Global Trigger/Clock/External Inputs** menu.

Winbar - Display

The Winbar with six buttons is displayed below the block diagram. Labelled buttons represent open menus, the label indicates the menu. If several menus are open, the button of the currently active menu is displayed in a lighter color. Up to six menus may be open simultaneously. When the seventh menu is opened, the menu that was opened first is automatically closed.

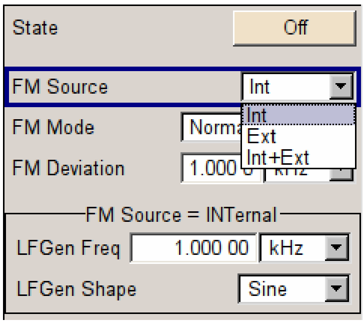


Any of the open menus can be activated with the respective button in the Winbar. In combination with the keys for menu operation ([CLOSE], [HIDE] and [REARR]), convenient menu operation can be ensured.

Menu operation is described in section "Menu Operation", on page 3.25.

Menu Structure - Display

The parameters are set in the menus. Menus are called either via the function blocks in the diagram or by means of the MENU key. The menus are displayed on top of the block diagram.

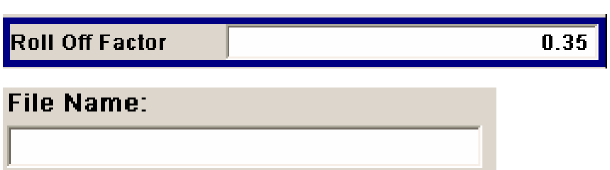


This section describes the menu structure. Menu operation is described in section section "Menu Operation", on page 3.25, the setting of parameters in section "Setting Parameters", on page 3.16.
The menus are in Linux format. They differ in details depending on their function but they consist of the same main elements.

Menu header

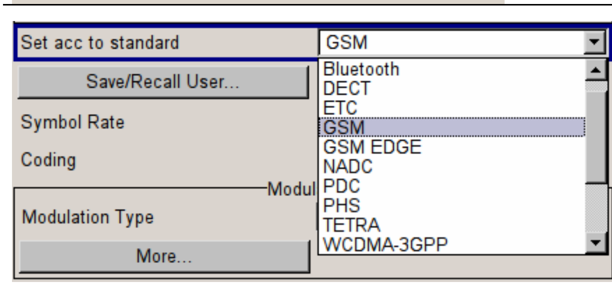
The header line contains the name of the menu (e.g. Frequency Modulation) and the button closing the menu. The button can be operated with the mouse. For operation from the front panel, the HIDE and CLOSE keys can be used.

The remaining menu area is variable and comprises various fields for setting parameters.
Each of the setting fields is assigned a parameter name. The kind of setting varies depending on the parameter to be set.



Entry field

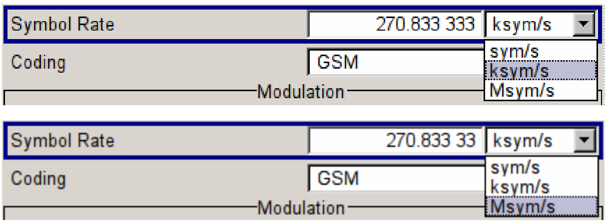
A numeric value (e.g. roll-off factor) or an alpha-numeric value (e.g. file name) can be entered in this field.



Selection field

The button indicates that a selection can be made from a list. The fold-down selection list is displayed below the selection field. Depending on the number of entries, the full list or only part of it is shown.

One entry at a time can be selected from the list.
If an item is not available for selection, it is printed in grey and cannot be accessed.

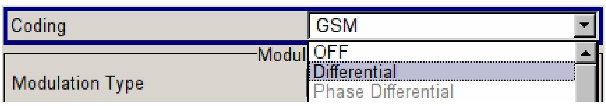


Units

The unit of a parameter is displayed next to the value. When the parameter is edited, the unit is selected either from the list or by means of the front-panel keys. When the entry is completed, the unit can be changed. In this case the value remains unchanged but is automatically adapted to the new unit.

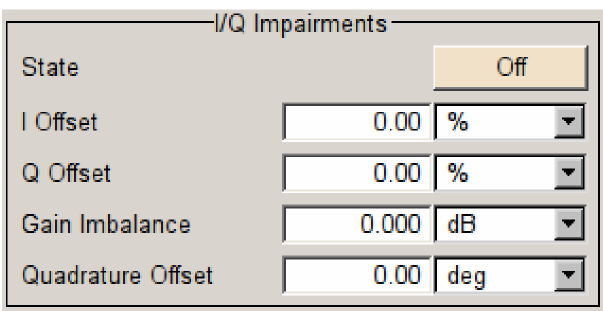
Check-box field

If the check box is ticked, the associated parameter setting is active (e.g. switched on).



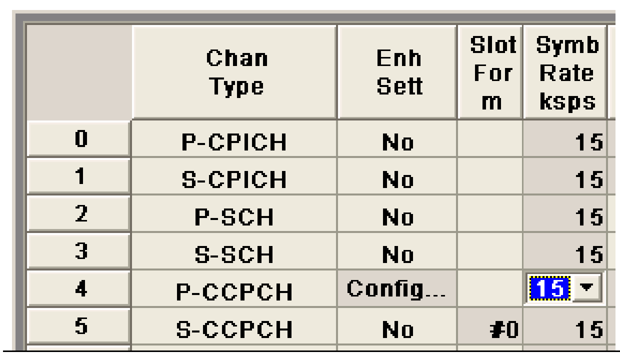
Access denied

Some settings can only be made in a specific configuration. If setting is not permitted with the specific configuration selected, the respective item is disabled and displayed in grey and the entry or selection field cannot be accessed.



Menu area

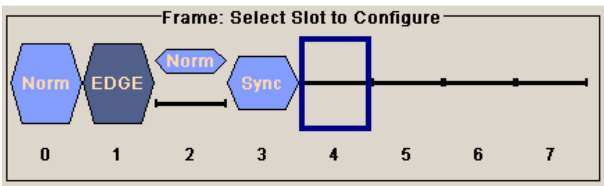
Several fields of associated but separately set parameters can be organized in a menu area. The menu area is framed and labelled with the function common to all parameters (e.g. Impairments).



	Chan Type	Enh Sett	Slot Form	Symb Rate ksps
0	P-CPICH	No		15
1	S-CPICH	No		15
2	P-SCH	No		15
3	S-SCH	No		15
4	P-CCPCH	Config...		15
5	S-CCPCH	No	#0	15

Tables

Tables are made up of a header, which normally contains the column labels, and lines containing the text.



Graphical display

Graphical displays show signal characteristics and in some of them the element to be set can be selected.

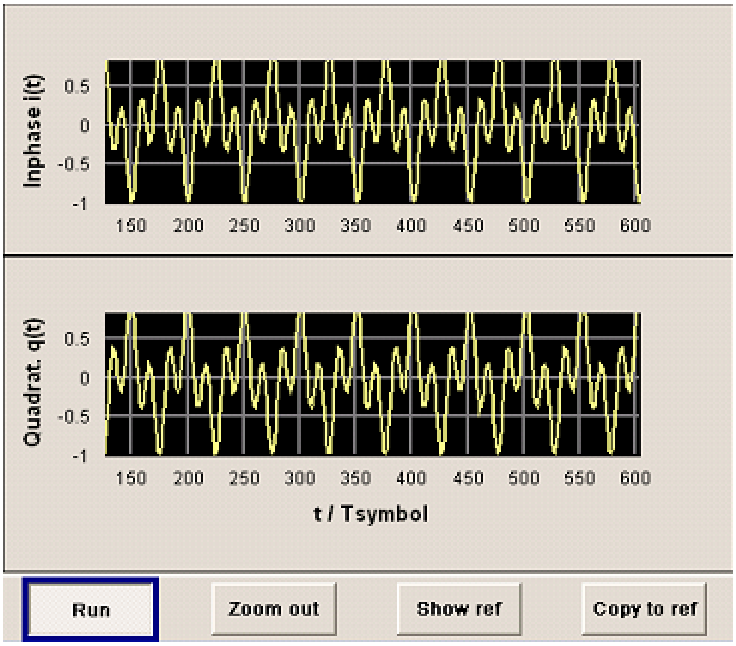
Buttons

The buttons either trigger a single action (e.g. **Execute Single Sweep**), or call the next menu level (to be identified by 3 dots, e.g. **Markers...**).

Graphical Display of Output Signal Characteristics

The graphical display of the output signal enables the user to rapidly check signal characteristics without connecting an analyzer. Zoom functions and the display of a reference trace allow in-depth evaluation. The diagram is displayed on top of the block diagram. It can be minimized and called in the same way as a menu.

Example: I/Q diagram



The **Graphics Settings** menu for selecting the graphics display of the output signal can be called either via the **Graphics** function block in the diagram or with the aid of the MENU key. Operation of the graphics windows is analogous to menu operation. The menu and the individual graphical displays are described in chapter 4, section "Graphics Display - Graphics".

Setting Parameters

The R&S SMBV offers several and sometimes alternative possibilities for setting parameters. Operation is possible from the front panel, with the aid of a mouse and/or from a PC keyboard. Operation of the R&S SMBV with the aid of these control media is shown in the tables below.

Frequency and level are directly set in the header area of the display using the FREQ and LEVEL keys. Some of the keys trigger a direct action, e.g. the RF OFF key switches the RF output on and off. An overview of key functions can be found at the end of this chapter (see section "Legend of Front-Panel Controls", on page 3.43), a detailed description of key functions is given in chapter 4, "Instrument Functions".

Most of the parameters are set in the menus. Menus can be opened from the function blocks of the diagram either with the aid of the rotary knob (= Enter) on the front-panel or by a mouse click on the **Config...** button.
An exception are the **Setup**, **File** and **Hcopy** menus. In the **Setup** menu, general settings are made which are not directly concerned with signal generation, e.g. setting of the IEC/IEEE-bus address. In the **File** menu, files and lists are managed; in the **Hcopy** menu, printout is configured and hardcopies can be made. These menus can only be called with the SETUP, FILE and HCOPY keys.

Specific settings can also be made directly in the block diagram, e.g. activating a function block by means of the TOGGLE key. Changes affecting the signal flow are immediately visible in the graphics display.

Calling a Menu - Setting Parameters

After instrument switch-on, the cursor is always on the first function block of the diagram (default setting). It can be moved by means of the rotary knob or the arrow keys. Clicking the rotary knob opens the menu associated with the function block. The MENU key opens the complete menu tree.
With the aid of the appropriate keys, the cursor can also be moved to the header area or the Winbar.

- The FREQ and LEVEL keys activate the frequency or level entry fields in the header area.
- The DIAGR key moves the cursor to the block diagram.
- The WINBAR key moves the cursor to the Winbar. The button that was active last in the Winbar is highlighted. The associated menu is activated by clicking the rotary knob (= Enter). If the Winbar was covered, it is now displayed in the foreground.
- The MENU key opens the complete menu tree, the FILE and SETUP keys the respective menus. Menus can be closed with the CLOSE key.
- The cursor can also be moved with the ESC key. However, the function of this key depends on the current cursor position:
  - **Parameter field** (editing mode)**:**
    The editing mode is terminated and the previous value is restored (exception: value variations with the rotary knob cannot be cancelled).
  - **Menu area:**
    The cursor is set to another menu area.

- **Menu:**
  The menu is closed and the cursor changes to the next higher control level.
- **Frequency/level field:**
  The cursor is set on the previously active menu or, if no menu was active, on the first function block in the diagram.
- **Function block in the diagram:**
  The cursor is set on the first menu in the winbar. If no menus are open, the current cursor position remains unchanged.

Function	Front panel	PC keyboard	Mouse
Edits the frequency or level in the entry fields of the header area	Press FREQ or LEVEL key. Enter value.	Press CTRL + F (frequency) or CTRL + L (level). Enter value.	Click the entry field and enter value.
Activates the block diagram	Press DIAGR key.	Press CTRL + D.	Click the function block.
Activates the Winbar	Press WINBAR key .	Press CTRL + F1... F6 Press CTRL + W.	Click button in Winbar.
Calls the Setup or File menu or the menu tree	Press SETUP, FILE or MENU key.	Press CTRL + E (Setup), CTRL + S (File) or CTRL + M (menu tree).	-

Selecting a Control Element - Setting Parameters

Control elements are always selected in the same way no matter whether a function block in the diagram, a menu in the menu tree, a parameter in the menu or an entry in a list or table is concerned.

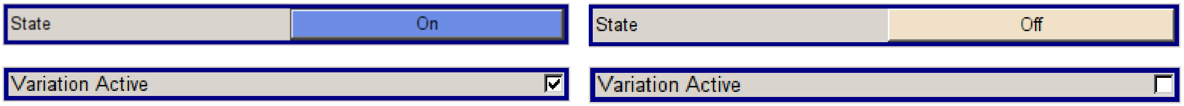
- An element is activated by means of the cursor. An active element is highlighted by a blue frame.

Function	Front panel	PC keyboard	Mouse
Selects an element	Select element by means of the rotary knob, the arrow keys or the TOGGLE key.	Select element by means of the arrow keys.	Click element.

Switching Parameters On/Off - Setting Parameters

A parameter can be activated and deactivated using a button or a check box.

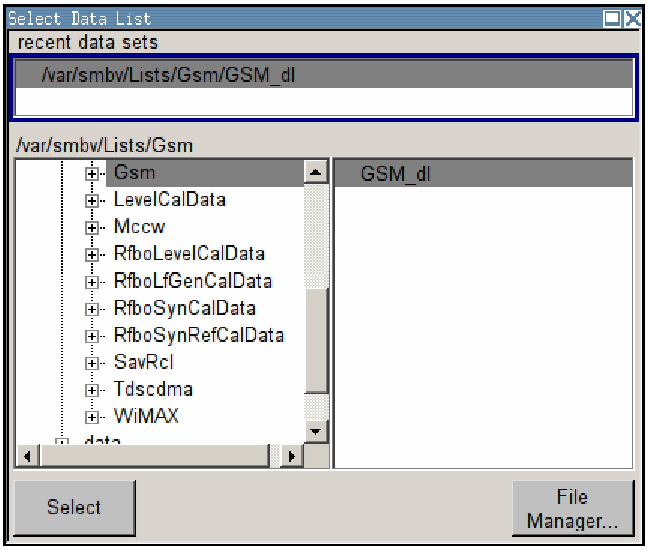
- The ENTER function of the different control media switches the highlighted element on or off (toggle function). Colour and label of a button change, the check box is ticked or the tick is removed.



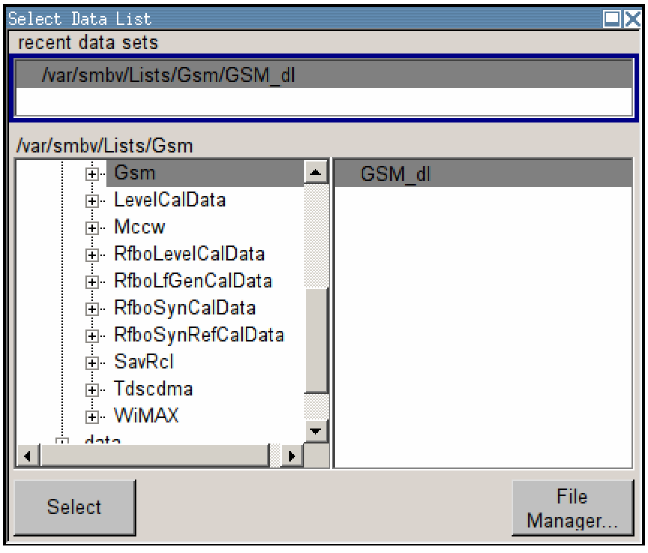
Function	Front panel	PC keyboard	Mouse
Switches on/off	Press rotary knob, ENTER or TOGGLE key.	Press Enter key.	Click check box or button.

Selecting and Exiting a Menu Area - Setting Parameters

Some menus are organized in areas. The cursor can be moved either only within an area or between the higher-level menu areas. This applies to the **File Select** menus when files are saved or loaded. When the menu is called, one of the menu areas is highlighted by a blue frame.



- Another menu area can be selected (highlighted) by means of the rotary knob or the arrow keys.
- Clicking the rotary knob (= Enter) moves the cursor to the highlighted menu area. When the cursor is placed on a lower-level area in the menu, the area is highlighted by a grey frame. The currently selected item is printed on a blue background (in the example the selected directory).
  The rotary knob and the arrow keys up/down move the cursor only within the grey-framed area.



- Clicking the rotary knob (= Enter) terminates the setting, i.e. selection of a file. The cursor is either set on the next higher menu level or the menu is closed as in our example.

- The left/right cursor keys first shift the entry focus within the menu range form left to right (or vice versa); in the example, from the directory tree to the file list. Press again and the entry focus is shifted up one menu level.Clicking the rotary knob (= Enter) performs a setting. In the example of the **File Select** menu, this is the display of the subdirectories if a directory is marked and, if a file is marked, the selection of this file. After a file has been selected, the menu closes automatically.The ESC key moves the cursor to the next higher menu level.

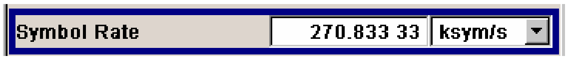
Function	Front panel	PC keyboard	Mouse
Selects a menu area	Select menu area using the rotary knob or the arrow keys. Press the rotary knob or the ENTER key. Rotary knob and arrow keys up/down move the cursor only within the selected menu area.	Select menu area using the arrow keys. Press the Enter key. The arrow keys up/down move the cursor only within the selected menu area.	- (The menu area is selected by selecting an entry.)
Exits a menu area	Press the ESC key. Rotary knob or arrow keys move the cursor between different menu areas.	Press the ESC key. The arrow keys move the cursor between different menu areas.	- (The menu area is exited by setting the cursor on an item outside the area).

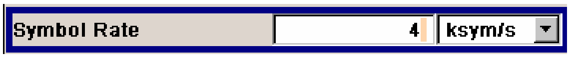
Entering a Value - Setting Parameters

Numeric and alphanumeric values can be edited in the entry fields. In the editing mode, cursors of different colour are used. A blue cursor indicates the overwrite mode, a green cursor the insert mode. The INSERT key toggles between the two modes. The insert mode is the default setting.
Numeric values can either be newly entered or the existing value can be varied. Incorrect entries are cleared with the BACK SPACE key.

Entering a new value:

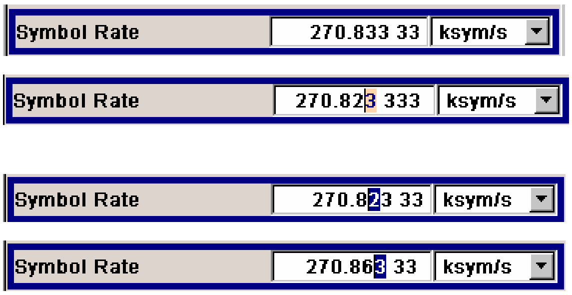
A click on a numeric key activates the editing mode. The previous value is cleared and the new value can be entered.





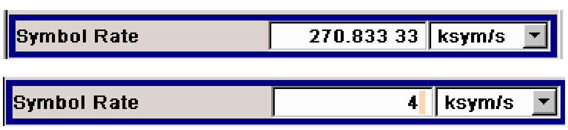
Editing a value in the insert mode (default setting):

Clicking the rotary knob (= Enter) activates the editing mode. Set the cursor to the left of the number to be changed using the left/right arrow keys. The cursor is displayed in green. A change to the overwrite mode is possible any time. In this case the cursor changes its colour and the number to be replaced is highlighted. If the cursor is placed at the right of the total value, the insert mode is always active.



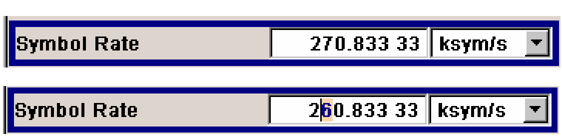
Editing a value in the overwrite mode:

Clicking the rotary knob (= Enter) activates the editing mode. Set the cursor on the number to be varied using the left/right arrow keys. In the overwrite mode, the cursor is blue. The highlighted value is overwritten by clicking a numeric key.



Variation:

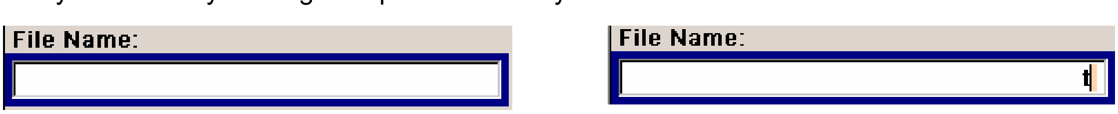
Clicking the rotary knob (= Enter) activates the editing mode. Set the cursor to the left of the number to be changed using the left/right arrow keys. The value at the cursor position is varied. An increase or decrease of the value depends on the cursor used (up/down) or on the direction of rotation of the rotary knob.



Alphanumeric values can either be newly entered or existing values can be edited (e.g. file name).

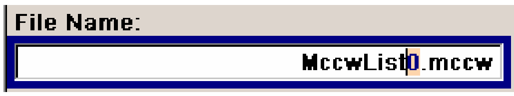
New entry:

The entry is started by clicking an alphanumeric key.



Editing:

An existing value, e.g. a file name, can be changed in the insert mode (see example) or in the overwrite mode.



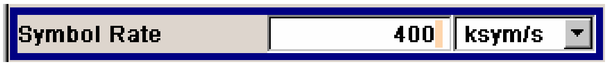
Function	Front panel	PC keyboard	Mouse
Enters a new value	Press an alphanumeric key. If **hexadecimal values** are to be entered, the numeric front-panel keys are automatically changed to hexadecimal values.	Press a letter key or a numeric key.	-
Edits a value	Click the rotary knob. Select the desired numeric digit with the rotary knob and mark it by clicking the button. Change the number using the keypad. Use the INSERT key to toggle between the insert and overwrite mode.	Press the Enter key. Select the desired numeric digit using the left/right arrow keys. Enter new value using the keyboard. Use the Insert key to toggle between the insert and the overwrite mode.	Click the desired position to set the cursor. Change the value using the keyboard.
Varies a value	Click the rotary knob. Select the desired numeric digit with the rotary knob and mark it by clicking the button. Vary the number using the rotary knob.	Press the Enter key. Select the desired numeric digit using the left/right arrow keys. Vary the number using the up/down arrow keys.	-

Selecting a Unit - Setting Parameters

The entry of a numeric value can be terminated by pressing a unit key on the front panel, selecting a unit in the selection field next to the value or by clicking the rotary knob (= Enter). The unit is assigned in different ways:

Terminating the value entry by pressing the unit key

When the entry is terminated with a unit key on the front panel, the key assigns the unit to the value. In the example, the M/µ key assigns Msym/s to the entered value 14.

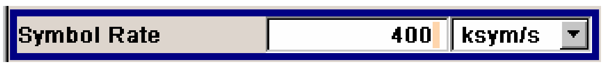


+

yields

Terminating the value entry by selecting a unit in the units field

When the entry is terminated by selecting a unit in the units field next to the value, the selected unit is assigned, e.g. sym/s (for list selection see next section).



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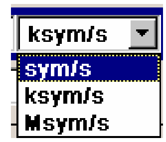
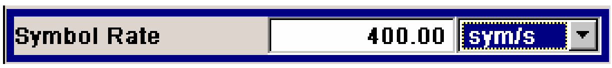
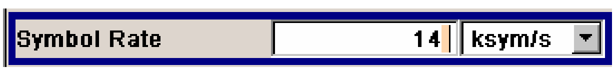


yields



Terminating the value entry with Enter

If an entry is terminated by clicking the rotary knob (= Enter) or with the [ENTER] key, the unit displayed in the entry field next to the value is assigned (in the example ksym/s).



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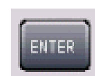
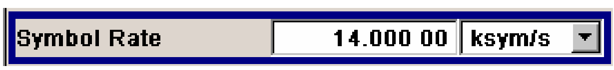


yields

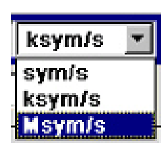


If a unit is subsequently changed, i.e. after the entry has been terminated and when the editing mode is not active, the value remains unchanged but the display is automatically adapted to the new unit. This applies if the unit is changed by means of the unit keys on the front panel or via the unit field next to the value.

\+

or

\+



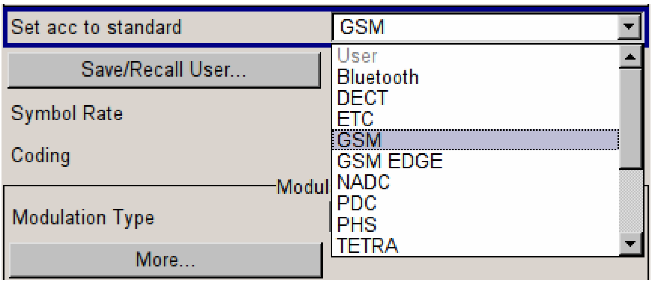
yields

Function	Front panel	PC keyboard	Mouse
Assigns a unit	To terminate the entry, press one of the [unit] keys or select unit in the field at the right of the value (for list selection see next section).	To terminate the entry press one of the key combinations ALT + F9/ + F10/+ F11/+ F12 or select unit in the field at the right of the value (for list selection see next section).	Select unit in the field at the right of the value **before** entering the value (for list selection see next section).
Changes a unit	After the value entry has been terminated press a [unit] key or select unit in the field at the right of the value (for list selection see next section).	After the value entry has been terminated press one of the key combinations ALT + F9/+ F10/+ F11/+ F12 or select unit in the field at the right of the value (for list selection see next section).	Select unit in the field at the right of the value **after** the value entry (for list selection see next section).

Selecting a Value from a List - Setting Parameters

The button next to the value field indicates that a selection list is available.

- Clicking the rotary knob (= Enter) opens the list. Selection is made by choosing an entry (item is highlighted) and confirmation with ENTER. If the list is longer than the displayed window, a scroll bar is available.



Function	Front panel	PC keyboard	Mouse
Opens the selection list	Press rotary knob or ENTER key.	Press Enter key.	Click button.
Selects an entry	Select entry using the rotary knob or the up/down arrow keys and confirm with the rotary knob or the ENTER key or press TOGGLE key several times until the desired entry is displayed in the selection field.	Select entry using the up/down arrow keys and confirm with the Enter key.	Double-click the desired entry.
Scrolls	Shift the displayed list section using the rotary knob or the up/down arrow keys.	Shift the displayed list section using the up/down arrow keys.	Press or button in the scroll bar until the desired entry is displayed.

Terminating Entries - Setting Parameters

Variations by means of the rotary knob are immediately set, e.g. RF frequency variation.
All other parameter settings have to be confirmed by a pressing the rotary knob or one of the unit keys (see also section "Selecting a Unit", page 3.21).

Some settings require additional confirmation with the **Accept** button. This is the case when it is useful to first enter a few values and to confirm them together, e.g. when carriers for a multicarrier CW signal are defined in the carrier table. Settings not yet confirmed by **Accept** are displayed in the menu on a yellow background. This indicates that the currently displayed values do not represent the desired signal.

All settings of instrument functions that can be switched on and off are calculated and effective only after this function has been switched on.
This applies to most settings on the R&S SMBV. An exception is, for instance, the frequency variation of the reference oscillator, which is immediately set after confirmation.
Calculation and setting may take up different periods of time. Many settings are made without noticeable calculation times. If a short period is required, **BUSY** is displayed during this time in the status field of the header section. If more time is required for calculation, a window with a progress bar is displayed.

Calculation can be aborted with the **Abort** button in this window.
If time-consuming calculations are required, signal generation is automatically switched off and calculation is interrupted to allow the user to make further settings. Calculation is restarted with the RECALC key and the modulation is switched on again when the calculation is completed.

Hint:
If several settings are to be made for an instrument function, recalculation of the signal can be prevented by switching the function off. When the function is switched on again after all parameter have been changed, the signal is recalculated only once.

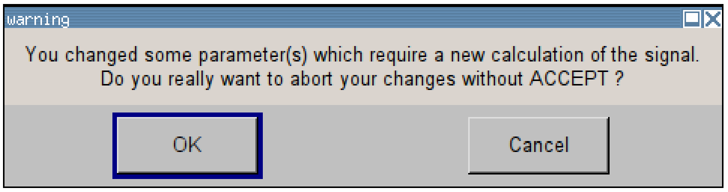
Function	**Front panel**	**PC keyboard**	**Mouse**
Accepts value immediately	Vary the value using the rotary knob or the up/down arrow keys.	Vary the value with the up/down arrow keys.	-
Confirms entries	Press rotary knob or ENTER key or press unit key.	Press Enter key or one of the key combinations ALT + F9/+ F10/+ F11/+ F12.	Exit entry field.
Confirms entries in the menus with the Accept button.	Press **Accept** button.	Select **Accept** button with the arrow keys and press Enter.	Click **Accept** button.
Sets the entries in the instrument	If the instrument function is active, the new value is immediately calculated and set. If the instrument function is not active, the new, confirmed value is calculated and set only when the function is switched on.	(see front panel)	(see front panel)

Restoring the Previous Value - Setting Parameters

Parameter variations with the rotary knob are immediately set and therefore not reversible.
Normally, values cannot be restored also in the case of mouse control because no explicit confirmation is required in this case and entries are automatically confirmed when the entry or selection field is exited.

In the case of front-panel control or operation from the keyboard, previous values can be restored as long as the new value is not confirmed, i.e. the entry is not completed. This can be done with the ESC key.

With settings requiring an additional confirmation with the **Accept** button, all settings are aborted when the ESC key is pressed. Before the changes are aborted, a confirmation query is displayed. If **OK** is clicked, the changes are aborted; if **Cancel** is clicked, the menu with the previous settings is displayed again.



When a window with a progress bar is displayed in the case of extended calculations, the calculation can be terminated with the **Abort** button. In this case all previous values are restored.

Function	Front panel	PC keyboard	Mouse
Restores previous values	Press the ESC key before the entries are confirmed.	Press the Esc key before the entries are confirmed.	-
Restores all previous values in menus with Accept button	Press the ESC key. Answer the confirmation query with OK (see above).	Press the Esc key. Answer the confirmation query with OK (see above).	Click the ☒ button. Answer the confirmation query with OK (see above).
Restores all previous values after an extended calculation has been started	Press the **Abort** button in the progress bar.	Select the **Abort** button in the progress bar using the arrow keys and press the Enter key.	Click the **Abort** button.

Menu Operation

Menus are operated with the aid of the Winbar buttons and with the HIDE, CLOSE, DIAGRAM and REARR keys on the front panel.

If the Winbar is covered by a menu, it can be called to the front with the WINBAR key.

- The DIAGR key moves the cursor to the block diagram. All active menus are minimized and displayed in the form of Winbar buttons.
- The CLOSE key closes an active menu.
- The HIDE key minimizes an active menu. It is displayed in the form of a Winbar button.
- The REARR key rearranges all open menus so that they overlap as little as possible.
- The WINBAR key toggles the cursor between a Winbar button and the block diagram.

Note:

The ESC key also closes the active menu if the cursor is at the highest menu level.

Function	Front panel	PC keyboard	Mouse
Displays the block diagram in the foreground	Press the DIAGR key.	Press CTRL + D.	Click function block.
Displays a menu in the foreground	Press the WINBAR key	Press CTRL + F1 to F6.	Click the respective button in the Winbar.
Minimizes an active menu	Press the HIDE key.	Press CTRL + H.	Click the ▁ button in the menu bar.
Closes an active menu	Press the CLOSE key.	Press CTRL + G.	Click the ☒ button in the menu bar.
Hides all menus	Click the DIAGR key.	Press CTRL + D.	-
Automatically arranges displayed menus	Click the REARR key.	Press CTRL + A.	- The menus can be shifted with the mouse as required. The frequency and level fields and the info line cannot be covered, however.

Editors

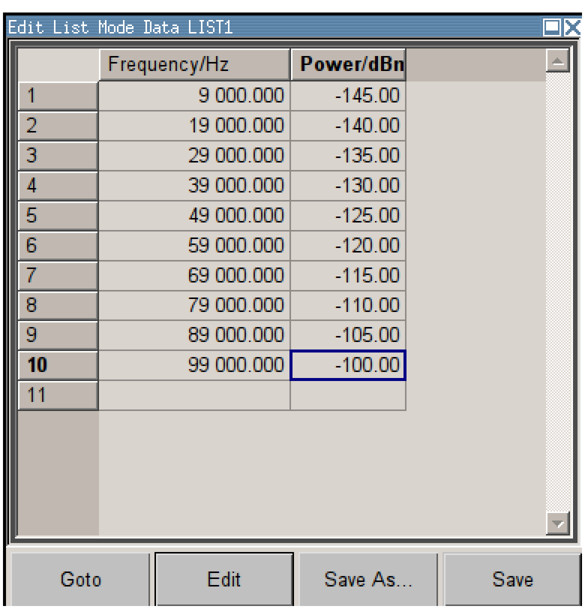
The R&S SMBV provides user-friendly editors for defining data lists as well as control and marker signals. Lists containing frequency and level value pairs are used for the list mode and the user-defined level correction. Internally generated data lists can be used for digital modulation and digital standards; the same applies to internally defined control and marker signals.

The lists are saved to files and may thus have any length. The file name of the lists and the directory to which the files are saved are user-selectable. The file prefix is different for each list type and is permanently assigned by the system (see section "File Management", page 3.36).

List Editor

The **User Correction** and **List Mode** menus provide the list editor for defining the frequency/level value pairs. The associated buttons call up the list editor.

- The selected list is displayed. If no list has been selected, a blank list of only one row is displayed.



- The value pairs are entered in the **Frequency/Hz** and **Power/dBm** table columns. A blank row is inserted at the end of the list.
- New rows can be inserted anywhere in the table by means of the **Edit** button.
- After the list has been edited, i.e. changed, it can be saved under its current name by means of the **Save** button, or under a new name by means of the **Save as...** button. Only complete value pairs are taken into consideration; rows containing an entry in only one column are ignored.
- An existing list can be edited in the insert or overwrite mode.
- A new list can be created under a new name either by generating a blank file in the **File Select** menu (see section "File Management", page 3.36) or by changing an existing list which will then be saved under a new name.

Function	Front panel	PC keyboard	Mouse
Call up editor The cursor marks the first row of the Frequency/Hz column.	Use the rotary knob or the cursor keys to mark the **Edit xxx Data...** button in the individual menu, click the rotary knob or press the ENTER key.	Mark the **Edit xxx Data...** button in the individual menu and press the Enter key.	Click the **Edit xxx Data...** button in the individual menu.
Enter value	Use the numeric keys to enter the value and terminate the entry by pressing the unit key.	Use the numeric keys to enter the value and terminate the entry by pressing the Enter key.	-
Change column	Press the left/right cursor keys.	Press the left/right cursor keys.	Click cell.
Change row	Use the rotary knob or the up/down cursor keys to mark the row.	Use the up/down cursor keys to mark the row.	Click cell.
Select row The cursor moves to the selected row.	Use the rotary knob or the cursor keys to mark the **GoTo** button, click the rotary knob or press the ENTER key. Enter the row index in the entry field by means of the numeric keys, click the rotary knob or press the ENTER key.	Mark the **GoTo** button and press the Enter key. Use the numeric keys to enter the row index and terminate the entry by pressing the Enter key.	Click cell.
Insert row A row is inserted above the currently marked row. If no row has been selected, a row is inserted at the beginning of the list.	Select the row above which the new row is to be inserted. Use the rotary knob or the cursor keys to mark the **Edit** button, click the rotary knob, in the submenu select **Insert Row** or press the ENTER key.	Select the row above which the new row is to be inserted. Mark the **Edit** button, in the submenu select **Insert Row** and press the Enter key.	Click the row above which the new row is to be inserted. Click the **Edit** button and in the submenu select **Insert Row**.
Save list under a new name	Use the rotary knob or the cursor keys to mark the **Save as..** button, click the rotary knob or press the ENTER key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Mark the **Save as..** button and press the Enter key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Double-click the **Save as...** button. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).
Save list under the same name	Use the rotary knob or the cursor keys to mark the **Save** button, click the rotary knob or press the ENTER key.	Mark the **Save** button and press the Enter key.	Double-click the **Save** button.
Create new list	Mark the **List Mode Data** or **User Correction Data** button, click the rotary knob or press the ENTER key. Mark Create New List, click the rotary knob or press the ENTER key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Mark the **List Mode Data** or **User Correction Data** button and press the ENTER key. Mark Create New List and press the Enter key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Double-click the **List Mode Data** or **User Correction Data** button. Double-click Create New List. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).

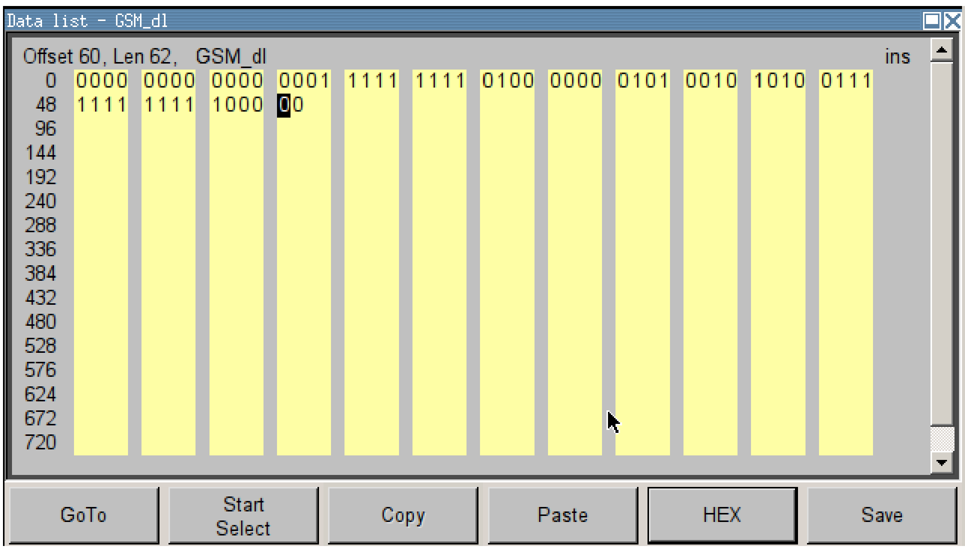
Data Editor

The **Data Editor** can be used to internally generate binary data lists for digital modulation and digital standards.

A list of binary values with a maximum length of 2^31 bits can be entered in the **Data Editor**. This value corresponds to a file size of approx. 268 Mbyte. While it is being processed, the file is continuously automatically buffered. When the menu is exited, the file is automatically saved with the new values, i.e. there is no extra **Save** button. Depending on the size of the file, saving may take some time.

It is called up in the individual menus by means of the **Edit Data List...** button.

- The selected data list is displayed.



- To increase readability, the bits are displayed in groups of four. The current cursor position, the length of the list and the list file name are displayed above the list. The offset starts with the value 0 which corresponds to the bit position on the left side of the first row, i.e. the beginning of the list. On the left edge of the editor, the last three offset positions are specified at the beginning of the row.
- An existing list can be edited in the insert or overwrite mode.
- By means of the **GoTo** button, any bit position can be accessed.
- By means of the **Start Select**, **Copy** and **Paste** buttons, any range of bits can be marked, copied and subsequently pasted at any position in the list.
- By means of the **HEX** button, switchover to hexadecimal display is possible.
- For a new list to be edited, it must first be created in the **File Select** menu (see section "File Management", page 3.36) and then selected.

Function	Front panel	PC keyboard	Mouse
Call up editor. The cursor marks the start value of the list.	Use the rotary knob or the cursor keys to mark the **Edit Data List...** button in the list management submenu of the individual menu, click the rotary knob or press the ENTER key.	Mark the **Edit Data List...** button in the list management submenu of the individual menu and press the Enter key	Click the **Edit Data List...** button in the list management submenu of the individual menu.

Function	Front panel	PC keyboard	Mouse
Enter value. Depending on selected mode, either insertion or overwrite, the value is either inserted or it replaces an existing value.	Use the numeric keys to enter the values 0 or 1.	Use the numeric keys to enter the values 0 or 1.	-
Delete value. The value before the marked bit is deleted.	Use the rotary knob or the cursor keys to mark the bit that follows the value to be deleted. Press the INSERT key to activate the insertion mode. Values cannot be deleted in the overwrite mode. Press the BACKSPACE key.	Use the cursor keys to mark the bit that follows the value to be deleted. Press the Insert key to activate the insertion mode. Values cannot be deleted in the overwrite mode. Press the Backspace key.	-
Select bit position. The cursor marks the bit at the selected position.	Use the rotary knob or the cursor keys to mark the **GoTo** button, click the rotary knob or press the ENTER key. Enter the bit position in the GoTo Offset entry field by means of the numeric keys, click the rotary knob or press the ENTER key.	Mark the **GoTo** button and press the Enter key. Use the numeric keys to enter the bit position in the Offset entry field and terminate the entry by pressing the Enter key.	Click bit.
Copy and paste bits. The selected and copied bits are pasted after the selected position.	Use the rotary knob or the cursor keys to mark the start bit of the selection. Press the ESC key. Use the rotary knob or the cursor keys to mark the **Start Select** button, click the rotary knob or press the ENTER key. Use the rotary knob or the cursor keys to mark the selection. Press the ESC key. Use the rotary knob or the cursor keys to mark the **Copy** button, click the rotary knob or press the ENTER key. Use the rotary knob or the cursor keys to mark the insert position. Press the ESC key. Use the rotary knob or the cursor keys to mark the **Paste** button, click the rotary knob or press the ENTER key.	Move the cursor to the start of the selection. Press the ESC key. Mark the **Start Select** button and press the Enter key. Move the cursor to the end of the selection. Press the ESC key. Mark the **Copy** button and press the Enter key. Move the cursor to the insert position. Press the ESC key. Mark the **Paste** button and press the Enter key.	Click the bit at the start of the selection. Click the **Start Select** button. Click the bit at the end of the selection. Click the **Copy** button. Click the bit position after which the copied bits should be pasted. Click the **Paste** button.
Display and edit the values in hexadecimal form. Each four bits are displayed as a hexadecimal value: To increase readability, the hexadecimal values in turn are displayed in pairs of two. The hex functions are automatically assigned to the numeric keys at the front panel.	Use the rotary knob or the cursor keys to mark the **Hex** button, click the rotary knob or press the ENTER key.	Mark the **Hex** button and press the Enter key.	Click the **Hex** button.

Function	Front panel	PC keyboard	Mouse
Save list. The list is saved automatically when the menu is closed.	Press the ESC key.	Press the ESC key.	Click the ☒ button in the menu bar.
Create new list.	Mark the **Data List...** button in the list management submenu of the individual menu, click the rotary knob or press the ENTER key. Mark Create New List, click the rotary knob or press the ENTER key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Mark the **Data List...** button in the list management submenu of the individual menu and press the Enter key. Mark Create New List and press the Enter key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37)	Double-click the **Data List...** button in the list management submenu of the individual menu. Double-click Create New List. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37)

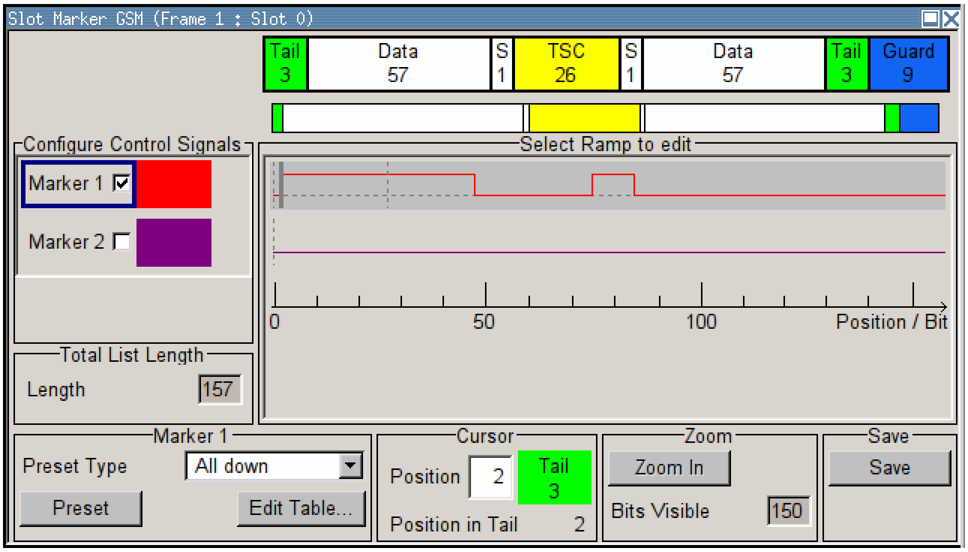
Control and Marker List Editor

The control and marker signals for digital modulation and digital standards can be very conveniently graphically defined in a **Control and Marker List Editor**.

The two available marker signals – and, with custom digital modulation, the CW, Hop, Burst Gate and Lev Att control signals – can be defined in the **Control and Marker List Editor**. While it is being processed, the file is continuously automatically buffered. When the menu is exited, the file is automatically saved with the new values, i.e. there is no extra **Save** utton. Depending on the size of the file, saving may take some time.

The **Control List Editor** is called up in the Custom Digital Mod menus by means of the **Edit Control List...** button.
The **Slot Marker Definition** Editor is called up in the Burst submenu of the GSM/EDGE menus by means of the **Slot Marker Definition...** button.

The following figure shows the **Slot Marker Definition** Editor of the GSM/EDGE menu as an example.

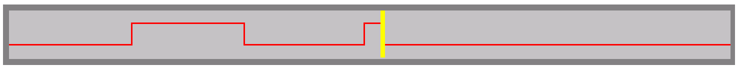


- The upper area displays the signal (in the example, the GSM slot) for which the marker signals are to be defined. On the left side, the available signals (marker and control signals) are listed and colour-coded.
- Auxiliary functions are offered in the lower editor area, e.g. presetting for the ramps in the marker signal, cursor positioning by entering the bit position and possible editing by means of value entries in a table.
- The actual graphic definition of the control signals occurs in the center area of the editor.
  Each control signal is represented by means of a colored line along the bit axis. A cursor can be shifted alongside this line and marks the position where a ramp is to be set.

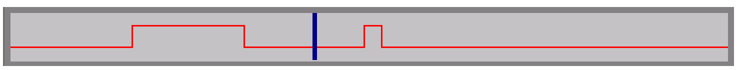
The color of the cursor changes depending on the current function. The switch over between the colors (and therefore functions) is by means of the Enter key:

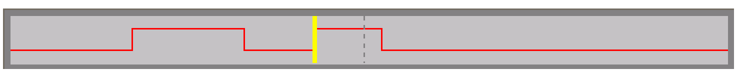
black	marks the bit position on the marker line
yellow	sets a ramp
green	activates the marked ramp for shifting

- The ramp transition of the newly set ramp depends on the current status (high/low) of the control signal. If the signal is low, a ramp with low/high transition is generated; if the signal is high, a ramp with high/low transition is generated.

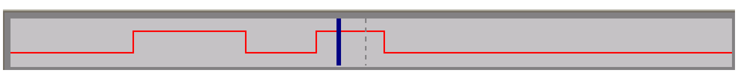


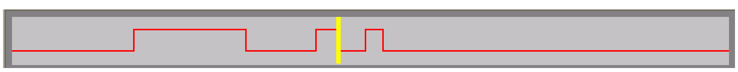
When ramps are set between existing ramps, the transition of the new ramp is also defined by the status of the signal before the new ramp. For this reason, a ramp that has already been set can be assigned low/low or high/high transition (as in the example), i.e. it will have no effect on the control signal in this configuration. However, the ramp remains saved, and its position is indicated by a dashed line.



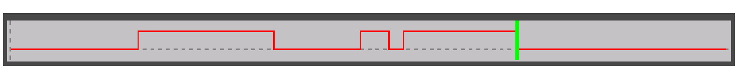


If another change produces effective transition, this ramp will be regenerated.





- An existing ramp can be shifted to any positions. The transitions are adjusted accordingly.



- To make the setting easy, a selection of preset ramp characteristics is offered in the **Preset Signal** area.
- In the **Cursor** area, the cursor can be specifically set to a defined bit position in the data signal.
- The ramps can also be set in the table in the **Marker Positions** area.

The various functions of the editor are explained in the individual menus. The following table explains only the general use of the graphic editor.

Function	Front panel	PC keyboard	Mouse
Call up editor The cursor marks the first control signal in the list on the left side of the menu.	Use the rotary knob or the cursor keys to mark the button in the individual menu, click the rotary knob or press the ENTER key.	Mark the button in the individual menu and press the Enter key.	Click the button in the individual menu.
Activate control/marker signal line for editing The cursor is active for the selected line.	Use the rotary knob or the cursor keys to mark the editable graphic area, click the rotary knob or press the ENTER key. Use the rotary knob or the cursor keys to mark the control/marker signal line, click the rotary knob or press the ENTER key.	Use the cursor keys to mark the editable graphic area and press the Enter key. Use the cursor keys to mark the control/marker signal line and press the Enter key.	Click row.

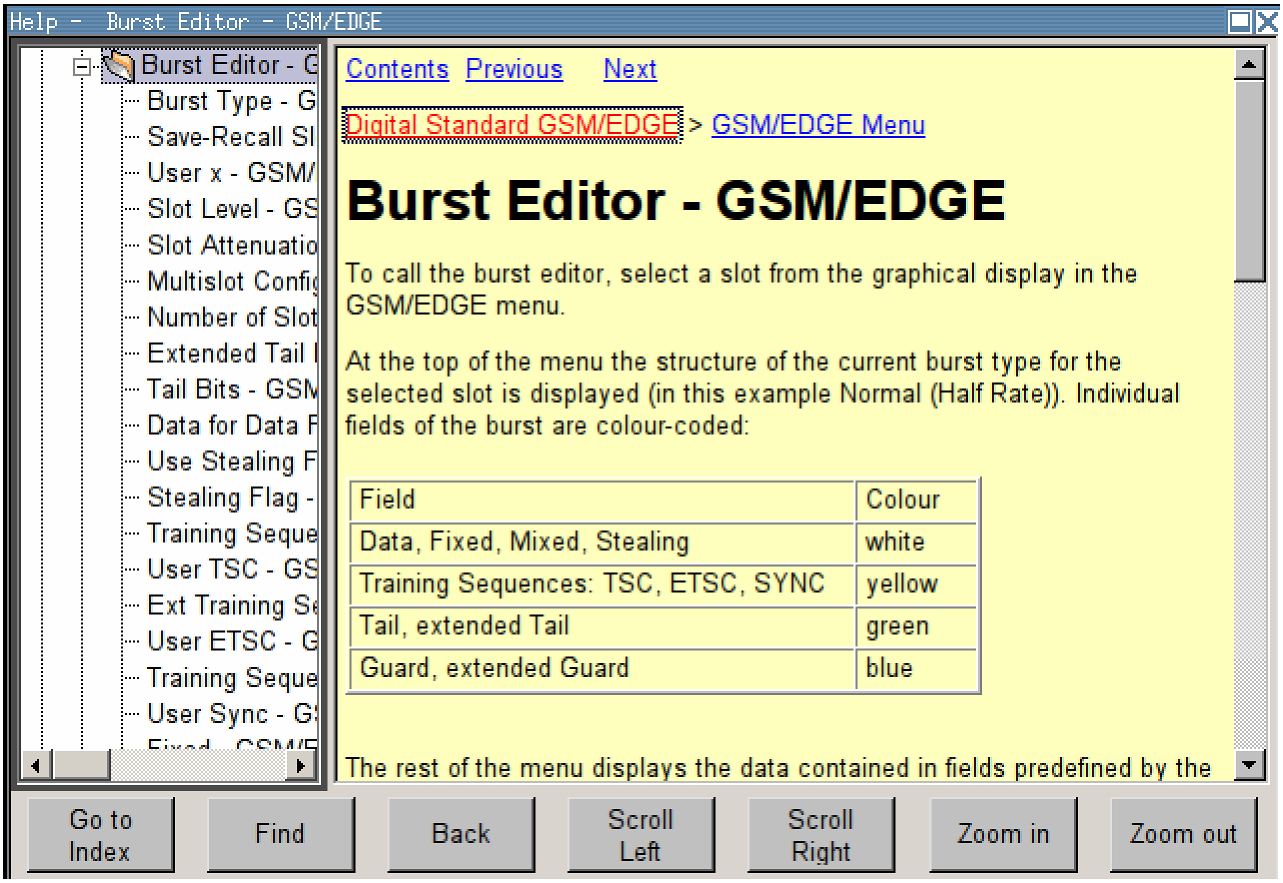
Function	Front panel	PC keyboard	Mouse
Set ramp The ramp transition depends on the status (high/low) of the control/marker signal before the ramp.	Use the rotary knob or the cursor keys to move the cursor to the position where the ramp is to be inserted. Click the rotary knob or press the ENTER key.	Use the cursor keys to move the cursor to the position where the ramp is to be inserted. Press the Enter key.	Double click cursor; the cursor changes colour and the ramp is inserted.
Shift ramp The ramp transition depends on the status (high/low) of the control/marker signal before the ramp.	Use the rotary knob or the cursor keys to move the cursor to the ramp position; the cursor changes colour. Click the rotary knob or press the ENTER key. The cursor again changes colour. The ramp will now be shifted by means of the cursor. Click the rotary knob or press the ENTER key. The ramp will be set at the current position.	Use the cursor keys to move the cursor to the ramp position; the cursor changes colour. Press the Enter key. The cursor again changes colour. The ramp will now be shifted by means of the cursor. Press the Enter key. The ramp will be set at the current position.	After double-clicking the cursor, click it once again and, while holding down the left-hand mouse button, drag it. The cursor changes colour. The ramp is set as soon as the left-hand mouse button is released.
Delete ramp The ramp transitions of the other ramps are adapted to the changed signal status (high/low).	Use the rotary knob or the cursor keys to move the cursor to the ramp position; the cursor changes colour. Press the BACKSPACE key. The ramp will be deleted.	Use the cursor keys to move the cursor to the ramp position; the cursor changes colour. Press the Delete key. The ramp will be deleted.	-
Define length of control list (Custom Dig Mod only)	Use the rotary knob or the cursor keys to mark the Total List Length entry field, click the rotary knob or press the ENTER key. Enter the length by means of the numeric keys. Click the rotary knob or press the ENTER key. The control list length is defined.	Use the cursor keys to mark the Total List Length entry field and press the Enter key. Enter the length by means of the numeric keys. Press the Enter key. The control list length is defined.	-
Zoom displayed range (Custom Dig Mod only) Approx. 300 bits around the current cursor position are displayed.	Use the rotary knob or the cursor keys to mark the **Zoom in** button, click the rotary knob or press the ENTER key.	Use the cursor keys to mark the **Zoom in** button and press the Enter key. Enter the length by means of the numeric keys. Press the Enter key. The control list length is defined.	Click the **Zoom in** button.
Save list The list is saved automatically when the menu is closed.	Press the ESC key.	Press the ESC key.	Click the X button in the menu bar.
Create new list (Custom Dig Mod only)	Mark the **Control List...** button in the list management submenu of the individual menu, click the rotary knob or press the ENTER key Mark Create New List, click the rotary knob or press the ENTER key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Mark the **Control List...** button in the list management submenu of the individual menu and press the ENTER key Mark Create New List and press the Enter key. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).	Double-click the **Control List...** button in the list management submenu of the individual menu. Double-click Create New List. Enter the file name in the File Select menu and select the directory (see section "File Select Menu", page 3.37).

Help system

The R&S SMBV is equipped with a context-sensitive help function. A help page is available for each parameter and can be called any time during instrument operation. The context-sensitive page which is opened with the HELP key is part of a comprehensive help system. It is possible to move from this context-sensitive page to any page of the help system.

Note:

Compiled online help systems are also available for all functions of the R&S SMBV on the CD-ROM supplied with the instrument. This help program can be called on any controller with Internet Explorer version V 4.0 and higher.



The help function is provided with a navigation bar, i.e. other help pages can be called from the context-sensitive page via the table of contents, the index, arrows for scrolling and page-internal links.

Operation of context-sensitive help

Function	Front panel	PC keyboard	Mouse
Open the help system The help page for the respective parameter is displayed.	Press HELP key.	Press F1 key.	-
Close the help system	Press HELP key again.	Press F1 key again.	-
Activate the link The help system branches to the linked page.	Select link with rotary knob or arrow keys and activate by clicking the rotary knob or ENTER key.	Select link using the arrow keys and activate with the Enter key.	Click link.
Scroll	Select **Previous** or **Next** in the help window using the arrow keys and activate by clicking the rotary knob or the ENTER key.	Select **Previous** or **Next** in the help window using the arrow keys and activate with the Enter key.	Click **Previous** or **Next.**
Select an item in the table of contents The help page of the item is displayed.	Activate Content window using the arrow keys left/right. Select the desired item using the rotary knob or the arrow keys up/down and activate by clicking the rotary knob or the ENTER key.	Activate Content window using the arrow keys left/right. Select the desired item using the arrow keys and activate with Enter.	Set indicated area by moving the vertical scroll bar. Click item.
Select an index term The help page of the term is displayed.	Select **Go-to-Index** button using the arrow keys and activate by clicking the rotary knob or the ENTER key. Enter the first letter of the term in the entry field. Select the term using the rotary knob or the arrow keys and press the rotary knob or the ENTER key.	Select the **Go-to-Index** button using the arrow keys and activate with the Enter key. Enter the first letter of the term and press the Enter key. Select the term with the arrow keys and press the Enter key.	Click the **Go-to-Index** button. Set indicated area by moving the vertical scroll bar. Click term.
Shift the indicated area of the navigation window to the left or right	Shift the entry focus up one level using the ESC key. Select **Scroll Right** or **Scroll Left** -button using the arrow keys and activate by clicking the rotary knob or the ENTER key.	Shift the entry focus up one level using the Esc key. Select **Scroll Right** or **Scroll Left** -button using the arrow keys and activate with the Enter key.	Set indicated area by moving the horizontal scroll bar.

File Management

The R&S SMBV uses files to save all instrument data, i.e. system and user data. The user data includes saved instrument settings, data for the different digital standards, lists for the List mode and the user correction as well as the waveforms for the arbitrary waveform generator.

The files are stored on the internal flash card of the instrument, on a USB-stick or on the a hard disk (R&S SMBV-B92). Both, the /var directory on the internal flash card or the /hdd directory on the hard disk (R&S SMBV-B92), can be used to save user-defined data. Any directory structure can be created on /var and /hdd. Some default subdirectories are predefined, but can be changed at any time.
The /opt directory is a protected system drive nad therefore unaccessible system directory on the internal flash card. The files on this directory contain data that must not be changed. Therefore, this drive should not be accessed, since reconstruction of the system partition will lead to data loss. To prevent inadvertent deletion or overwriting of system files, this drive is not specified in the file menus.
Files can be exchanged either via a memory stick or a connected network. A memory stick is connected to the USB interface and is accessed via the **File** menu.

The user data can be roughly divided into four data types:

- Settings
- Lists
- Complex modulation and control data
- Waveforms

The files are accessed in a **File Select** window in the individual menus. Depending on the data type, a file can either be selected or it can be selected and saved:

- Settings, e.g. the frame setting of the GSM/EDGE standard, can be loaded and saved. In this case, the current setting is saved to the specified file.

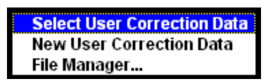
- Lists, e.g. user correction lists, can be loaded. They can be generated either externally or internally. For internal generation, a new list must be created in the **File Select** window which will then be edited in the list editor of the individual menu.

- Complex modulation and control data can be loaded. It can be generated either externally or internally. For internal generation, a new list must be created which will then be edited in the data and control list editor. These functions are offered in the **Data List Management** window of the individual modulation menu.

- Waveforms are generated externally (e.g. by means of the R&S WinIQSIM program that is supplied together with the optional Baseband Generator R&S SMBV-B10) and can be loaded in the **Arbitrary Waveform Generation** menu.

The files are differentiated according to their extensions; each type of file is assigned a specific file content. The extension is usually of no consequence to the user since access to the files occurs in the individual menus where only the relevant type of file is available. For example, files with frame settings can only be saved and loaded in the **GSM/EDGE** menu.

A button in the individual menu calls up the selection of the **Save**, **Recall** and **File Manager** functions. If the file can only be loaded, the **Select** or **Load** and **File Manager** selection is available.



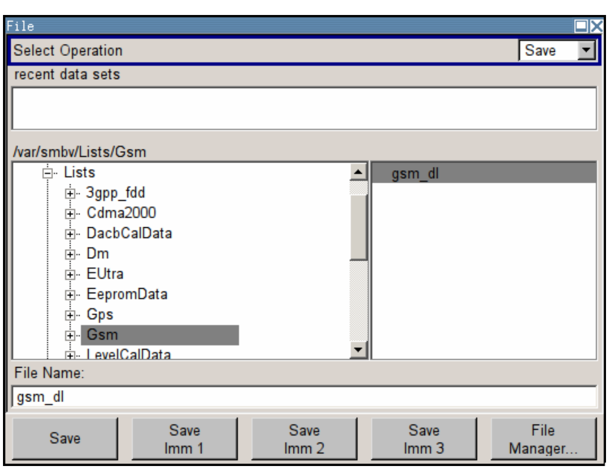
After the **Save/Recall** or **Select/New** selection, a **File Select** window for loading, saving or creating a file is displayed (see the following section "File Select Menu", page 3.37).

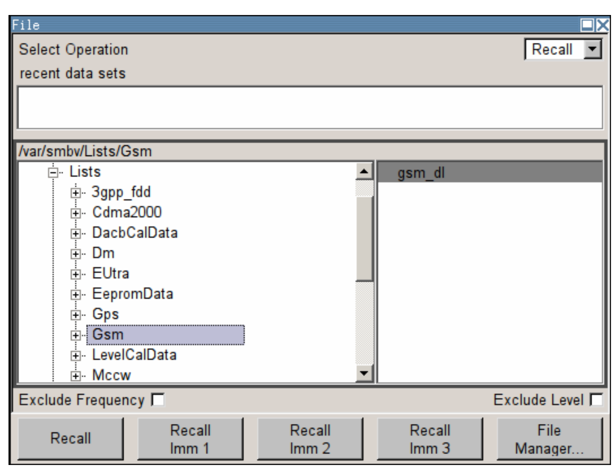
After the **File Manager** selection, a menu for managing all files is displayed (see section "File Manager", page 3.39).

All instrument settings are saved and loaded in the **File** menu which is called up by means of the [File] key (see chapter 4, section "Storing and Loading Instrument Data - File Key").

File Select Menu

The **File Select** menu consists of several areas.





In the upper area, **Recent Data Sets**, the files last used are listed; a maximum of ten files is displayed. The available drives and directories are displayed on the left side, the files of the selected directory on the right side. The currently selected path is displayed above the windows. Only the relevant files without file extensions are displayed. If the area is opened several times, the path last selected is displayed.

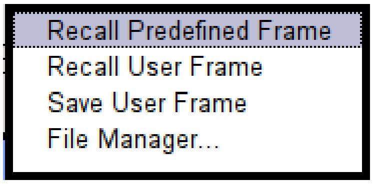
When a file is saved or created, its name is user-selectable; the extension is assigned automatically and cannot be entered.

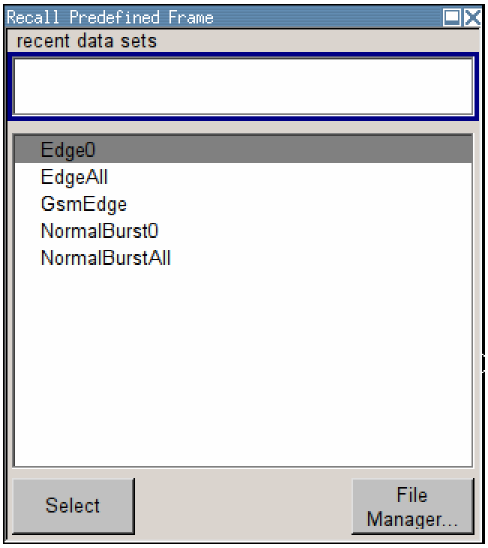
The file is saved to the selected path.

Operation is similar to the operation of menus with several areas (see section "Selecting and Exiting a Menu Area - Setting Parameters", on page 3.18):
By using the rotary knob or cursor keys, the area is marked; the entry focus is shifted to this area by clicking the rotary knob or using the Enter key. The rotary knob and the up/down cursor keys will then navigate only within this area. By using the left/right cursor keys, it is possible to switch between the directory tree and the file list. The subdirectories of the selected directory will only be displayed after a short delay to allow quick navigation in the directory tree. Pressing the ESC key again shifts the entry focus up one level. The button for saving or loading the file can be selected and pressed. After the setting, e.g. after selecting the file, the menu will be closed automatically.

- Load file:
  Mark file and load it by clicking the rotary knob or by pressing the **Select** button.
- Save file:
  Enter file name in the **File Name:** field. Mark the directory to which the file is to be saved and then click the **Save** button.
- Create file:
  Enter file name in the **File Name:** field. Mark the directory to which the file is to be saved and then click the **Create** button. The created file is empty; it must be filled with the necessary values in the individual editor.

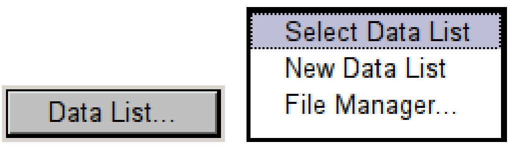
In addition to the files saved by the user, some menus also offer files containing predefined contents. These files are saved to a specific directory on system drive C.\; for this reason, this directory cannot be chosen from the **File Select** menu. The following example shows the **File Select** menu of the GSM/EDGE digital standard when **Recall Predefined Frames** is selected.



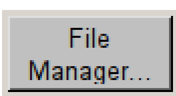


File Manager

The **File Manager** allows general file management such as copying, shifting, renaming and deleting files as well as generating new directories. Thus, also externally created files, for example waveforms created by the **R&S WinIQSIM** program, can be saved to the R&S SMBV by copying them from a memory stick or a network to the internal hard disk.
The **File Manager** can be called up in any menu to which files can be saved. Call-up is either at the level of the small selection menu



or via the **File Manager** button in the **File Select** window.



The File Manager can also be called up in the **Save/Recall - Setup-Settings** menu.
In the upper area, **File Type**, the **File Manager** allows the type file selection to be displayed. This can be used to process either all files (all files (*:*) selection) or a specific selection of files (e.g. waveforms (*.wv) selection). The table at the end of this section contains a list of the file types.
The available drives and directories are displayed on the left side, the files of the selected directory on the right side. The currently selected path is displayed above the windows. If the area is opened several times, the path last selected is displayed. Unlike the **File Select** window, the **File Manager** displays the full file names including extensions.
The buttons trigger the associated actions such as copying, shifting or deleting the marked files. Plus, a new directory can be created in the level below the marked directory.
Operation is similar to the operation of menus with several areas (see section "Selecting and Exiting a Menu Area - Setting Parameters", on page 3.18):
By using the rotary knob or cursor keys, the area is marked; the entry focus is shifted to this area by clicking the rotary knob or using the Enter key. The rotary knob and up/down cursor keys will then navigate only within this area. By using the left/right cursor keys, it is possible to switch between the directory tree and the file list. The subdirectories of the selected directory will only be displayed after a short delay to allow quick navigation in the directory tree. Pressing the ESC key again shifts the entry focus up one level. The buttons can be selected and activated.

- Shift file:
  Mark file and then press the **Cut** button. Mark the directory to which the file is to be shifted and then click the **Paste** button. If the target directory already contains a file with the same name, a confirmation query is displayed to confirm overwriting of this file.
- Copy file:
  Mark file and then press the **Copy** button. Mark the directory to which the file is to be copied and then click the **Paste** button. If the target directory already contains a file with the same name, a confirmation query is displayed to confirm overwriting of this file.

- Rename file:
  Mark file and then press the **Rename** button. An entry window for entering the new file name opens. Enter the name and press the Enter key. If a file with the same name already exists, a confirmation query is displayed to confirm overwriting of this file.
- Delete file:
  Mark file and then press the **Delete** button. Prior to deletion, a confirmation query is displayed which the user must confirm for this file to be deleted.
- Create new directory:
  Mark drive or directory level where the new directory is to be created and then press the **Create New Directory** button. An entry window for entering the directory name opens. Enter the name and press the Enter key.

Table 3-1 List of file extensions for user files the R&S SMBV assigns automatically

List type	Contents	File suffix
Instrument State		
Instrument State	Instrument settings	*.savrcl
User Correction		
User Correction	User-defined level correction values	*.uco
List Mode		
List	User-defined frequency/level value pairs	*.lsw
Frequency Response Correction		
Frequency Response Correction	User-defined frequency response correction file	*.frc
Arbitrary Waveform Generator		
Waveform Multi segment waveform	ARB waveforms ARB multi segment waveforms	*.wv
Multi carrier waveform	ARB multi carrier settings	*.arb_multcarr
Configuration data	Configuration file for creation of multisegment ARB waveforms	*.inf_mswv
DM		
Data List	Digital modulation data	*.dm_iqd
Control List	Data to control digital modulation	*.dm_iqc
Settings	Digital modulation settings	*.dm
User Standard	Digital modulation user standard	*.dm_stu
User Mapping	Digital modulation user mapping	*.vam
User Filter	Digital modulation user filter	*.vaf
GSM/EDGE		
Settings	GSM/EDGE settings	*.gsm
Slot	User-defined slot data	*.gsm_slu
Frame	User-defined frame data	*.gsm_fu
Higher symbol rate slot	Higher symbol rate slot	*.gsm_hslu
Higher symbol rate frame	Higher symbol rate frame	*.gsm_hfu
3GPP FDD		
3GPP Settings	Complete setting of the 2GPP (FDD) menu	*.3g
Channel Coding DPCH	Channel coding enhanced DPCH channels (downlink)	*.3g_ccod_dl_s
Channel Coding DPDCH	Channel coding enhanced DPDCH channels (uplink)	*.3g_ccod_ul

List type	Contents	File suffix
CDMA2000		
CDMA2000 Settings	Complete setting of the CDMA2000 menu	*.cdma2k
TD-SCDMA2000		
TD-SCDMA2000 Settings	Complete setting of the TD-SCDMA2000 menu	*.tdscdma
TD-SCDMA Test Model	Test Model for TD-SCDMA2000	*.tdtmd
1xEV-DO		
1xEV-DO Settings	Complete setting of the 1xEV-DO menu	*.evdo
IEEE 802.11 WLAN		
WLAN Settings	Complete setting of the IEEE 802.11 WLAN menu	*.wlan
IEEE 802.11 n WLAN		
WLAN n Settings	Complete setting of the IEEE 802.11n WLAN menu	*.wlann
Beamforming data	Beamforming data	*.bmf
IEEE 802.16 WiMAX		
WiMAX Settings	Complete setting of the IEEE 802.16 WiMAX menu	*.wimax
EUTRA/LTE		
EUTRA/LTE Settings	Complete setting of the EUTRA/LTE menu	*.eutra
IQW Data List	User-defined IQ-File	*.iqw
DVB		
DVB Settings	Complete setting of the DVB menu	*.dvb
DVB Transport Stream	DVB Transport Stream	*.gts *.ts *.trp

Remote Access

The R&S SMBV can be remote-accessed from an external PC. This allows convenient operation of the vector signal generator from the desktop although the instrument is integrated in a rack somewhere else.

Remote access in contrast to **remote control** does not use remote-control commands but the regular user interface displayed using separate software which is installed on the external PC. The instrument can thus be manually operated from the PC as on the unit itself.

Preconditions for remote access are a connection between signal generator and PC via a LAN network and the installation of the VNC client software on the PC and VCN server software on the R&S SMBV. Establishing the connection and installation of the remote-accessed software on the external PC is described in chapter 1, section "Connecting the R&S SMBV to a Network (LAN)", on page 1.26.

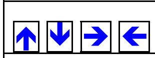
After the connection is established, the current signal generator screen with the block diagram is displayed and the R&S SMBV can be remote-accessed from the external PC. The individual functions are operated using the mouse and keyboard. Specific instrument functions can be executed using specific key combinations on the keyboard. Front-panel keys which are not directly available on the keyboard can be substituted by key combinations or by the front panel key emulation panel (see next section).

When the connection is set up, direct control on the R&S SMBV is possible while remote control is established, it can be performed alternately with the remote access.

For return to direct operation on the R&S SMBV, the connection must be closed. After closing the connection, it is still enabled and can be established again any time (see chapter 1, section "Remote Access via an External Controller", on page 1.29).

Legend of Front-Panel Controls

The following table lists all key functions available on the front panel. Key combinations used on the PC keyboard to trigger key functions on the instrument front panel are also described. Keyboard labels are described in alphabetical order.
In addition, a front panel key emulation and an on-screen keyboard can be used for manual operation by mouse only (see below).

Front-panel key	Key of PC keyboard	Function
	Tab key (towards the right) Shift + Tab (towards the left)	Sets the cursor with the rotary knob.
	Enter	Pressing the rotary knob confirms an entry; it has the same function as the ENTER key.
	Arrow keys	Moves the cursor.
*1 / dB(m)	ALT + F12	Confirms entries in the base unit and values without a unit. Selects dBm for the RF level and dB for level offset and level step width.
. / *...#	. / *...#	Enters a period/decimal point. Enters a special character.
+/- / A↔a	- / (shift+) a—z	Enters the sign. Switches between upper-case and lower-case letters.
0-9 / a...z	CTRL+ 0-9 / a...zCTRL	Enters the number/letter.
BACKSPACE	Backspace	Clears the last entry (number, sign or decimal point)
CLOSE	CTRL + G	Closes an active menu.
DIAGRAM	CTRL+ D	Sets the cursor on the block diagram and hides all menus.
ENTER	Enter	Terminates an entry.
ESC	ESC	Selects the next higher menu/selection level. When the editing mode is exited with ESC, the previous value is restored.
FILE	CTRL + S (storage under Windows)	Activates the menu for storing instrument settings.
FREQ	CTRL+ F	Activates the frequency entry.
G/n / dBµV	ALT + F9	Selects the unit Giga/Nano, dBµV for the RF level and dBu for the LF level.
HCOPY	CTRL+ Y	Opens the menu for configuring and starting a hardcopy.
HELP	F1	Opens/closes context-sensitive help.
HIDE	CTRL+ H	Minimizes the active menu.
INFO	CTRL + I	Opens/closes the info window
INSERT	Ins	Activates the insert mode.
k/m / µV	ALT + F11	Selects the units Kilo/Milli and µV for RF levels.
LEVEL	CTRL + L	Activates the level entry.

Front-panel key	Key of PC keyboard	Function
LOCAL	CTRL + Q	Switches the instrument from remote control to manual control.
M/µ / µV	ALT + F10	Selects the units Mega/Micro and µV for RF levels.
MENU	CTRL + M	Calls the menu selection list.
MOD OFF	CTRL + O	Switches modulation on/off. MOD OFF is indicated in the status line.
TOGGLE	CTRL + T	Switches a block or parameter on/off. Toggles between the different possibilities of setting a selection parameter.
PRESET	CTRL + P	Restores a defined basic instrument setup.
REARR	CTRL + A	Adjusts the size of the active menu.
RECALCULATE	CTRL + C	Starts recalculation of the signal.
RF OFF	CTRL + R	Switches the RF output signal on/off. RF OFF is indicated in the status line.
SETUP	CTRL + E	Opens the setup menu for general instrument settings.
	CTRL + F1 – F6	Triggers the function assigned to the buttons of the winbar.
WINBAR	CTRL + W	Toggles between the active menus.

Front Panel Key Emulation

The R&S SMBV provides a front panel key emulation to enable execution of the front panel key functions by mouse e.g. for manual remote control. The emulation is called by a right mouse click. The front panel key functions are executed by a mouse click on the associated button.

Contents - Chapter 4 "Instrument Functions"

4 Instrument Functions

Overview of Instrument Functions

This chapter explains the functions of the vector signal generator and the options available in the setting menus. The associated IEC/IEEE-bus command is specified for each parameter (where applicable).

The description begins with the general instrument settings which do not directly affect signal generation. The majority of these settings can be accessed by means of front-panel softkey menus and not by means of function block menus. One exception is, for example, the signal graphics which are called up in the **Graphics** block.

The signal generation functions are then described, beginning with the RF section functions which affect the RF signal and the analog modulations and which are compiled in the **RF/A Mod** block of the block diagram.

This is followed by an explanation of all functions which are in the signal flow prior to being fed into the RF block and which do not affect the internal generation of a baseband signal - I/Q modulation and impairment of the digital signal. These functions are accessed by means of the function blocks **I/Q Mod** and **IMP**.

The remaining (and largest) part of the chapter describes the functions used for the internal generation of the signals in the baseband (these functions are provided in the **Baseband** block).

The general instrument settings include various functions, such as:

- Setting a defined basic setup using the PRESET key
  (section "Default Instrument Settings - Preset Key" on page 4.3")
- Switching from remote control to manual control using the LOCAL key
  (section "Switching to Manual Control - Local Key" on page 4.22")
- Configuring the generator and its interfaces in the **Setup** menu - e.g. setting the IEC/IEEE-bus address, starting an adjustment, querying instrument data
  (section "General Configuration of Instrument - Setup Key", page 4.5)
- Generating a hard copy of the display using the HCOPY key
  (section "Generating a Hard Copy of Display - HCOPY Key", page *4.23*)
- Calling up the online help using the HELP key
  (section "Help System - Help Key", p*age 4.29*)
- Querying messages using the INFO key
  (section "Messages - Info Key", *page 4.29*)
- Loading and storing complete instrument settings in the **File** menu
  (section "Storing and Loading Instrument Data - File Key", *page 4.31*)
- Calling up the baseband signal graphics in the **Graphics** function block
  (section "Graphical Display - Graphics", page *4.37*)

The RF signal is configured and the analog modulations activated in the **RF/A Mod** function block:

- CW mode
  (section "Overview of RF Signal and Analog Modulation", page *4.50*)
- List mode
  (section "List Mode - List", page *4.80*)
- Sweep mode
  (section "Sweep Mode", page *4.90*)
- Analog modulations
  (section "Analog Modulations", page *4.108*)

In the I/Q-Mod function block, I/Q modulation is possible with external analog signals and internally generated baseband signals.

Noise can be added to the baseband signal and the baseband signal can be impaired before input into the I/Q modulator. It is therefore possible to output a baseband signal with impairments via the I/Q-OUT outputs (**Impairment** function block). Impairment is also possible during I/Q modulation (**I/Q Mod** function block).

- I/Q modulator
  (section "I/Q Modulator - I/Q MOD Function Block", page 4.125)
- Impairing the signal prior to input into the I/Q modulator
  (section "Introduction - Impairments", page 4.133)

The baseband signal is available at the I/O outputs.

- Output of the baseband signal
  (section "Output of the Baseband Signal - I/Q Out", page 4.139)

The R&S Vector Signal Generator offers various possibilities for generating digital modulation signals in compliance with the definitions of digital standards or with characteristics which can to a large extent be freely defined. The range of software options for this is being extended continuously.

- Baseband signals - Introduction
  (section "*Baseband Signal - Baseband*, page *4.93*)
- Digital modulation
  (section "*Digital Modulation - Custom Digital Modulation*", page 4.105)
- Arbitrary waveform generator ARB
  (section "*Arbitrary Waveform Generator ARB*", page 4.129)
- Multi Carrier CW signals
  (section "*Multi Carrier Continuous Wave*")
- Digital standard GSM/EDGE
  (section "*Digital Standard GSM/EDGE*")
- Digital standard 3GPP FDD (WCDMA)
  (section "*Digital Standard 3GPP FDD (WCDMA)*)
- Digital standard 1xEV-DO
  (section "*Digital Standard 1xEV-DO*")
- Digital standard IEEE 802.11 (a/b/g) (WLAN)
  (section "*Digital Standard IEEE 802.11 (a/b/g) (WLAN)*")
- Digital Standard EUTRA/LTE
  (section *"Digital Standard EUTRA/LTE"*)
- Digital Standard DVB-H
  (section *"Digital Standard DVB-H"*)

General Instrument Settings

Overview of General Instrument Settings

The section "General Instrument Settings" describes the settings which do not directly affect signal generation.

Most of these settings can only be accessed by means of menus which are opened using. This does not apply to the graphical representation of output signals which is activated in the **Graphics** function block, or settings which can additionally be called up in the menus of the function blocks, e.g. input configuration which is possible in the **Setup** menu and in almost every menu of the **Baseband** function block.

The general instrument settings therefore affect various functions, such as storing instrument settings or setting the IEC/IEEE-bus in the menu of the SETUP key. The order in which the descriptions are given corresponds to the layout of the keys on the front panel of the Signal Generator (from top left to bottom right).

Default Instrument Settings - Preset Key

The PRESET key calls up a defined instrument setup. All parameters and switching states are preset (also those of inactive operating modes). The default instrument settings provide a reproducible initial basis for all other settings. However, functions that concern the integration of the instrument into a measurement setup are not changed, e.g. IEC/IEEE bus address or reference oscillator source settings.

Remote-control command:
`*RST`

Note:
*Resetting the instrument to the factory state is possible in the **Factory Preset - Setup Settings** menu.*

In addition, only those settings associated with the menu can be reset directly in the individual menus, e.g. all digital modulation settings in the **Custom Digital Mod** menu. These settings are identical to those which are called up using the PRESET key.

When the instrument is switched on, it is not the preset state that is active, but rather the instrument state that was set before the instrument was switched on.

User-defined instrument states can be stored and called up in the **File** menu.

The following table gives an overview of the presets for the most important generator settings. The other presets can be found in the preset tables of the individual menus and the information accompanying the IEC/IEEE-bus commands.

The list below the table shows the settings that are not affected by the PRESET key.

Table 4-1 Preset state - important generator settings

Settings	**Preset Value**
RF frequency	1 GHz
RF level	RF output switched off
Offsets	0
Modulations	Switched off
Uninterrupted level setting	Switch off; level attenuator mode: AUTO
Internal level control	Level ALC: AUTO
User correction	Level Ucor: OFF
LF output	Switched off
Sweep	Switched off
List mode	Switched off

Settings that are not affected by the PRESET key

- Reference frequency settings (Ref Oscillator menu)
- Power on settings (Level/EMF menu)
- Network settings (Setup menu)
- IEC/IEEE-bus address (Setup menu)
- *IDN? Identification and emulation (Setup menu)
- Password and settings protected by passwords (Setup menu)
- Start/Stop Gui Update (Setup menu)
- Display and keyboard settings (Setup menu).

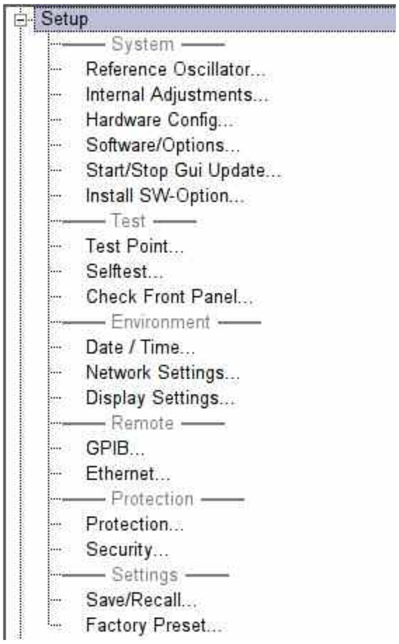
General Configuration of Instrument - Setup Key

The SETUP key opens the **System** menu. The Setup menu is divided into several sections.

- The **System** section is used to set general instrument parameters.
- The **Test** section is used to perform function tests.
- The **Environment** section is used to configure the controller interfaces.
- The **Remote** section is used to configure the remote control interfaces.
- The **Protection** is used to set the protection level for service functions.
- The **Settings** section contains the **Save/Recall** menu.

Most submenus of this key can be accessed only via the SETUP key or the menu tree (MENU key), with the following exceptions:

- The **Reference Oscillator** submenu can also be called up in the **RF / A Mod** block and is therefore described in the section on this block (see section "RF Reference Frequency - Reference Oscillator", page 4.56).
- The **Save/Recall** submenu can also be called up with the FILE key and is therefore described in the section on this key (see section "Storing and Loading Instrument Data - File Key", page 4.31).
- The **Global Trigger/Clock/ External Inputs** submenu (see section "Global Trigger/Clock/External Input Settings - Setup-Environment", page 4.16) is also available in all modulation menus of the **Baseband** function block where it can be called up with the **Global Trigger/Clock Settings** button in the trigger/marker and clock submenus.



Internal Adjustments - Setup-System

The R&S Vector Signal Generator is extremely accurate thanks to the integrated procedures for adjustments.

All internal adjustments for which no external measuring equipment is needed can be started in the **Internal Adjustments...** menu. The adjustments with external measuring equipment are described in the Service Manual (on CD ROM, supplied with the instrument).

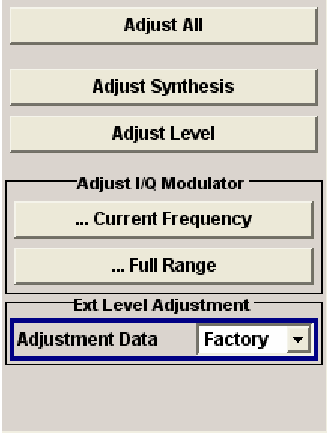
Adjustment is recommended if the temperature range in which the instrument is operated changes, or prior to all applications which require maximum level and frequency accuracy.

During adjustment a bar indicates the status of progress. If an error occurs, adjustment is terminated and an error message is output in the info line.

NOTICE **Risk of invalid adjustment**

In order to achieve correct adjustment of the instrument, make sure that the instrument is warm before performing adjustments. The warm-up time is 30 minutes.

The **Internal Adjustments** menu is opened up using the SETUP or MENU key under **System**. The adjustments offered also depend on the installed options, e.g. FM Modulator.



Adjust All - Setup Internal Adjustments

Starts all internal adjustments for which no external measuring equipment is needed. The adjustments with external measuring equipment are described in the Service Manual (supplied).

Remote-control command:
`CAL:ALL?`

Adjust Synthesis - Setup Internal Adjustments

Performs all adjustments which affect the frequency.

Remote-control command:
`CAL:FREQ:MEAS?`

Adjust Level - Setup Internal Adjustments

Performs all adjustments which affect the level. The acquired correction values improve the settling time and the signal quality.

Remote-control command:
`CAL:LEV:MEAS?`

Adjust I/Q Modulator Current Frequency - Setup Internal Adjustments

Starts the adjustment for the I/Q modulator for the currently set frequency, I/Q swap, and baseband gain. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature.

Adjustment for only the set frequency is considerably faster than adjustment across the entire frequency range. This is possible with **... Full Range**.

Remote-control command:
`CAL1:IQM:LOC`

Adjust I/Q Modulator Full Range- Setup Internal Adjustments

Starts the adjustment for the I/Q modulator for the entire frequency range. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature.

Remote-control command:
`CAL1:IQM:FULL?`

Adjustment Data - Setup Internal Adjustments

Selects the data used for external level correction.

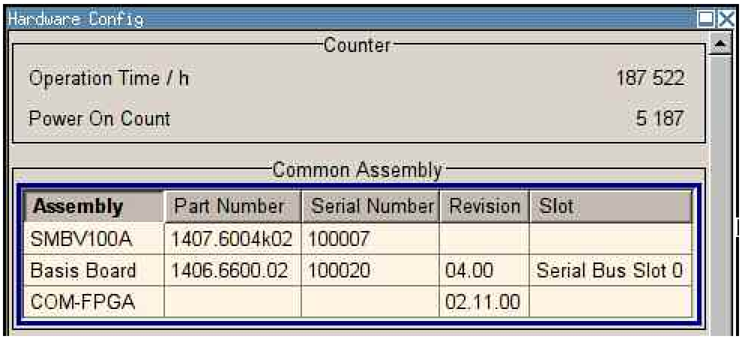
By default the instrument uses correction data obtained in the factory before delivery. In addition, customer data can be used for external level correction. The customer data is obtained using a R&S NRP power sensor. External level correction is a protected function (see service manual, chapter 2, "Adjustment").

Remote-control command:
`CAL:LEV:EXT:DATA FACT`

Hardware Config... - Setup-System

In the **Hardware Config** menu, the installed assemblies together with their variants and revision states can be displayed for servicing purposes.

The **Hardware Config** menu is opened using the SETUP or MENU key under **System**.



Section **Counter** in the upper part of the menu shows the **Operation Time** (in hours) and the number of power-on (**Power On Counter**).

Remote-control command:
`DIAG:INFO:OTIM?`
Response: `"100023"`

`DIAG:INFO:POC?`
Response: `"123"`

A table below lists the installed assemblies. It is divided into the sections **Common Assembly**, **RF Assembly** and **Baseband Assembly**.

Assembly	Assembly name
Part Number	Part Number of assembly
Serial Number	Serial Number of assembly
Revision	Revision state of assembly
At slot	Indicates whether the assembly is connected to the serial bus or PCI bus

Remote-control command:
```
DIAG:BGIN? "MBRD"
Response:
"MBRD 1141.3501.02 1.5.3 100023"
```

Software / Options... - Setup/System

The **Software / Options...** shows the firmware version of the instrument software as well as all installed hardware and software options.

Note:

Software options purchased at a later stage can be activated with a keycode. The activation code is supplied with the software option. How to install options is described in Chapter 4 of the Service Manual (supplied with the instrument).

The installation of hardware options purchased at a later stage is also described in Chapter 4 of the Service Manual (supplied with the instrument). Most hardware options need to be installed at an authorized Rohde&Schwarz service shop.

The **Software / Options** menu is opened using the SETUP or MENU key under **System**.

Remote-control commands:
`*OPT?`

Response:

`"SMBV-B106, SMBV-B10, SMBV-B1, SMBV-B61, SMBV-B90, ...."`

`*IDN?`

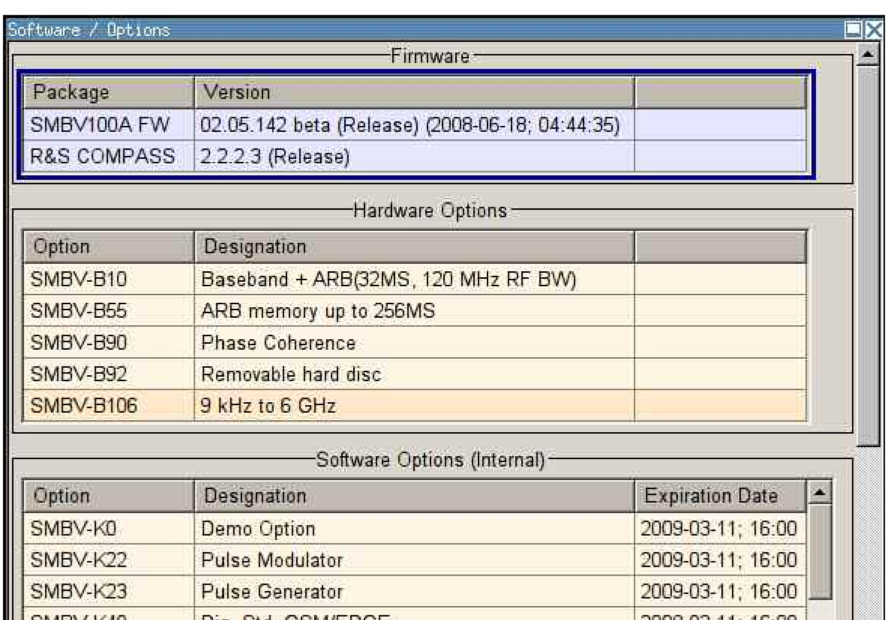
Response:

`"Rohde&Schwarz,SMBV100A,1407.6004k02/000000,2.1.64.0-02.05.140 (Release)"`

The **Firmware** section of the menu shows the firmware version and the version of the software platform.

Note:

Your R&S Signal Generator is delivered with the latest firmware version available. Firmware updates as well as the Release Notes describing the improvements and modifications are provided on the Internet at the download site of the Rohde & Schwarz Signal generator home page. This home page always offers the latest information on your signal generator, e.g. also on changes of the firmware update procedure.



The tables in the sections **Hardware, Software** and **WinIQSIM** list the installed hardware and software options.

Option	Short name of option
Designation	Name of Option
Expiration Date	Expiration date of option For regular options, Permanent is indicated in this column. Some options are available as trial versions. This column shows their expiration date. After this date, the option is no longer available on the instrument.

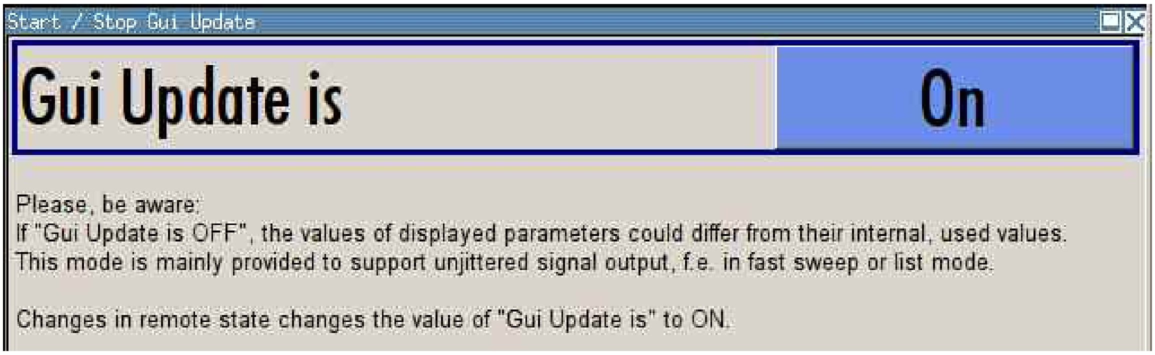
Gui Update... - Setup/System

The **Start/Stop Gui Update** menu**...** provides the possibility to switch off update of the displayed parameters in order to increase speed for certain settings.

Note:

It is especially recommended to switch off the GUI update for optimum sweep performance with short dwell times and for fast settling times.

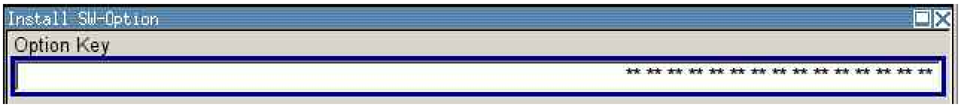
The indicated values are not updated and may therefore differ from the intern, used values.



Remote-control command:
`SYST:DISP:UPD OFF`

Install SW-Option... - Setup/System

Newly purchased software options are enabled in the **Install SW-Options** menu**...**. They are ready to operate after they are enabled by means of a key code supplied with the option.

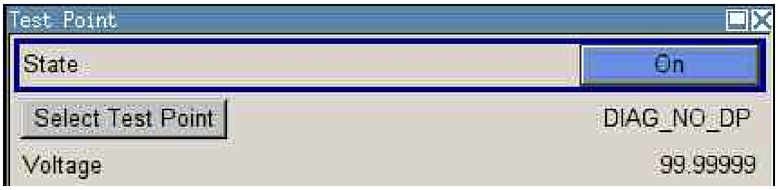


Only if the R&S Vector Signal Generator is equipped with an older firmware version, a firmware update prior to enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option. The firmware update is described in the service manual instrument, chapter 4 (on CD ROM, supplied with the instrument).

Test Point... - Setup-Test

The **Test Point...** menu provides access to the test points available in the instrument. When activated, the voltage of the selected test point is measured and displayed. A detailed description of the test points can be found in Chapter 3 of the Service Manual (supplied with the instrument).

The **Test Point...** menu is opened using the SETUP or MENU key under **System**.



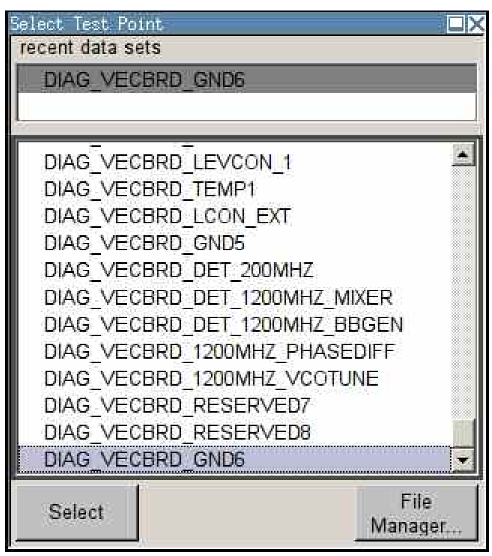
State Test Point - Setup

Activates the measurement of the voltage at the selected test point.

Remote-control command:
`DIAG:MEAS:POIN? 'DIAG_IQOP3_LCM_CAL_I'`
Response: `99.99`

Select Test Point - Setup

Calls the submenu for selecting the test point. The currently selected test point is shown next to the button.



Remote-control commands:
`DIAG:POIN:CAT?` (Command lists all test points)
`DIAG:MEAS:POIN? 'DIAG_IQOP3_LCM_CAL_I'`
(With remote control, voltage measurement starts as soon as the test point is selected)

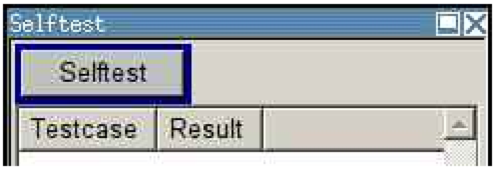
Voltage Test Point - Setup

Displays the measured voltage measurement at the selected test point.

Remote-control command:
`DIAG1:MEAS:POIN? 'DIAG_IQOP3_LCM_CAL_I'`
Response: 2

Selftest - Setup-Test

A selftest is provided for service purposes. The selftest is a protected test procedure, which can be accessed if protection level 1 is disabled. The protection dialog is called in the **Setup** menu (see Protection - Setup-Protection, on page 4.19).



Selftest - Setup System Selftest

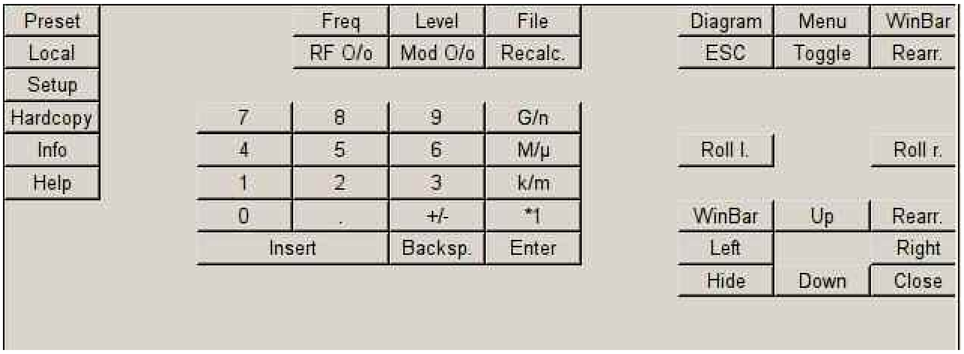
Performs a selftest on all installed hardware options.

A list of the performed tests cases and the result of each of them (passed or failed) is displayed.

Remote-control command:
`TEST:ALL?`
Response: "Succeeded", "Failed"

Check Front Panel - Setup-Test

The **Check Front Panel** menu**..** is used to check whether the front panel keys are functioning correctly. The menu displays all the front panel keys arranged in the same way as on the front panel. The respective function is executed by pressing the associated key.



Date and Time - Setup-Environment

The **Date/Time...** menu provides access to the system time and date settings. It is opened using the SETUP or MENU key under **Environment**. The time is used on the internal controller.

Date - Setup

Enters the date in the format day.month.year.

Remote-control command:
`SYST:DATE 2007,03,20`

Time - Setup

Enters the time in the format hour.minute.second.

Remote-control command:
`SYST:TIME 23,59,59`

Network Settings - Setup-Environment

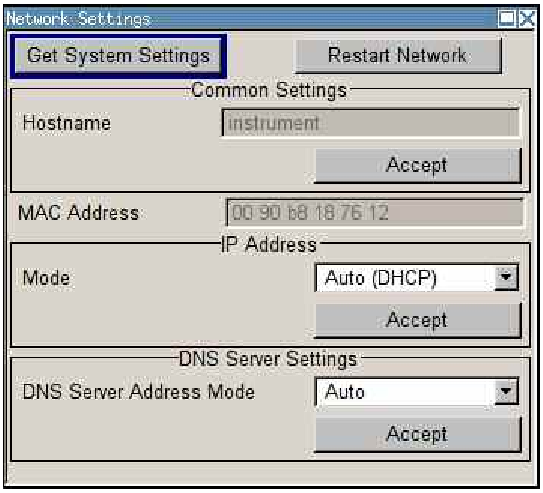
The **Network Settings...** menu provides access to the network settings. It is opened using the SETUP or MENU key under **Environment**. The R&S SMBV is equipped with a network interface and can be connected to an Ethernet LAN (local area network). How to connect the signal generator to the network is described in Chapter 1, Section "Connecting the R&S SMBV to a Network (LAN)".

NOTICE **Risk of network errors!**

Connecting errors may affect the entire network.

We recommend to coordinate the connection of the instrument to the network with the network administrator.

Do not connect or disconnect the network cable until the instrument is **switched off** (standby). Only then the network connection can be reliably detected and impairments to instrument operation can be avoided.



The menu is divided into the sections **Common Settings** where the general network environment is defined, **IP Address** section where the specific identification of the computer in the network is defined, and **DNS Server Settings** where the DNS server is entered.

Accept - Network Settings - Setup

Accepts a new entry or selection and changes the settings accordingly.

Remote-control command:
`SYST:COMM:NETW:DNS:SET`
`SYST:COMM:NETW:COMM:SET`
`SYST:COMM:NETW:IPAD:SET`

The indications of the menu are only updated after pressing the **Get System Settings** button.

Get System Settings - Setup

Retrieves the current system settings of the instrument.

The indications in the network menu are only updated after pressing this button.

Remote-control command: `SYST:COMM:NETW:GET`

Restart Network - Setup

Shuts down the network connection of the instrument and subsequently re-establishes the connection.
This function can be used to resolve network problems.

Note:
Only the connection of the instrument to the network restarts, the network itself is not affected.

Remote-control command: `n.a.`

Hostname - Setup

Enters the individual computer name of the R&S SMBV.

Note:
The computer name can only be changed after protection level 1 is deactivated (see section "Protection - Setup-Protection")

A predefined name is indicated and can be used for network connections.

Remote-control command:
`SYST:COMM:NETW:HOST RSSMBV100A123456`

MAC Address

Indicates the MAC address of the network adapter.

Remote-control command: `SYST:COMM:NETW:MAC?`

Mode - Setup

Selects if the IP address is assigned automatically or manually or if a Peer to Peer connection is used.

Auto (DHCP)

The IP address is assigned automatically.

The network used must support automatic assignment of IP address (DHCP) in order to use this function.

Remote-control command:
`SYST:COMM:NETW:IPAD:MODE AUTO`

Static

The IP address is assigned manually.

Remote-control command:
`SYST:COMM:NETW:IPAD:MODE STAT`

Peer-to-Peer

A Peer to Peer connection is used.

Remote-control command:
`SYST:COMM:NETW:IPAD:MODE P2P`

IP Address - Setup

Only for Static and Peer to Peer mode.

Enters the IP address manually.

Remote-control command:
`SYST:COMM:NETW:IPAD 7.8.9.10`

Subnet Mask - Setup

Only for Static and Peer to Peer mode.

Enters the Subnet mask.

This number is used together with the IP address to identify the network segment the instrument is in.

Remote-control command:
`SYST:COMM:NETW:IPAD:SUBN:MASK 255.255.255.0`

Def Gateway - Setup

Only for Static mode.

Enters the IP address of the default gateway.

This address identifies the router on the same network as the instrument that is used to forward traffic to destinations beyond the local network.

Remote-control command:
`SYST:COMM:NETW:IPAD:GAT 7.8.9.10`

DNS Server Address Mode - Setup

Selects if the DNS server address is assigned automatically or manually.

Auto (DHCP)

The DNS server address is assigned automatically.

The network used must support automatic assignment of address (DHCP) in order to use this function.

Remote-control command:
`SYST:COMM:NETW:DNS:MODE AUTO`

Static

The DNS server address is assigned manually.

Remote-control command:
`SYST:COMM:NETW:DNS:MODE STAT`

Preferred DNS Server - Setup

Only for Static mode.

Enters the preferred DNS server address manually.

Remote-control command:
`SYST:COMM:NETW:DNS:PREF 7.8.9.10`

Alternate DNS Server - Setup

Only for Static mode.

Enters the alternate DNS server address manually.

This server is used if the DNS server specified in **Preferred DNS Server** is unreachable.

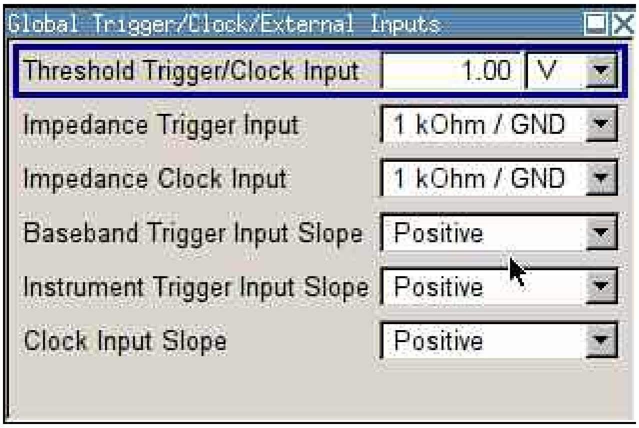
Remote-control command:
`SYST:COMM:NETW:DNS:ALT 7.8.9.10`

Global Trigger/Clock/External Input Settings - Setup-Environment

The **Global Trigger/Clock/External Inputs** menu can be opened using the SETUP or MENU key under the **Environment** menu as well as in all clock and trigger menus of the **Baseband** function block.

This menu is used to determine the physical characteristics of the input connectors for trigger, clock and control signals of the baseband and RF section. A common trigger threshold and input impedance is effective for all trigger and control signal inputs. The settings influence the digital modulations, the generation of waveforms or multi carrier signals, and all digital standards. These data sources are available for digital modulation (**Custom Digital Modulation**).

The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger.



Threshold Trigger/Clock Input - Global Settings

Sets the high/low threshold in volts for the trigger and clock signal inputs of the baseband section.

The setting affects the TRIGGER input and the CLOCK IN/OUT connectors (BNC connectors at the rear of the instrument).

Remote-control command:
`SOUR:INP:TRIG:LEV 1.0`

Impedance Trigger Input - Global Settings

Selects the input impedance for the external trigger inputs. 1kOhm/GND should be selected for high clock rates.

The setting affects the TRIGGER input connector (BNC connector at the rear of the instrument).

Remote-control command:
`SOUR:INP:TRIG:IMP G1K`

Impedance Clock Input - Global Settings

Selects the input impedance for the clock inputs. 1kOhm/GND should be selected for high clock rates.

The setting affects the CLOCK IN connector (BNC connector at the rear of the instrument).

Remote-control command:
`SOUR:INP:CLOC:IMP G1K`

Baseband Trigger Input Slope - Global Settings

Selects the polarity of the active slope of an externally applied trigger signal at the BNC connector TRIGGER 1.

This setting affects the INST TRIG input connector (BNC connector at the rear of the instrument).

Remote-control command:
`SOUR:INP:TRIG:BBAN:SLOP POS`

Instrument Trigger Input Slope - Global Settings

Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input connector (BNC connector at the rear of the instrument).

Remote-control command:
`SOUR:INP:TRIG:SLOP POS`

Clock Input Slope - Global Settings

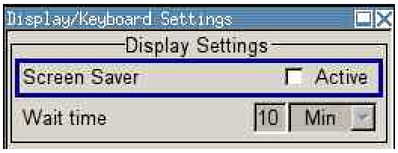
Sets the polarity of the active slope of an externally applied symbol clock pulse.

This setting affects the CLOCK input connector (BNC connector at the rear of the instrument).

Remote-control command:
`CLOC:INP:SLOP POS`

Display/Keyboard Settings - Setup-Environment

In the **Display/Keyboard Settings** menu the power-save mode and external keyboard settings are made. It is opened using the [SETUP] or [MENU] key under **Environment**.



Screen Saver Active - Setup

Activates/deactivates the screen-save mode of the display.

If activated, the display including backlight is completely switched off after the elapse of the **Wait Time** when no entries via front panel, external mouse or external keyboard are made.

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

Remote-control command:
`DISP:PSAV ON`

Wait Time - Setup

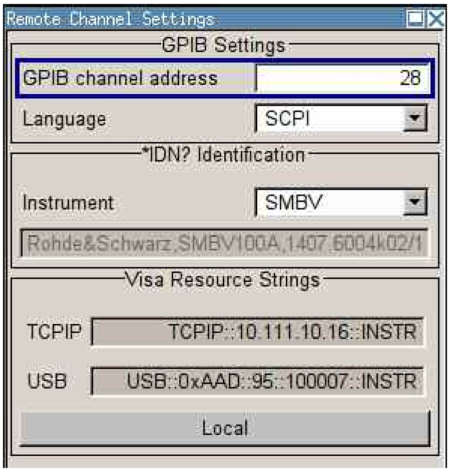
Sets the wait time for the screen-save mode of the display.

The available value range is 1 to 60 minutes, the resolution 1 minute.

Remote-control command:
`DISP:PSAV:HOLD 10`

GPIB/Ethernet - Setup-Remote

The **Remote Channel Settings** menu provides access to the GPIB and Ethernet settings. The **Remote Channel Settings** menu is opened using the SETUP or MENU key under **Remote**.



GPIB channel address - Remote Channel Settings

Sets the IEC/IEEE-bus address of the instrument.

Remote-control command:
`SYST:COMM:GPIB:ADDR 28`

Language

Indicates the remote control command set.

Remote-control command:
`SYST:LANG?`

***IDN? Identification**

Selects if the instruments identifies itself as R&S SMBV or as R&S SML generator when queried with common command *IDN?. Selection R&S SML allows to easily replace the R&S SML by an R&S SMBV in existing test setups.

In addition, a user defined identification string can be entered, e.g. to provide individual identification for each generator, e.g. 'MY_R&S_SMBV1'.

Remote-control command:
```
SYST:IDEN USER
SYST:IRES 'MY_R&S_SMBV1'
```

Visa Resource String - Remote Channel Settings

Indicates the visa resource string. This string is used for remote control of the instrument.

A separate string is provided for remote control via the LAN and the USB interface.

Remote-control commands:
```
SYST:COMM:NETW:RES?
Response:    TCPIP::192.1.2.3::INSTR
SYST:COMM:USB:RES?
Response:    USB::54::000000::INSTR
```

Local - Remote Channel Settings

Switches the instrument to operate in local control mode.

Switching from remote to local control mode can be also done with one of the following actions:

- manually with the LOCAL key on the front panel
- with the interface command **`&GTL`** via the remote-control interface
- with the key combination CTRL + Q

Remote-control command: `n.a.`

Protection - Setup-Protection

The **Protection** menu provides access to the unlocking of protected service functions (authorized personnel of R&S Service Departments only). To unlock the lock-out, the correct password has to be entered. After the instrument has been switched on, the lock-out 2 to 5 is automatically activated.

Protection Level 1 can be activated to lock-out internal adjustment. The password is 123456.

Remote-control command:
```
SYST:PROT1:STAT ON
SYST:PROT1:STAT OFF, 123456
```

Security - Setup -Protection

The **Security...** menu provides access to the passwords and mass storage security settings. It is opened using the SETUP or MENU key under **Environment**.

The menu is divided into the password sections and the security settings section. In the password section, the passwords for securing a controlled access to the instrument are defined and changed. In the security section, the remote interfaces are enabled and disabled.

A change of security password requires the entry of the old and new password and the conformation of the new password. All settings are only accepted after the **Accept** button is pressed.

New Password - VNC

Enters the new password.

The VNC password is required for remote access to the instrument Ultr@VNC (see chapter 1).

The default password is "instrument".

Remote-control commands: n.a.

Confirm New Password - VNC

Enters the new password for conformation.

The new password is only valid after the **Change Password** button is pressed.

Remote-control commands: n.a.

Change Password - Setup

Changes the password accordingly.

Remote-control command: n.a.

USB Device - Setup

Enables/disables the USB interfaces. Any device connected to the USB interface is not recognized by the instrument when the interface is disabled.

The setting requires the entry of the security password and is only accepted after the **Accept** button is pressed.

Remote-control commands: n.a.

LAN Connection - Setup

Enables/disables the LAN interfaces. Any device connected to the LAN interface is not recognized by the instrument when the interface is disabled.

The setting requires the entry of the security password and is only accepted after the **Accept** button is pressed.

Remote-control commands: n.a.

Security Password - Setup

Enters the security password that is required to enable or to disable the LAN or USB interface. Default is '123456'.

All settings are only accepted after the **Accept** button is pressed.

Remote-control commands: n.a.

Accept - Setup

Accepts a new entry or selection and changes the settings accordingly.

Remote-control command: n.a.

Save Recall - Setup-Setting

The **Save/Recall** submenu can also be called up with the FILE key and is therefore described in the section on this key (see section "Storing and Loading Instrument Data - File Key", page 4.31).

Factory Preset - Setup-Setting

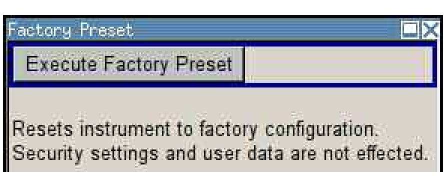
The **Factory Preset** submenu provides a function to reset the instrument's settings to their factory state. This function is activated by pressing the **Execute Factory Preset** button.

Note:
*Since **Factory Preset** resets the Remote Channel and network settings to the default values, executing Factory Preset via remote control terminates the connection to the instrument, if these settings had been configured to values different to the default ones!*

The **Factory Preset** function resets nearly all instrument settings. In addition to the regular preset by means of the PRESET key, a **Factory Preset** resets also the following values:

- Reference frequency settings (Ref Oscillator menu)
- Power on settings (Level/EMF menu)
- Network settings including hostname (Setup menu)
- Remote Channel settings including IEC/IEEE-bus address and emulation (Setup menu)
- Start/Stop Gui Update (Setup menu)
- Display and keyboard settings (Setup menu).

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.
Not affected by the **Factory Preset** are also user data, lists or instrument settings files, created for example by means of the Save/Recall function.



Remote-control command:
SYST:FPR

Help - Setup-Help

The **Help** submenu offers comprehensive online help for the R&S Vector Signal Generator. A desired topic can be selected via the table of contents (select **Manual**) or the index (select **Index**).

For context-sensitive information about a marked parameter, press the HELP key. For a description of the **Help** menu, refer to the section covering to the HELP key (see section "Help System - Help Key", on page 4.29).

Switching to Manual Control - Local Key

In remote control mode a status message appears in the display header. The rest of the display remains unchanged and shows the current instrument status, i.e. the status which exists under the remote control settings. The instrument can be operated (e.g. menus can be opened). However, it is not possible to enter or change values.

The status message additionally indicates whether the LOCAL key is disabled or enabled (see also Chapter 5 , section *"Switch-Over to Remote Control"*).

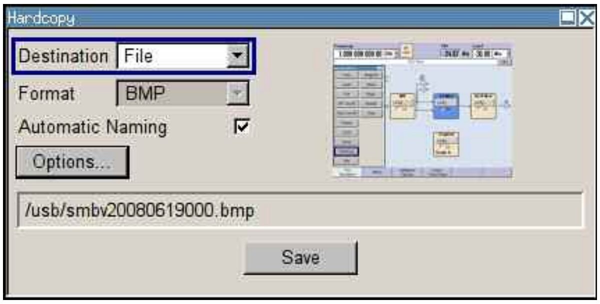
If the **REMOTE** status message is shown, the LOCAL key switches the instrument from remote control to manual control. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

If the **REM-LLO** status message is displayed, the instrument can be switched from remote control to manual control by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`); the LOCAL key is disabled. The key is disabled by remote control with the command LLO.

When switching from remote to manual control, the display update suppression function, if active (SETUP - **GUI Update is Off**), is automatically deactivated (SETUP - **GUI Update is On**).

Generating a Hard Copy of Display - HCOPY Key

The HCOPY key opens a window for configuring the hard copy setting, like output file format, printer or path and file name. The parameters to be set change in dependency of the selected output device.



Destination - Hard copy Dialog

Selects the destination to which the hard copy (snapshot) should be transferred to.

The hard copy either can be printed out by selecting **Printer** or can be saved in a file by selecting **File**, respectively (see also Printer - Hard copy Dialog, on page 4.23 and Printer Setup - Hard copy dialog, on page *4.25* or File - Hard copy Dialog, on page 4.24 and File Setup - Hard copy, on page 4.26).

Remote-control command:
`HCOP:DEV FILE | PRIN`

Options - Hard copy Dialog

Opens the **Hard copy Options** dialog for setting the parameters of the hard copy to be stored. Depending on the selected destination either the printer or the file parameters can be set (see Printer Setup - Hard copy dialog, on page *4.25* or File Setup - Hard copy, on page 4.26).

Remote-control command: n.a.

Printer - Hard copy Dialog

In this dialog the parameters for the selected printer can be configured.

Orientation

Defines the orientation of the printer page for the hard copy. The selectable orientations are **Portrait** and **Landscape** (see **Orientation** in the Printer Setup - Hard copy dialog, on page *4.25*).

Remote-control command:
`HCOP:PRIN:PAGE:ORI PORT | LAND`

Paper size

Sets the size of the printer paper for the hard copy command (for detailed description on setting the paper size (see Paper Size in the Printer Setup - Hard copy dialog, on page 4.25).

Remote-control command:
`HCOP:PRIN:PAGE:SIZE LETT | LEG | EXEC | A4 | A5`

Printer

Selects a printer from a list of available printers. The name of the selected printer is indicated in the selection field.

Remote-control command:
`HCOP:PRIN:LIST?`
`HCOP:PRIN:NAME "printer1"`

File - Hard copy Dialog

In this dialog parameters like format or automatic naming for storing the hard copy in a file can be configured.

Format

Sets the image format in which the hard copy should be stored.

Remote-control command:
`HCOP:DEV:LANG BMP | JPG | XPM | PNG`

Automatic Naming

Specifies whether the destination file name of the hard copy command should be automatically generated.

Note:
As default the automatically generated file name is composed of:
*"***`<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`***".*
Each component can be deactivated/activated separately to individually design the file name *(see File Setup - Hard copy, on page 4.26).*

Remote-control command:
`HCOP:FILE:NAME:AUTO:STAT ON | OFF`

File...

Manually naming only

Opens the **Select Hard Copy Save File** dialog to select a path and define the file name for storing the hard copy.

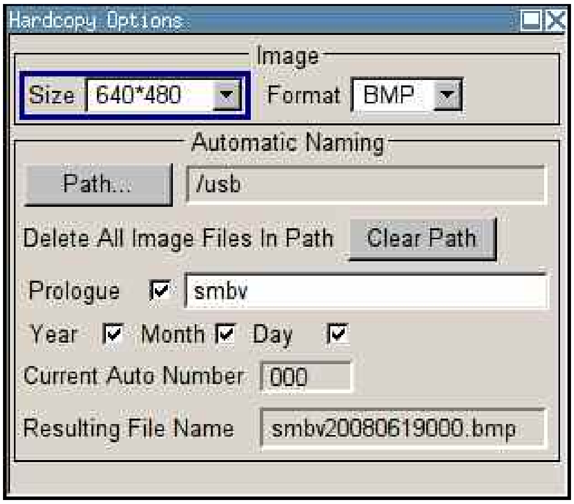
Note:
For selecting the destination path a file name must be entered as well. Otherwise the error message "The name of a list may not be empty" is displayed and the selection will be canceled.

Remote-control command:
`HCOP:FILE:NAME 'usb\HCopy'`

Infoline

Displays the file name of the file in which the hard copy is stored.

Remote-control command: n.a.



Printer Setup - Hard copy Dialog for setting the printer parameters.

Printer

Selects a printer from a list of available printers. The name of the selected printer is indicated in the selection field.

Remote-control command:
`HCOP:PRIN:LIST?`
`HCOP:PRIN:NAME "printer1"`

Unit

Defines the physical unit of the page size and margins used for the hard copy. The selectable units are **inches** or **centimeter**.

Remote-control command:
`HCOP:PRIN:PAGE:UNIT CM | IN`

Orientation

Defines the orientation of the printer page for the hard copy.

Portrait - the page's height is greater than its width.

Landscape - the page's width is greater than its height.

Remote-control command:
`HCOP:PRIN:PAGE:ORI PORT | LAND`

Paper Size

Selects the size of the printer paper for the hard copy. The currently selectable paper formats are **Letter, Legal, Executive, A4** and **A5**. For information on the paper format width and height values are indicated additionally. Depending on the set physical unit by the parameter **Unit**, width and height are expressed in cm or inches.

Remote-control command:
`HCOP:PRIN:PAGE:SIZE LETT | LEG | EXEC | A4 | A5`

Margins

Defines the margins of the paper size for printing the hard copy. **Top, bottom, left** and **right** margin values have to be entered in this sequence, separated by commas. Decimal places are separated by a decimal point. Depending on the set physical unit by the parameter **Unit**, width and height are expressed in cm or inches.

Remote-control command:
`HCOP:PRIN:PAGE:MARG 2.5,2.0,1.5,1.5`

File Setup - Hard copy

Dialog for setting the file parameters.

Size

Sets the image size in which the hard copy should be stored.

The default value depends on the device and is for example:

SMBV: 640*480

Remote-control command:
`HCOP:IMAG:SIZE 640,480`

Format

Sets the image format in which the hard copy (snapshot) should be stored.

Remote-control command:
`HCOP:DEV:LANG BMP | JPG | XPM | PNG`

In the **Automatic** Naming section the parameters for assembling the automatic file name are set.

Note:
As default the automatically generated file name is composed of:
*"***`<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`***".*
Each component can be deactivated/activated separately to individually design the file name.

Path...

Automatic naming only

Opens the **Select Hard Copy Destination Path** dialog to select a path for storing the hard copy.

Note:
For selecting the destination path a file name must be entered as well. Otherwise the error message " The name of a list may not be empty" is displayed and the selection will be canceled.

Directory, path and file name are displayed in the infoline right to the **Path** button.

Remote-control command:
`HCOP:FILE:AUTO:DIR 'usb\TEMP'`

Clear Path

Deletes all image files in the path directory of the hard copy files.

Before deleting the image files a warning message is displayed requiring the confirmation of deletion. If confirmed, all files with the extensions "bmp", "img", "png" and "xpm" are deleted.

Remote-control command:
`HCOP:FILE:AUTO:DIR:CLE`

Prefix

Automatic naming only

Defines whether the parameter **<Prefix>** should be appended to the file name of the hard copy to be stored. The parameter is defined in the selection field to the right of prefix checkbox.

Remote-control command:
`HCOPy:FILE:AUTO:PREF:STAT OFF | ON`

Enter prefix

Automatic naming only

Defines the parameter **<Prefix>** that is appended automatically to the file name of the hard copy. The prefix is appended only, if the parameter is activated in the checkbox to the left.

Remote-control command:
`HCOP:FILE:AUTO:PREF 'Snapshot'`

Date - Year / Month / Day

Automatic naming only

Defines the assembling of the automatically generated file name for storing the hard copy. The selectable parameters are **year**, **month** and **day**. If activated the **current** year, month or day are appended to the file name, respectively.

Remote-control command:
`HCOP:FILE:AUTO:YEAR:STAT OFF | ON`

`HCOP:FILE:AUTO:MONT:STAT OFF | ON`

`HCOP:FILE:AUTO:DAY:STAT OFF | ON`

Current Auto Number

Automatic naming only

Appends a file number of three digits to the automatically generated file name of the hard copy.

Note:
On initially switching on the device the number will be reset to the lowest possible value. Starting with number 0 the output directory will be scanned for already existing files. As long as files with the same name are existing the number will be increased by 1. The number will be automatically set to a number so that the resulting file name will be unique within the selected path. The current number will not be saved in the save recall file but will be temporarily stored within the database. On subsequent saves the number will be increased.

Remote-control command:
`HCOP:FILE:AUTO:NUMB?`

Resulting File Name

Automatic naming only

Indicates the automatically generated file name in which the hard copy will be saved in.

Remote-control command:
`HCOP:FILE:AUTO:FILE?`

Print / Save

Executes the hard copy command to the selected destination.

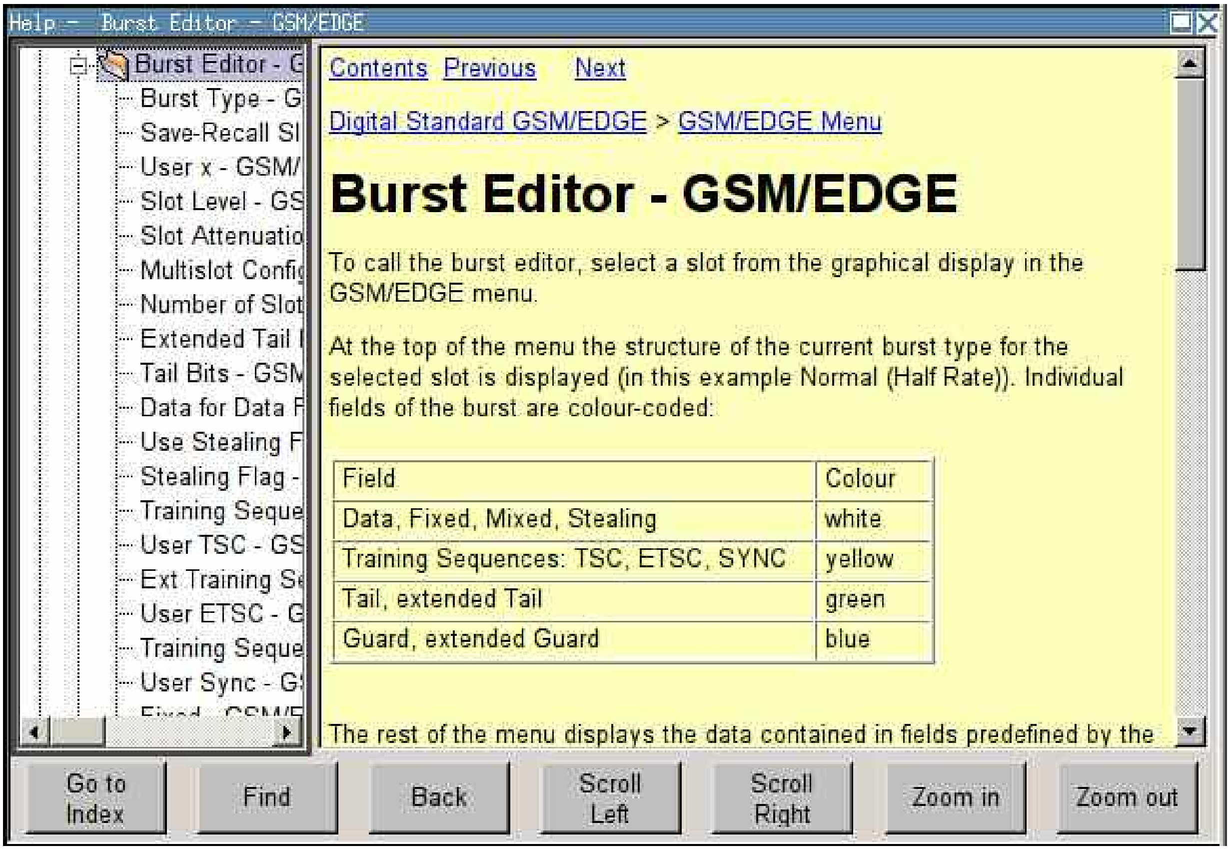
Remote-control command:
`HCOP`

Messages - Info Key

The [INFO] key opens a window containing a detailed description of every message displayed in the info bar, see chapter 3, section *"Info and Status Bar"* and chapter 9, section "*Error Messages*".

Help System - Help Key

The [HELP] key opens a browser window containing a context-sensitive description of the highlighted parameter.



The context-sensitive page which is opened with the [HELP] key is part of a comprehensive help system. It is possible to move from this context-sensitive page to any page of the help system. The following navigation aids are available:

- **Internal links in the text**
  They open pages which are directly linked to the described function. In this way it is possible, for example, to call up the description of the IEC/IEEE-bus command for any particular function.
- **Previous/Next links**
  The Previous/Next links allow scroll through the help pages. The sequence of the described functions corresponds to their position in the menus.
- **Back**
  The Back button calls up the page last viewed.

- **Contents in the navigation panel**
  The contents list is used to open the individual help pages. It has a hierarchical structure. The highlighted line indicates where the currently displayed page is within the contents list.
- **Index in the navigation panel**
  The index is used to call up all pages which contain the selected entry. The index has an alphabetical structure and also contains all IEC/IEEE-bus commands.
- **Find**
  The find function allows you to look for freely selectable terms in all help pages. A list of the pages containing the entered term is displayed as the search result. The search can be limited to words in the page title to increase the number of hits.

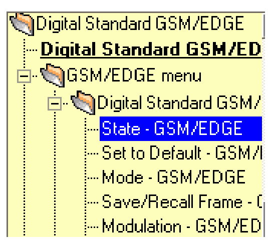
Index / Tree - Help

Switches the navigation window display between the contents tree and index entries. The input focus must be in the left-hand navigation window.

Remote-control command: -

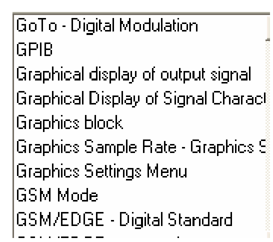
Contents tree:

The contents tree is the contents list of the help system. The cursor always highlights the entry which is currently being displayed in the right-hand help window. The associated page can be opened by selecting an entry.



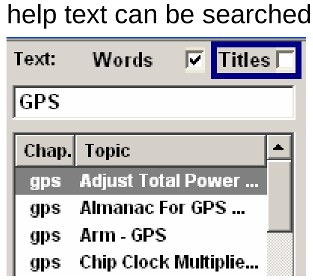
Index:

The index contains an alphabetical list of all terms which refer to functions of the instrument. For example, it contains all parameter names and all IEC/IEEE-bus commands. The associated help page can be opened by selecting an entry.



Find - Help

Opens the search panel. The content of the titles only or the complete help text can be searched for the entered term.



Remote-control command: -

Scroll Left / Scroll Right - Help

Shifts the indicated area of the navigation window.

Remote-control command: -

Zoom in / Zoom out - Help

Increases and reduces the font size of the help text.

Remote-control command: -

Storing and Loading Instrument Data - File Key

The R&S Vector Signal Generator allows complete instrument settings to be stored in files on the internal flash card, the USB stick or on the hard disk (requires option B92). Defined and complex instrument settings can then be reproduced at any time by loading this data. If required, these settings can be loaded to various signal generators.

The FILE key open the menu used to store and load instrument settings in a file. The data can be stored on the internal flash card, the USB stick or on the hard disk (requires option B92). Additionally there are three intermediate memories in which the current instrument setting can be stored and then called up again by pressing a key. This makes it possible to switch quickly between defined instrument settings.

All settings which differ from the preset plus the configuration data for the operating elements (e.g. window positions) are stored. When loaded, these referenced settings are implemented and all non-referenced parameters are set to the associated preset value. As a result the files remain relatively small since they only contain the relevant information. Furthermore, this also allows instrument settings to be transferred easily between different signal generators since once again only the settings which differ from the preset values have to be adjusted.

If a list, e.g. a frequency/level list, is used for the LIST mode or a list of frame or channel configurations is used for a digital standard, a reference to this list also stored. The list is also loaded when the associated instrument setting is loaded. If the list has been deleted in the meantime (or it is not available on a different instrument), an error message appears if an attempt is made to access this list after the instrument setting has been loaded. The associated setting or operating mode, e.g. the List mode, is only started after the user has selected an existing list. If the list has been overwritten in the meantime, the new entries will be used.

Note:

Lists are stored and loaded in the appropriate menus. For example, the GSM frame definitions are created and stored in the GSM menu.

When loading an instrument setting, it is possible to select whether the current frequency and level setting is to be retained or whether the stored settings are to be activated. It is possible to delete stored instrument settings. A file can be copied by loading it with "Recall" and then storing it under a new name.

Settings can be transferred easily between instruments with different equipment options and/or firmware versions because only the settings which differ from the preset values are affected. When settings are loaded, only those which are possible on the instrument are implemented. Error messages indicate the settings which cannot be implemented.

The stored file is transferred from one instrument to another using the memory stick.

General file management functions such as copying and moving data are available in the **File Manager** submenu.

File Menu

The settings available in the File menu depend on the operation selected under **Select Operation**.

Select Operation - File

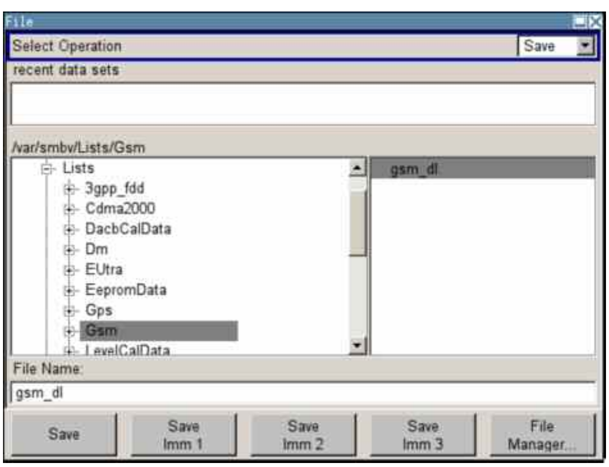
Selects the file function.

Save… Calls the menu for storing the current instrument setting.

Recall... Calls the menu for calling up a stored instrument setting.

Storing Instrument Settings - File

If **Save** is selected under **Select Operation**, the File menu provides options for storing the current instrument setting in a file.



Recent data sets - File

Displays the files last used. The entire path is shown in plain text.

Remote-control command: n.a.

Directory - File

Selects the directory in which the file is to be stored.

The window opposite lists all settings files in this directory.

A new directory can be created in the File Manager (**File Manager** button).

Remote-control command:
`MMEM:CDIR "var/smbv/user"`
(The path can also be entered when the file is stored.)

File List - File

Displays the files which are in the selected directory.

If a file is highlighted, it is overwritten when the file is stored.

Remote-control command:
`MMEM:CAT?`

File Name - File

Enter the file name of the file without file extension. This file is then created.

Remote-control command: n.a.
(The file name is entered when the file is stored.)

Save - File

Stores the current instrument settings under the specified path.

Remote-control command:
```
*SAV 4
MMEM:STOR:STAT 4,'var/smbv/user/test.savrcl'
```

Save Immediate x- File

Stores the current instrument setting in one of the three intermediate memories.

These instrument settings are retained until a different instrument setting is stored in the intermediate memory. When the instrument is switched off, the contents of the intermediate memories are retained.

Remote-control command:
`*SAV 1`

File Management- File

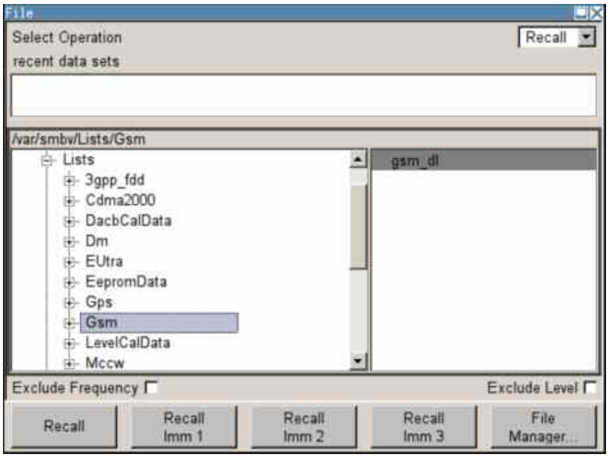
Calls the **File Management** menu.

Directories can be created and files managed in this menu (see the section "File Manager - File", page 4.35").

Remote-control command: n.a.

Loading Instrument Settings - File

If **Recall** is selected under **Select Operation**, the **File** menu provides options for loading complete instrument settings. Here it is possible to select whether the current or stored RF frequency and RF level settings are to be used.



Recent data sets - File

Displays the files last used. The entire path is shown.

If the desired file is in the list, it can be selected in this window.

Remote-control command: n.a.

Directory - File

Enter the directory in which the file with the instrument setting to be loaded is located.

The **Selected file** window lists all the files in this directory.

Remote-control command:
`MMEM:CDIR "var/smbv/user"`

File List - File

Selects the file with the desired instrument configuration.

Remote-control command:
`MMEM:CAT?`

Exclude Frequency - File

The current frequency is retained when a stored instrument setting is loaded.

Remote-control command:
`SOUR:FREQ:RCL EXCL`

Exclude Level - File

The current level is retained when a stored instrument setting is loaded.

Remote-control command:
`SOUR:POW:RCL EXCL`

Recall - File

Load the selected configuration.

If an instrument setting in which a sweep was activated is stored, the sweep is started when the recall command is called.

If an instrument setting which accesses lists is stored, this list is also loaded.

If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

Remote-control command:
```
MMEM:LOAD:STAT 4,'var/smbv/test.savrcl'
*RCL 4
```

Recall Intermediate x- File

Loads the selected configuration from one of the three intermediate memories.

If an instrument setting in which a sweep was activated is stored, the sweep is started when the recall command is called.

If an instrument setting which accesses lists is stored, this list is also loaded.

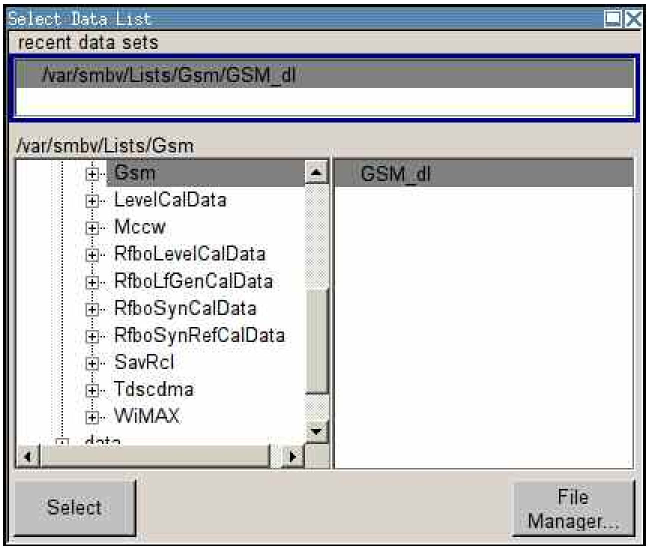
If the list has been deleted in the meantime, an error message appears when the instrument setting is loaded. If the list has been overwritten in the meantime, the new entries will be used.

A message appears if no instrument configuration is stored in this memory.

Remote-control command:
`*RCL 1`

File Manager - File

The **File Manager** menu provides all the functions required for file management. Directories can be created, and files copied, deleted and moved between the directories on the drives (internal flash card, memory stick and hard disk (requires option B92).



File Type - File Manager

Selects the file types to be indicated. If a file type with a specific file extension (e.g. List Mode List (*.lsw)) is selected only files with this extension are indicated in the selected directory.

Remote-control command: n.a.

Directory - File Manager

Selects the directory in which the file to be deleted or copied is located. The window to the right lists all files in this directory. The file to be deleted or copied can be highlighted. The path is indicated above the directory window.

Remote-control command:
`MMEM:CDIR "var/smbv/user"`

File Name - File Manager

Selects the file.

Remote-control command: n.a.

Cut - File Manager

Cuts the selected file. It can be pasted into a different directory using the **Paste** button.

Remote-control command:
`MMEM:DEL 'var/smbv/user/test.savercl'`

Copy - File Manager

Copies the selected file. It can be pasted into a different or the same directory using the **Paste** button. When pasting the file into the same directory file name "Copy of <file name>" is given automatically. When pasting the file into a different directory, the original file name is kept.

Remote-control command:
`MMEM:COPY`
`"var/smbv/user/set1.wv","var/smbv/user/set2.wv"`

Paste - File Manager

Pastes the file that has been copied or cut before.

Remote-control command: n.a.

Rename - File Manager

Renames the selected file or directory. The new name can be entered in the **New Filename** window.

Remote-control command:
`MMEM:MOVE "test02.dm_iqd","set2.dm_iqd"`

Delete - File Management

Deletes the selected file. Before the file is deleted, a message appears prompting the user to confirm deletion of the file.

Remote-control command:
`MMEM:DEL 'var/smbv/user/test.savrcl'`

Create New Directory - File Management

Creates a new directory. The name of the new directory can be entered in the **New Directory** window.

The directory is created as a subdirectory in the selected level.

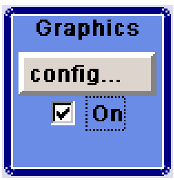
Remote-control command:
`MMEM:MDIR 'var/smbv/user/smbv/test'`

***Note**:*
When the subdirectory is entered, it is possible to enter an absolute path name (e.g. "`var/smbv/user/meas`") or the path relative to the current directory (e.g. "`..\MEAS`").

Graphical Display - Graphics

Graphical Display of Signal Characteristics

The R&S Vector Signal Generator can be used to graphically display the generated baseband signal. A selection of different signal displays assists the user in assessing and checking the increasingly complex modulation signals.



The Graphics function block is available for instruments equipped with one of the options R&S SMBV-B10/B50/B511 (Baseband + ARB) or R&S SMBV-B62 (Noise Generator).

It is the baseband signal actually generated that is recorded and displayed, and not a signal calculated on the basis of the set parameters.

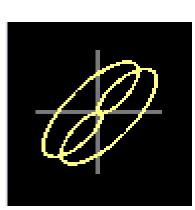
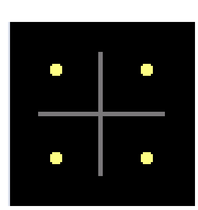
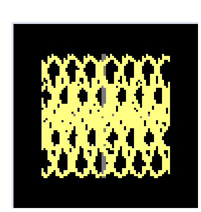
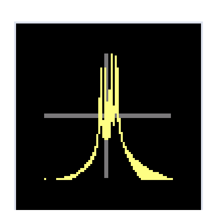
This graphical display allows the user to quickly view and check the current signal characteristics and also gives an overview of the changes in the signal over time. The signal quality can be permanently monitored. The results of parameter changes on the signal, such as a change in modulation mode, or the effects of certain configurations, e.g. the activation of several base stations in the case of (W)CDMA signals, can be analyzed directly in the display. Freezing the signal and then zooming permit a detailed evaluation of any signal segment. The definition and display of one or more reference curves makes it possible to compare various signals (i.e. by comparing the CCDF (Complementary Cumulative Distribution Function) with different channelization codes, or the spectra if different filter parameters are selected).

The displayed signal segment can be influenced by selecting the trigger that defines the time for recording to start. With automatic triggering, the signal is tapped at the point in the signal path that is best for the respective display. The displayed signal segment is selected internally depending on the signal such that the signal characteristics of interest (e.g. the useful signal) are displayed. This selection is appropriate for a representative display of the complete signal.

In addition, a user-definable trigger is available with which the displayed signal segment can be limited.

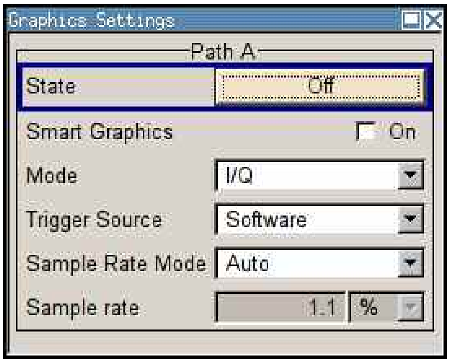
The time resolution can be set either automatically or manually, whereby for manual setting the bandwidth for which the trace is to be displayed is selected. The transient recorders used for signal recording have a variable recording depth which is specified under the respective display.

In addition to the large graphics window, the display can also be shown in a small window ("smart graphics"). This window is fitted into the block diagram as a block, and can be used for basic checking purposes (e.g. whether the signal is still being generated).

Graphics Settings Menu

The **Graphics Settings** menu for selecting the graphical display of the output signal is opened either in the **Graphics** function block or in the menu with the same name which is opened using the [MENU] key.



The signal display can be selected and activated in the menu.

Status - Graphics Settings

Activates the selected graphical display.

After activation, the diagram selected with **Mode** is displayed in the block diagram.

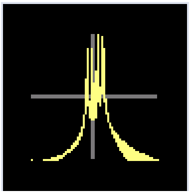
At the bottom of each graphics window there are several buttons for freezing and zooming the display and for activating a reference curve (see the following section "Bar of Graphics Window", page 4.40).

Remote-control command: n.a.

Smart Graphics - Graphics Settings

Activates the "smart graphics".

The graphic is displayed in a small window which is roughly the size of a block. These windows are displayed permanently in the block diagram until they are deactivated, and allow basic checking of the signal. They do not contain any buttons.



Remote-control command: n.a.

Mode - Graphics Settings

Selects the graphical signal display. The display is not shown until it has been activated with **Status On**.

The individual signal displays are described in the following sections under "Signal Displays - Graphics", from page 4.44 onwards.

Remote-control command: n.a.

Trigger Source - Graphics Settings

Defines the trigger for the starting time of the graphic recording.

Remote-control command: n.a.

Software

Recording of signals is started automatically in specified intervals.

This asynchronous method is appropriate when a representative display of the complete signal is desired, as recording starts in a random time reference to the signal.

Marker 1

The starting point for recording signals is determined by marker 1 in the menu of the active standard.

This synchronous method is appropriate when specific signal segments are to be shown in greater detail. With periodic signals, a static image is obtained by selecting a period length of marker 1 that is equal to the signal period.

The displayed signal segment can be shifted as needed by entering a marker delay in the Trigger/Marker menu of the active standard.

Scrambling Code - Graphics Settings

(only if Code Domain (3GPP FDD DL) is selected) Sets the scrambling code if the **Code Domain** display is selected. Since it is possible to select a different scrambling code in the menu for each of the 4 base stations and it is also possible to display an external signal, the scrambling code for which the display is to be generated must be explicitly specified here.

Remote-control command: n.a.

Sample Rate Mode - Graphics Settings

Sets how the time resolution of the signal is determined. Maximum resolution corresponds to a display covering the entire signal bandwidth. The higher the resolution is, the shorter the length of the displayed signal segment will be for the specified recording depth.

Auto

The resolution is set to an optimum value on the basis of the signal and display type.

Remote-control command: n.a.

Full Bandwidth

The resolution is set such that the display covers the entire signal bandwidth.

Remote-control command: n.a.

User

Under **Graphics Sample Rate**, the user can determine the resolution by setting the signal bandwidth for which the display is to be generated.

Remote-control command: n.a.

Graphics Sample Rate - Graphics Settings

With **Auto** and **Full Bandwidth**:
Displays the signal bandwidth for which the display is to be generated.

With **User**:
Selects the signal bandwidth for which the display is to be generated. The setting range moves between the minimum and maximum bandwidth which is possible for the selected display. The selection is made graphically by moving the pointer.

Remote-control command: n.a.

Bar of Graphics Window

At the bottom of each graphics window there are buttons for freezing and zooming the display and for defining and activating a reference curve.

Run

Freezes the current display.

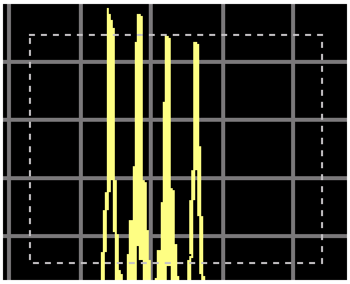
Clicking the button again reactivates the normal, permanently updated display.

Freezing the display allows it to be analyzed more easily. Zooming the display at the same time permits detailed evaluation of any signal segment.

Remote-control command: n.a.

Zoom In
(only possible with mouse)

The mouse can be used to freely select any section to be zoomed. This section is selected by pressing the left-hand mouse key and dragging a rectangular marquee. In this way a display can be zoomed in several steps. The zoom is cancelled by clicking the **Zoom Out** button.



Remote-control command: n.a.

Zoom out

Cancels the zoom.

Remote-control command: n.a.

Time

(I/Q mode only)

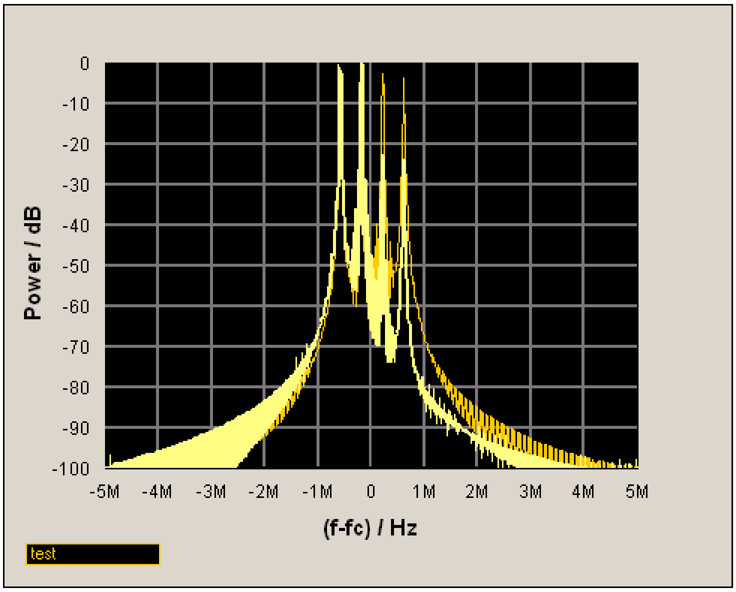
Switches to seconds for time representation on the X axis of the I/Q diagram.

Remote-control command: n.a.

Show ref

Displays the reference curve(s). All defined reference curves are displayed simultaneously (see the description of the **Copy to ref** button).

The reference curves are displayed together with the current signal. They allow visual comparison of two or more signals with different settings, e.g. with different filters.



Clicking the button again hides the reference curves.

The reference curves must be defined beforehand using the **Copy to Ref** button.

Remote-control command: n.a.

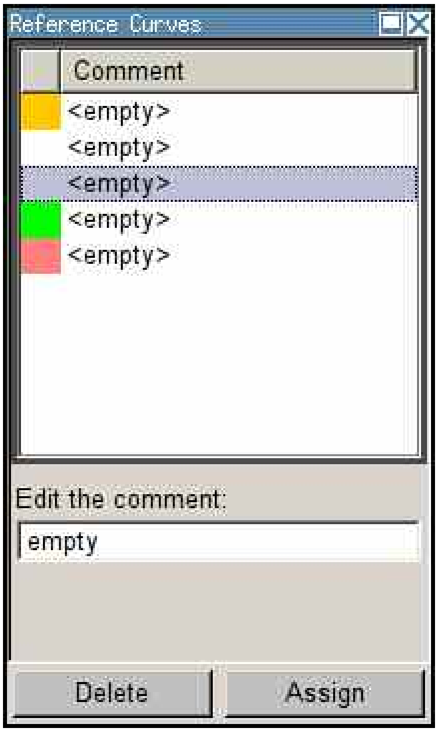
Copy to ref

Defines the current curve as the reference curve.

A window opens in which the curve can be given a comment and a color.

First of all the desired color is highlighted in the top window. If this color has already been assigned to a reference curve, this curve is overwritten. The command is entered in the bottom **Comment** section. This comment then appears next to the highlighted color.

Up to 5 reference curves can be defined and displayed simultaneously in different colors together with the current signal.



Each reference curve is available until it is deleted.

Remote-control command: n.a.

Display area

The comments entered for the defined reference curve are shown in the display area next the assigned color. A maximum of five colors (and reference curves) are available. If no reference curve is assigned to a particular color, the comment <empty> is displayed.

Remote-control command: n.a.

Comment

Enters a comment for the current curve which is to be defined as the reference curve. This comment then appears next to the highlighted color in the display area.

Remote-control command: n.a.

Delete

Deletes the curve highlighted in the display area.

Curves which are no longer required can be deleted to reduce the number of reference curves displayed simultaneously.

Remote-control command: n.a.

Assign

Defines the current curve as the reference curve.

The new reference curve is shown together with the entered comment next to the selected color in the display area.

Remote-control command: n.a.

Signal Displays - Graphics

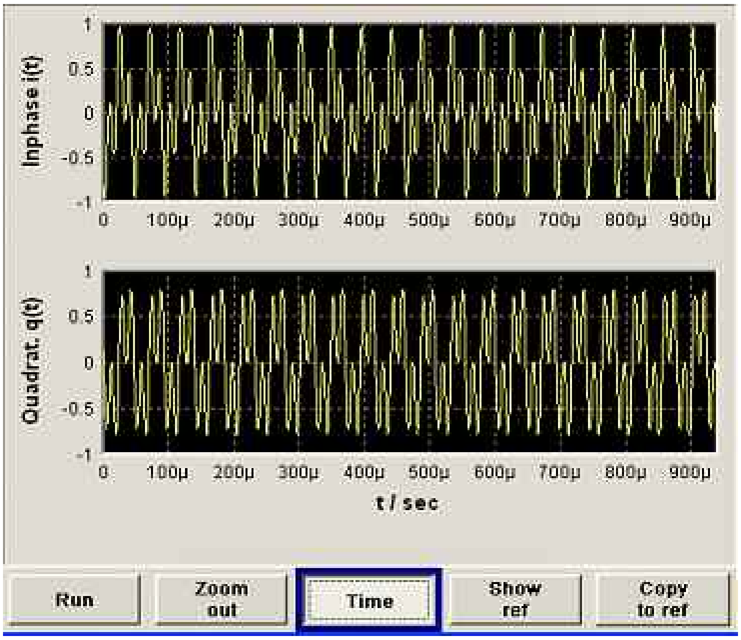
All signal displays which are used for analyzing a baseband signal can be selected. A number of signal displays are only available if the corresponding signal is generated, e.g. Code Domain only available for (W)CDMA signals.

I/Q Diagram - Graphics

The I/Q diagram displays the inphase component (i[t]) and quadrature component (q[t]) of the I/Q signal over time.

The diagram is displayed in a window with two separate coordinate systems. The coordinate systems have identical X and Y axes. The time (in number of symbols, chips or samples depending on the signal) is plotted on the X axes, and the amplitude scaled to the peak envelope power (PEP) is plotted on the Y axes (minimum scaled amplitude = -1; maximum scaled amplitude = +1). The recording depth is 1 kSamples.

This signal is picked off at the output of the baseband main module (**Impairment** function block). Impairment of the signal as defined by the user and the addition of noise is contained in the displayed signal.

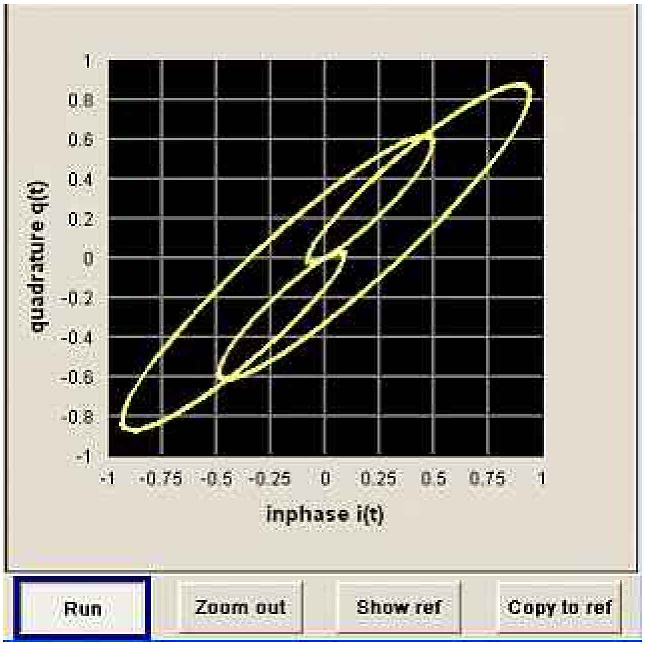


Vector Diagram - Graphics

The Q component is displayed over the I component in the vector diagram. Each point is determined by a vector. The amplitudes of the signal components scaled to the peak envelope power (PEP) are plotted on the X and Y axis (minimum scaled amplitude = -1; maximum scaled amplitude = +1).

This display shows the curves between the various states of modulation mapping. The recording depth is 1 kSamples.

This signal is picked off at the output of the baseband main module (**Impairment** function block). Impairment of the signal as defined by the user and the addition of noise is contained in the displayed signal.



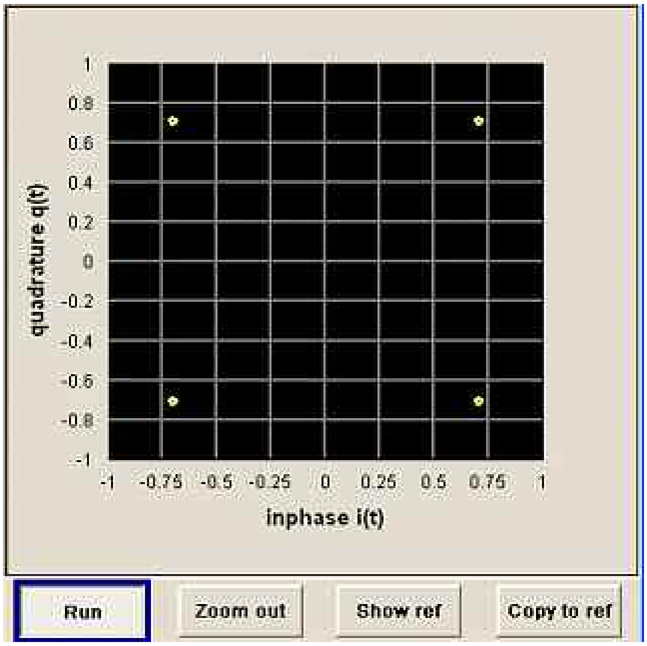
Constellation Diagram - Graphics

In the constellation diagram, the Q component is also displayed over the I component. However, only the values at the constellation points (signal value at the ideal scanning instant of the symbol) are displayed, i.e. for each symbol only 1 value in the form of a circle is shown for the I and Q component.

The amplitudes of the signal components scaled to the peak envelope power (PEP) are plotted on the X and Y axis (minimum scaled amplitude = -1; maximum scaled amplitude = +1). The recording depth is 2kSamples.

This signal is picked off at the output of the unicoder (**Baseband** function block) upstream of baseband filtering. Impairment of the signal as defined by the user and the addition of noise is not effective in this signal because signal impairment and noise addition occur further down the signal path.

This display shows the various states of modulation mapping which occur in the signal. The example shows the constellation diagram of a QPSK modulation signal.



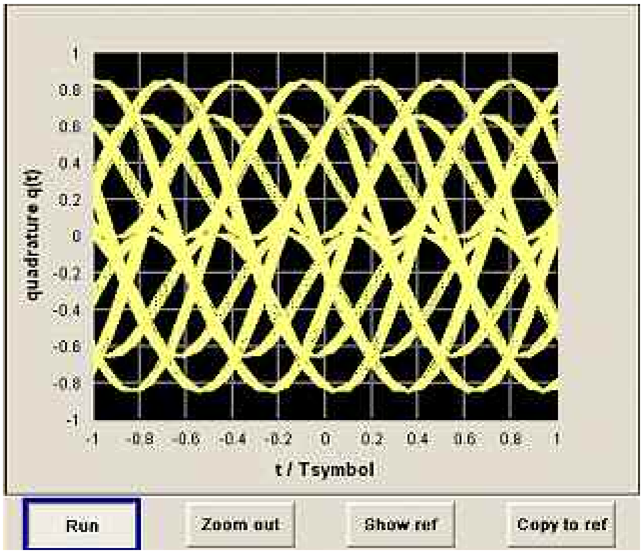
Eye Diagram - Graphics

The eye diagram displays synchronized and superimposed sections of either the inphase or quadrature components of the signal.

The display width (eye length) is set at 2 symbols; several hundred curve segments are superimposed. The time (in the range -/+ 1 symbol) is plotted on the X axis, and the amplitude scaled to the peak envelope power (PEP) is plotted on the Y axis (minimum scaled amplitude = -1; maximum scaled amplitude = +1). The beginning of recording is synchronous to the symbol and chip clock pulse. The recording depth is 2kSamples.

This signal is picked off at the output of the unicoder (**Baseband** function block) downstream of baseband filtering. Impairment of the signal as defined by the user and the addition of noise is not effective in this signal because signal impairment and noise addition occur further down the signal path.

The exactness of the superimpositions and therefore the size of the eye gaps depend on the used filter.



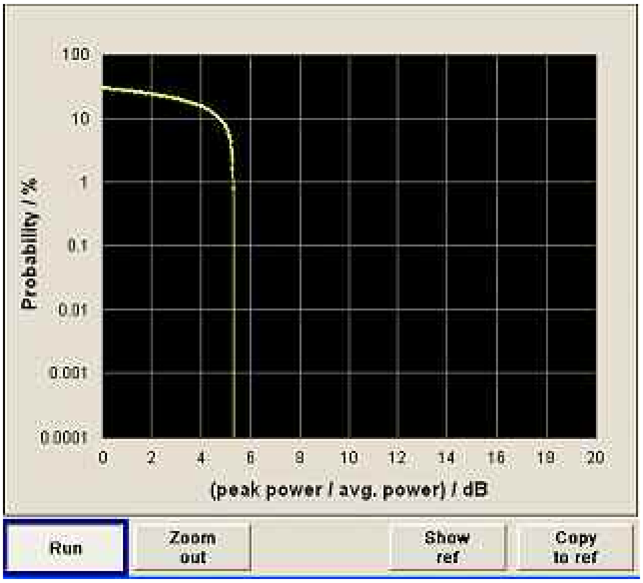
CCDF Display - Graphics

The **C**omplementary **C**umulative **D**istribution **F**unction shows the probability with which the output signal will exceed the average power.

The level over the average power is plotted from 0 to 20 dB on the X axis; the average power (RMS) corresponds to the origin. The probability of exceeding the average power is plotted between 0.0001% and 100% on the Y axis. The recording depth is 8kSamples.

This signal is picked off at the output of the baseband main module (**Impairment** function block). Impairment of the signal as defined by the user and the addition of noise is not effective in this signal because signal impairment and noise addition occur further down the signal path.

The point at which the CCDF curve intersects the X axis gives the crest factor of the signal.



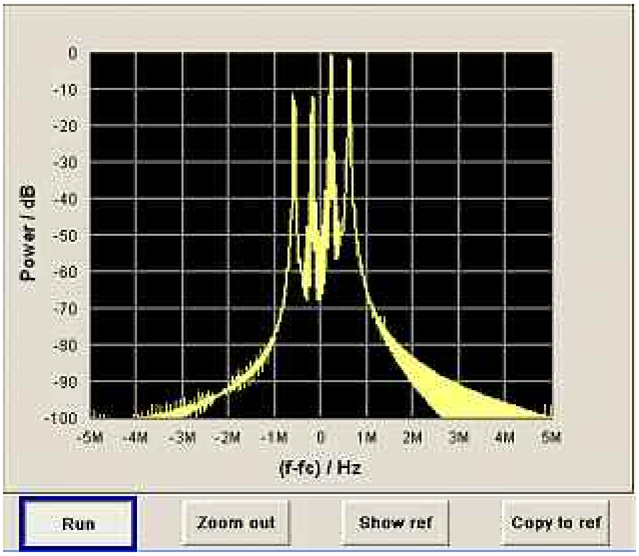
Power Spectrum - Graphics

With the spectrum display, the signal spectrum is calculated from the I/Q signal by means of Fast Fourier Transform (FFT).

The power density over frequency is displayed. The power density is plotted on the Y axis, and the frequency is plotted symmetrically on the X axis (-sampling rate/2 to +sampling rate/2). FFT Points indicates the number of I/Q value pairs which are used for calculating a (part-)FFT. AVG indicates the number of subspectra used for averaging. The recording depth is 8kSamples.

This signal is picked off at the output of the baseband main module (**Impairment** function block). Impairment of the signal as defined by the user and the addition of noise is contained in the displayed signal.

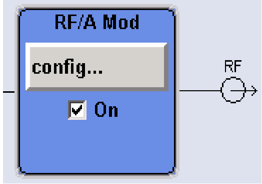
The spectrum display of the output signal is particularly suitable for checking multi carrier signals.



RF Signal and Analog Mod - A Mod-RF A

Overview of RF Signal and Analog Modulations

Settings for the RF output signal and analog modulation are made under "RF Signal and Analog Modulations". These settings can be accessed in the block diagram by way of the **RF/A MOD** function block, or by means of the menu with the same name which is opened using the MENU key.

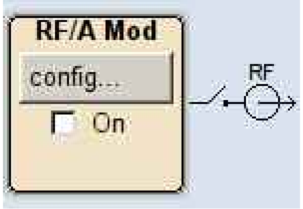


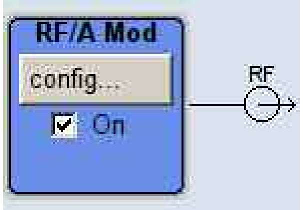
The function block is available for the basic unit (R&S SMBV + frequency option R&S SMBV-B10x) without additional equipment options.

The RF ON/OFF key can also be used to activate and deactivate the output signal (here, however, the current entry focus is irrelevant).

Remote-control commands:
`OUTP:STAT OFF`

The activated and deactivated state is indicated in the block diagram by means of the different block color and the status of the **On** checkbox. The disconnected connection to the output is additionally shown when the output is deactivated. Active analog modulation is also indicated in the block.





The RF output state can also be set in the **Configure** menu of the RF /MOD block.

Remote-control command:
`OUTP:STAT OFF`

The CW, Sweep and List modes are available for generating the RF signal.

CW The RF signal is generated with the set frequency and level. This is the default mode.

Sweep The RF signal is generated as a sweep with the set parameters.

It is not possible to activate frequency, level and LF sweep simultaneously.

List Mode The RF signal is generated on the basis of a list of predefined frequency and level values. The duration of the individual steps can be predefined.

Instruments connected downstream can be taken into consideration when setting the frequency and level by entering a frequency and/or level offset.

Automatic level control ensures maximum level accuracy, even with I/Q modulation.

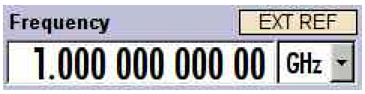
User-specific lists which contain level correction values for any frequency range (User Correction) can be created to, for example, compensate the cable attenuation in a test assembly setup.

The RF signal can be generated in unmodulated or analog form. An internal LF generator, internal pulse generator and/or the external modulation inputs MOD EXT and PULSE EXT at the rear of the instrument is available as the source for the analog modulations.

An external trigger signal for the analog modulations, the sweeps and the LIST mode can be provided at the INST TRIG input. The input REF IN is used to input an external instrument reference, and the output REF OUT serves as the output of the reference frequency (internal or external).

RF Frequency - RF Frequency/Phase/LO Coupling

The simplest way to set the RF frequency is to enter it directly in the header of the display.



The entry is activated by pressing the [FREQ] key. Changes to the frequency have an immediate effect (without confirmation with the Enter key) on the output signal.

Remote-control command
`SOUR:FREQ 100 MHz`

Note:
*The IEC/IEEE-bus command sets the level of the **Freq** display, i.e. an entered frequency offset is taken into consideration in the frequency value (see below).*

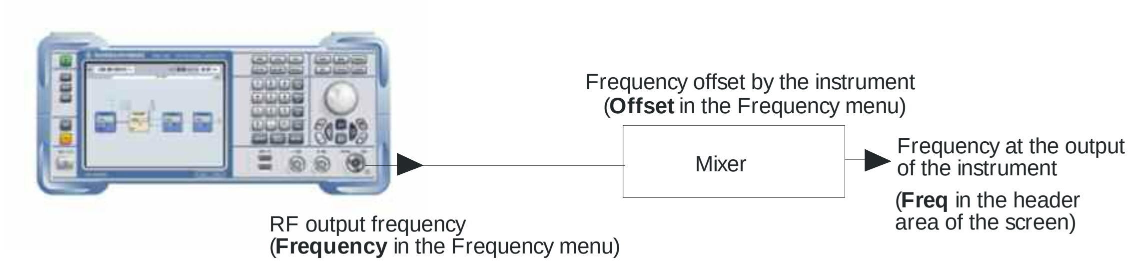
The frequency entered and displayed in the frequency field takes any set frequency offset into consideration, e.g. an offset set for a downstream instrument. This means that with a frequency offset the frequency displayed in the header does not correspond to the frequency at the RF output, but rather to the frequency at the output of the downstream instrument. A set frequency offset is indicated by the **FREQ OFFSET** status message.

This allows the desired frequency at the output of a downstream instrument to be entered in the frequency field. The R&S Vector Signal Generator changes the RF output frequency according to the entered offset.

However, the frequency entered and displayed in the **Frequency/Phase** menu of the **RF/Ana Mod** function block always corresponds to the RF output frequency. Any frequency offset is not taken into consideration.

The correlation is as follows:

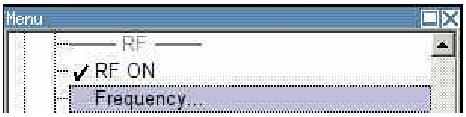
Freq in header = RF output frequency (= Freq in menu) + Freq offset (= Offset in menu)



The frequency offset is entered in the **Frequency/Phase** menu. Here it is also possible to set the frequency without taking the offset into consideration, to set the step width for the frequency entry using the rotary knob, and to set the phase for the RF output signal.

Frequency Menu

The **Frequency/Phase** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.

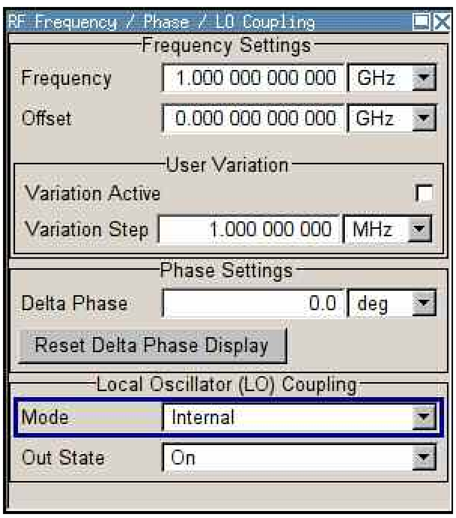


Frequency and offset of the RF output signal are set in the upper part of the group menu.

The step width which is used when setting the frequency using the rotary knob (with **Variation Active On**) is set in the **User Variation** section.

The phase of the output signal can be changed in the **Phase Settings** section. The **Phase Settings** menu is described in section *"Phase - RF Frequency/Phase/LO Coupling"*, page *4.1*.

The lower parts concern the settings of the local oscillator (LO) and are described in the section *"Local Oscillator - LO Coupling"*, page *4.58*.



The frequency and offset are set in the top section of the menu.

Frequency - RF Signal

Sets the RF frequency of the RF output connector. The frequency entered and displayed here corresponds to the frequency at the RF output, i.e. any offset entry is not taken into consideration.

Remote-control command: n.a.

Note:

The IEC/IEEE-bus command `SOUR:FREQ` *sets the frequency of the* ***FREQ*** *display, i.e. the frequency containing offset.*

Frequency Offset - RF Signal

Sets the frequency offset relative to the RF frequency. The frequency offset of a downstream instrument (e.g. a mixer) is entered.

The entry does not change the value of the RF frequency at the RF output. It only changes the RF frequency displayed in the display header. The value of the RF frequency in the header corresponds to the frequency.

Remote-control command:
`SOUR:FREQ:OFFS 0 Hz`

If the frequency is set using the rotary knob, the step width is defined in the **User Variation** section.

Variation Step - RF Signal

Sets the user-defined step width. This step width is used when entering the RF frequency using the rotary knob. Frequency variation with this step width must also be activated with **Variation Active**.

Remote-control command:
`SOUR:FREQ:STEP 1 MHz`

Variation Active - RF Signal

Activates the user-defined step width used when varying the frequency value with the rotary knob.

ON

The frequency value set with the rotary knob is varied using the user-defined step width which is entered under **Variation Step**.

Remote-control command:
`SOUR:FREQ:STEP:MODE USER`

OFF

The frequency value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

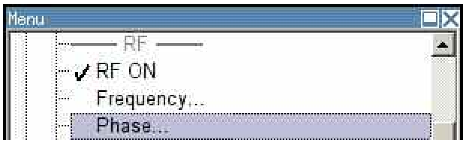
Remote-control command:
`SOUR:FREQ:STEP:MODE DEC`

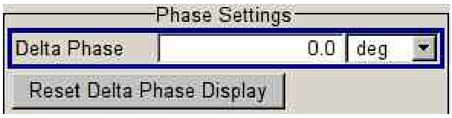
Phase - RF Frequency/Phase/LO Coupling

The phase of the RF output signal can be changed in the **Phase Settings** section of the **RF Frequency/Phase/LO Coupling** menu.

Phase - Menu

The **Phase** menu is opened in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.





The phase of the RF output signal can be changed in the **Phase Settings** section.

Delta Phase - RF Signal

Sets the phase of the RF signal. The current phase of the signal is used as the reference. This function allows, for example, the phase of the output signal to be synchronized with the phase of a signal from a second signal generator.

Remote-control command:
`SOUR:PHAS 10 DEG`

Reset Delta Phase Display - RF Signal

Resets delta phase value. The set phase is adopted as the new current phase, i.e. the delta phase value is reset to 0.

Remote-control command:
`SOUR:PHAS:REF`

RF Reference Frequency - Reference Oscillator

In the internal reference mode the internal reference signal is available at the REF OUT connector (rear of instrument). The frequency of the internal reference signal is permanently set to 10 MHz.

External impairment is possible in both **Adjustment State** states (**On** or **Off**).

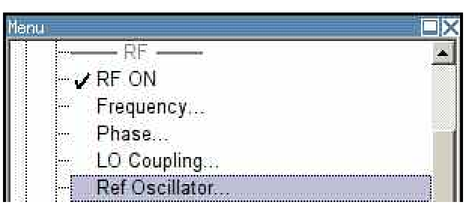
For **EFC (Electronic Frequency Control)**, e.g. in phase noise measurement systems, external FM modulation (DC coupling) in low noise mode is used. FM-DC mode yields a fixed tuning sensitivity which is independent from the set RF output frequency. The tuning sensitivity is equal to the set FM deviation.

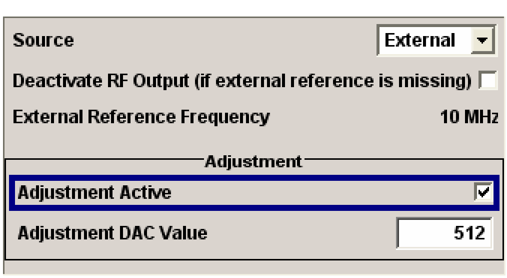
In the external reference mode, an external signal with selectable frequency and defined level must be input at the REF IN connector. This signal is output at the REF OUT connector. The **EXT REF** status message appears in the display header.

Note:
The settings of the reference oscillator are not influenced by an instrument preset (PRESET key).

Reference Oscillator Menu

The **Reference Oscillator** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.





Source - Reference Oscillator

Selects the source of the reference frequency.

Internal

The internal reference signal of 10 MHz is used.
Remote-control command:
`SOUR:ROSC:SOUR INT`

External

An external reference signal is used. The frequency of the external reference signal must be selected under **External Reference Frequency**.
An external reference signal is required for each slave instrument configured to work in a synchronous mode (see "Synchronous Signal Generation")

The REF IN connector of the slave instrument(s) has to be connecter to the REF OUT connector of the master instrument or of the previous slave one.

This allows the slave instrument(s) to synchronise with the master instrument.

Remote-control command:
`SOUR:ROSC:SOUR EXT`

Deactivate RF Output - Reference Oscillator

Determines if the RF output is switched off in case of a missing external reference signal for selection external source.

If enabled, this setting ensures that no improper RF signal due to the missing external reference signal is output and used for measurements.

In addition to the error message "Ext Ref missing", info "RF output deactivated' is indicated.

This setting is not influenced by a reset.

Remote-control command:
`SOUR:ROSC:EXT:RFOF:STAT ON`

External Reference Frequency - RF Signal

Selects the frequency of the external reference signal.

Remote-control command:
`SOUR:ROSC:EXT:FREQ 13E6`

Adjustment Active - Reference Oscillator

Selects adjustment mode.

OFF

The calibrated adjustment value of the internal reference frequency is used. This value is determined at one of the R&S service shops during calibration.

Remote-control command:
`SOUR:ROSC:INT:ADJ:STAT OFF`

ON

A user-defined adjustment value is used. The value is entered under **Adjustment DAC Value**.

This allows the frequency to be impaired freely, for example to simulate a frequency error.

The instrument is no longer in the calibrated state. However, the calibration value is not changed and the instrument resumes the calibrated state after switching the Adjustment State to Off.

Remote-control command:
`SOUR:ROSC:INT:ADJ:STAT ON`

Adjustment DAC Value - RF Signal

Enters a user-defined adjustment value for the internal reference frequency. This value is not used unless **Adjustment Active On** is selected.

Remote-control command:
`SOUR:ROSC:INT:ADJ:VAL 1400`

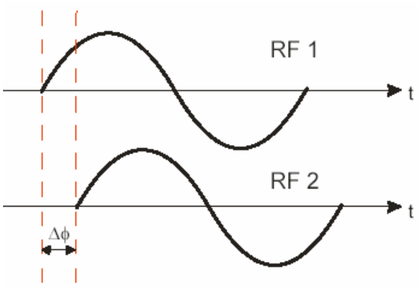
Local Oscillator - LO Coupling

The LO Coupling function allows a distribution of the local oscillator signal in way that multiple RF signals can be driven by the same LO signal. This is mandatory for minimizing the phase drift between these RF signals.

The LO Coupling function is available only for instruments equipped with the option R&S SMBV-B90 (Phase Coherence). The local oscillator signal is available at the LO OUT connector (rear of instrument). In the external local oscillator mode, an external signal must be input at the LO IN connector.

Phase Coherence

Phase coherence of two RF signals means that there is a defined and stable phase relationship between two (or more) RF carriers, i.e. there is a fixed delta phase ΔΦ between the carriers. Strictly speaking, phase coherence is only defined for CW carriers with the same frequency (or for CW carriers at frequencies that are multiples of each other).

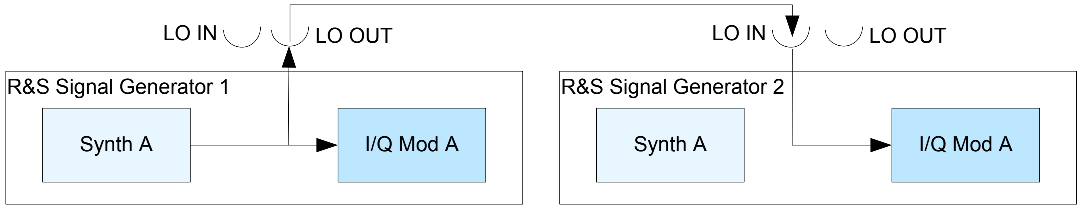


If two signal generators are coupled via their 10 MHz reference, they are generating exactly the same frequency but only from the long term perspective. Having a closer look into the instantaneous differential phase (“delta phase”) of these two RF signals, this is quite instable due to phase noise of the two synthesizers, “weak” coupling at 10 MHz and a long synthesis chain up to the RF domain or temperature differences which cause a change of the effective electrical length of some synthesizer components.

Most critical for a stable delta phase is the thermal RF phase drift between multiple RF synthesizers. This drift can be minimized by use of a common synthesizer, i.e. a common local oscillator (LO) signal, for all RF carriers. Only if this LO signal (which is internally used for upconverting the baseband signal to the RF) is the same for all carriers, a stable phase between the RF signals can be achieved.

Typical Applications - LO Coupling

The LO Coupling function can be used to generate a 2X2 MIMO signal with two R&S Signal Generators, working in External mode.



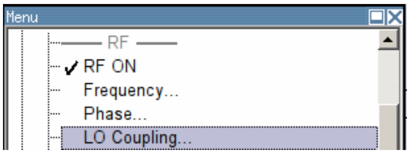

```
SOUR:FREQ:LOSC:MODE INT
SOUR:FREQ:LOSC:OUTP:STAT ON
```

```
SOUR:FREQ:LOSC:MODE EXT
```

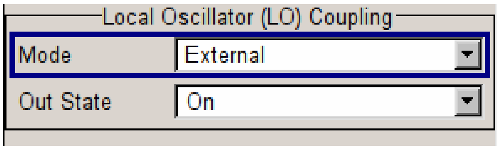
LO Coupling Menu

The **LO Coupling** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.

The menu is available only for instruments equipped with the option R&S SMBV-B90. This option enables phase coherent RF outputs of two or more RF paths of two or more instruments.



The local oscillator coupling is set in the lower areas of the group menu. The upper areas are for setting the frequency and phase of the RF output signal, see section *"RF Frequency - RF Frequency/Phase/LO Coupling"*, page *4.52*, and section *"Phase - RF Frequency/Phase/LO Coupling"*, page *4.55*.



The menu is used to select the mode of the LO coupling and to switch on/off the state of the local oscillator output.

Mode - LO Coupling

Selects the mode of the local oscillator coupling.

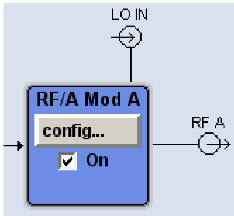
Internal

This mode corresponds to a normal operation; the internal local oscillators are used.

Remote-control command:
`SOUR:FREQ:LOSC:MODE INT`

External

An external signal is used.



Note:

*Selection of LO Coupling **External** mode, disables all parameters in the **Frequency/Phase/Ref Osc** menu.*

Remote-control command:
`SOUR:FREQ:LOSC:MODE EXT`

Out State - LO Coupling

Switches on/off the LO output.

On

The internal local oscillator signal is also available on the LO OUT connector (in order to couple two instruments).

Remote-control command:
`SOUR:FREQ:LOSC:OUTP:STAT ON`

Off

The LO OUT signal is switched off.

Remote-control command:
`SOUR:FREQ:LOSC:OUTP:STAT OFF`

Power Sensors

Up to three R&S NRP power sensors can be connected to the generator. The SENSOR connector for the first R&S NRP power sensor is on the front panel, a second and third R&S NRP power sensor can be connected via the USB interfaces (front and rear panel, requires USB adapter R&S NRP-Z3 or R&S NRP-Z4). The connected R&S NRP power sensors are automatically detected and indicated in the **NRP-Z Power Viewer** menu.

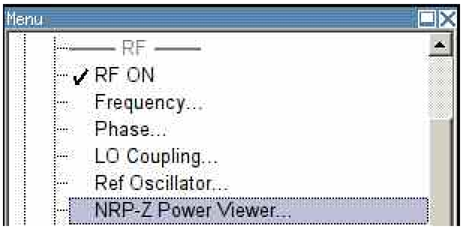
The average signal power is continuously measured by the R&S NRP power sensor(s) and indicated in the Power Sensors menu (**NRP-Z Power Viewer**). Permanent display of the measurement results in the block diagram can be activated.

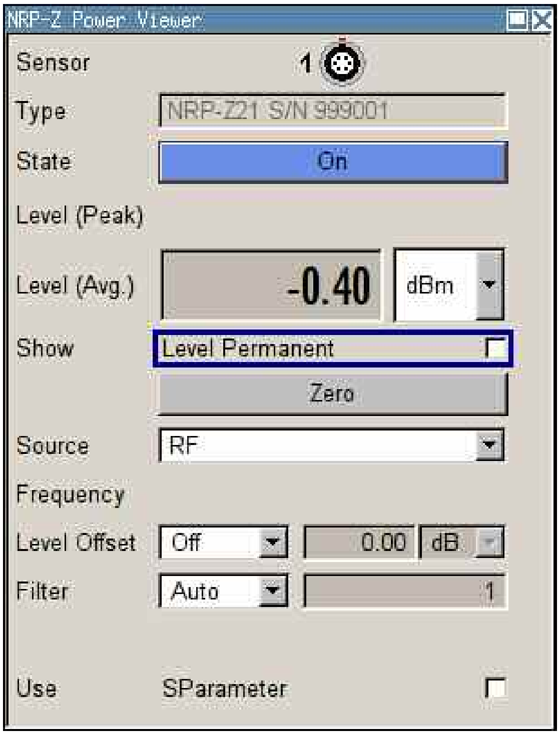
The signal generator supports the use of R&S NRP power sensors for the acquisition of level correction data. The acquired level correction data is used to create and activate lists in which level correction values predefined by the user are freely assigned to RF frequencies. Correction is performed by the user-defined table values being added to the output level for the respective RF frequency (see User Correction, on page 4.72).

Note:
Please see your R&S NRP power sensor manual for detailed information on the used power sensor.

NRP-Z Power Viewer Menu

The **NRP-Z Power Viewer** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**. The menu is structured like a table showing the values for sensor 1 in the left "column" and the values of the second/third sensor in the middle/right "column". Only the detected sensors are indicated, i.e. if only one sensor is connected only one column is indicated. The sensor connected to the SENSOR port is always indicated as sensor 1, and the sensors connected to the USB interface are always indicated as sensor 2 and 3.





Sensor - Power Sensors

Indicates the connector used for the detected sensors. The values listed below belong to the respective sensor.

Remote-control command:
SENS:POW:STAT?
Response. 0 (no power sensor is connected)
Response. 1 (a power sensor is connected at the Sensor connector)

The sensor is selected by suffix **1**, **2** or **3** in key word SENSe or READ of the command header. Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor connected first to one of the USB interfaces and suffix 3 the sensor connected second to one of the USB interfaces.

Note:
The software version of the connected power sensor can be retrieved by means of the remote control command:
SENS:POW:SVER?

Type - Power Sensors

Indicates the type of the connected R&S NRP power sensor. The sensor type is automatically detected.

Remote-control command:
SENS:POW:TYPE?

State - Power Sensors

Activates/deactivates level measurement by the power sensor.

Remote-control command:
`INIT:POW:CONT OFF|ON`

The local state is set with the INIT command. Switching the local state off enhances the measurement performance.

In remote control, the sensors are set up using the SENSe commands. The remote measurement is triggered by the READ query which also provides the measurement results. The state is not influenced by these commands, measurements results can be retrieved with local State on or off.

```
SENS:POW:FILT:TYPE USER
SENS:POW:FILT:LENG:USER 16
READ:POW?
```

Level (Peak)- Power Sensors

With certain power sensors only, e.g. R&S NRP-Z81.

Indicates the measured peak level value with the selected unit.

Remote-control command:
`READ:POW?`
Response: `-55.62403263352178,-22.419472478812476`
(the second value is the peak level value)

Level (Avg.) - Power Sensors

Indicates the measured level value with the selected unit.

Remote-control command::
`READ:POW?`
Response: -45.6246576745440230

Unit - Power Sensors

Selects the unit used for result display.

The power sensor provides the measured value in Watt.

In which unit the measured value is indicated is selected here and might be Watt, dBm or dBuV.

Remote-control command:
`SENS:UNIT:POW DBM`

Show Level Permanent - Power Sensors

Activates the permanent indication of the power measurement result in the upper right corner of the block diagram. For each sensor, the type of sensor, the connector, the measurement source and - if set - the offset is indicated.

Remote-control command:
`SENS:POW:DISP:PERM:STAT ON`

Zero - Power Sensors

Activates the auto zero function.
Zeroing calibrates the external power sensor by adjusting its reading at zero signal power. For this purpose, the RF power source must be switched off or disconnected from the sensor (see tips below). R&S power sensors automatically detect the presence of any significant input power. This aborts zeroing and generates an error message. Zeroing can take a few seconds, depending on the sensor model; refer to the documentation of your external power sensor for more information.

Tips for zeroing

Perform zeroing
- During warm-up after switching on or connecting the instrument
- After a substantial change of the ambient temperature
- After fastening the power sensor module to an RF connector at high temperature
- After several hours of operation
- When very low-power signals are to be measured, e.g. less than 10 dB above the lower measurement limit.
- -Switch off the RF power source for zeroing; do not disconnect it from the power sensor. In this way you will maintain the thermal equilibrium, and zeroing will also compensate for the noise superimposed on the measured signal (e.g. from a broadband amplifier).

Remote-control command:
`SENS:POW:ZERO`

Source - Power Sensors

Selects the source for measurement.

RF A/B

Measurement source is the RF signal of the generator. The RF frequency is used as the measurement frequency of the sensor and the corresponding correction factor is used.

In this mode the RF frequency of the generator is send to the sensor automatically if changed.

If two sensors are connected, both sensor can be allocated the same path, e.g. for measurements before and after the DUT.

For single path instruments, only selection RF A is offered.

Remote-control command:
`SENS:POW:SOUR RF`

User

Measurements source is any freely selectable source. The frequency is entered manually under frequency (e.g. for measurement of amplifier gain with 2 sensors).

Remote-control command:
`SENS:POW:SOUR USER`

Frequency - Power Sensors

Source User only

Enters the frequency for measurement source **User**.

Remote-control command:
`SENS:POW:FREQ 2.5MHz`

Level Offset - Power Sensors

Activates and defines a level offset which is added to the measured value. This allows e.g. an attenuator in the signal path to be taken into account. The offset is always entered in dB, irrespective of the selected unit for result display.

Remote-control command:
`SENS:POW:OFFS:STAT ON`
`SENS:POW:OFFS -2 dB`

Filter Length - Power Sensors

Selects the filter length used for measurement.
The averaging filter is used to reduce fluctuations in the measured result to the extent desired. Such fluctuations can be caused by inherent noise of the measuring instrument, modulation of the measurement signal or beats from the superposition of adjacent carriers. A more stable display has to be traded off against longer measurements. The measurement result is obtained from a two-stage averaging process.

Note:
Longer measurements does not mean that it takes longer to display a new result, but rather that it takes longer for the result to settle when the power changes.

Measurements are continuously repeated in a predefined time window. The measurement result is obtained by averaging the measured values for the last 2N time windows. The number N is the filter length, the factor of 2 arises because the output signals from the microwave detector to suppress low-frequency noise are chopped at the same rate as the time windows, which means that an independent measured value can only be obtained from two consecutive values. As the filter length is the multiplier for the time window it directly influences the measurement time.

The filter length can be selected automatically or can be manually set to a fixed value. As a preliminary, you should always check if the auto mode is giving satisfactory results because you will always have to adjust an optimal, manual filter-length setting if the power is not constant.

Selection **Fixed Noise** is offered for reaching a defined measurement accuracy.

Auto

The filter length is automatically selected and adapted to the currently measured value. With very high signals the filter length and therefore the measurement time can be short. With very low signal levels the filter length and therefore the measurement time is increased in order to reduce noise. The used filter length is indicated in the field to the right.

Remote-control command:
`SENS:POW:FILT:TYP E AUTO`
`SENS:POW:FILT:LENG:AUTO?`

User

The filter length is set manually.

The filter length is entered in the entry window to the right. As the filter length works as a multiplier for the time window, this results in a constant measurement time. Values 1 and 2^n are settable.

Note:
The time window varies in manual control, it is fixed to 20 ms in remote control.

The **Auto Once** button can be used to search for the optimum filter length for the current measurement conditions. The found filter length is indicated in the field to the right.

Remote-control command:
`SENS:POW:FILT:TYPE USER`
`SENS:POW:FILT:SONC`
`or`
`SENS:POW:FILT:LENG:USER 16`

Fixed Noise

The averaging factor is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content.

The desired noise content is entered in the entry field to the right.

To avoid very long settling times when the power is low, the averaging factor can be limited with the **Timeout** parameter.

Remote-control command:
`SENS:POW:FILT:TYPE NSR`
`SENS:POW:FILT:NSR 0.001`
`SENS:POW:FILT:NSR:MTIM 4`

Use SParameter - Power Sensors

Activates the use of the s-parameters correction data of the connected power sensor. For sensor with attenuator this checkbox is automatically checked.

Please see the manual of the connected R&S NRP power sensor for a description on how to use the s-parameters table.

Remote-control command:
`SENS:POW:CORR:SPD:STAT ON`

RF Level/EMF - Level / EMF

Note:

*The message **Level overrange/underrange** appears in the status line if the set level (**Level**) or the displayed peak envelope power (**PEP**) (Digital Modulation or Digital Standard) is in the overrange (see data sheet). The correct level setting cannot be guaranteed for the entire frequency range if the set level is in the overrange/underrange.*

The simplest way to set the RF level is to enter it directly in the header of the display.

The entry is activated by pressing the LEVEL key. Changes to the level have an immediate effect (without confirmation with the Enter key) on the output signal.

Remote-control command:
`SOUR:POW:LEV:IMM:AMPL -30 dBm`

Note:

*The IEC/IEEE-bus command sets the level of the **Level** display, i.e. an entered level offset is taken into consideration in the level value (see below).*

The center line (**Level**) and, to the left of this, the peak envelope power (**PEP**) of the modulated RF output signal is displayed in the case of digital modulation or digital standard.

dBm, dBµV, mV and µV can be used as the level units. The 4 unit keys are labeled with these units.

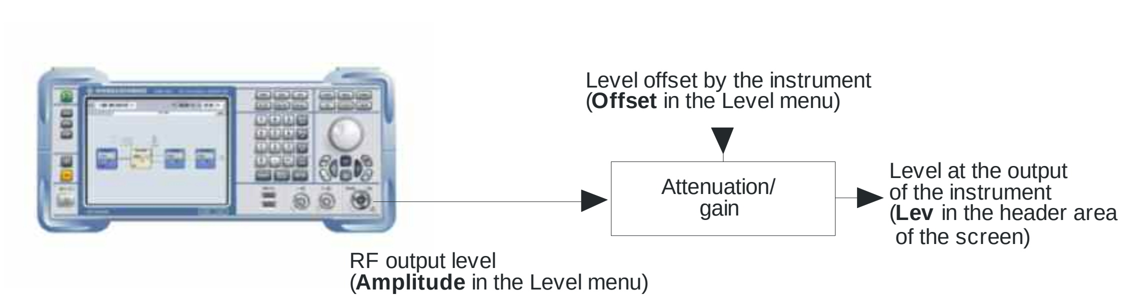
The level entered and displayed in the Level field takes the offset of any downstream attenuators/amplifiers into consideration by way of calculation. This means that with a level offset the level displayed in the header does not correspond to the level at the RF output, but rather to the level at the output of the downstream instrument.

This allows the desired level at the output of downstream instruments to be entered. The R&S Vector Signal Generator changes the RF output level according to the set offset.

However, the level entered and displayed in the **Level** menu of the **RF/Ana Mod** function block always corresponds to the RF output level. Any level offset is not taken into consideration.

The correlation is as follows:

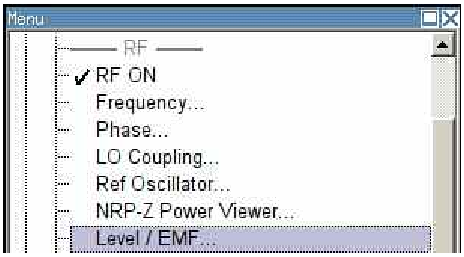
Level in header = RF output level (= Level in menu) + Level offset



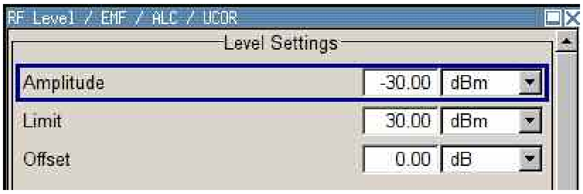
The level offset is entered in the **Level** menu. Here it is also possible to set the level without taking the offset into consideration, and to make other settings, such as level offset, attenuator mode, power-on state.

Level - EMF Menu

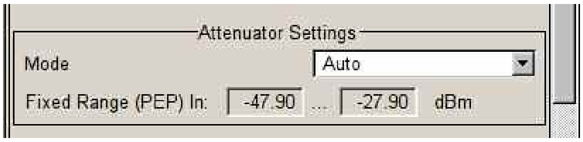
The **RF Level - EMF** menu is opened either in the **RF/A Mod** function block or using the [MENU] key under **RF/A Mod**.



The top sections of the combined menu **RF Level / EMF / ALC /UCOR** provide access to the level and attenuator settings. The lower sections provide access to the automatic level control settings, see section "Automatic Level Control - ALC", page 4.70 and to function User Correction, see section "User Correction", page 4.72.

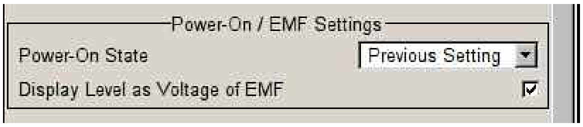


The offset-free level, attenuation mode, level offset and level limit are set in the top section of the menu.



The attenuator is set in the **Attenuator Settings** section.

The step width which is used when setting the level using the rotary knob (with **Variation Active On**) is set in the **User Variation** section.



The power-on behavior of the R&S Vector Signal Generator and the level display in the display header are set in the **Power-On / EMF Settings** section.

The offset-free level, attenuation mode, level offset and level limit are set in the top section of the menu.

Amplitude - RF Signal

Sets the RF level of the RF output connector.

The level entered and displayed here corresponds to the level at the RF output, i.e. any offset entry is not taken into consideration.

Remote-control command: n.a.

Note:

The IEC/IEEE-bus command `SOUR:POW:LEV:IMM:AMPL` *sets the level of the **Level** display, i.e. the level containing offset.*

Limit - RF Signal

Sets the level limit.

The value specifies the upper limit of the level at the RF output connector. A message appears if an attempt is made to set a level above this limit and the level at the RF output is confined to the upper limit. However, the level indication is not influenced.

Remote-control command:
`SOUR:POW:LIM:AMPL 30 dBm`

Offset (Level) - RF Signal

Sets the level offset relative to the RF level.

The level offset of a downstream instrument (e.g. an attenuator or amplifier) is entered.

The entry does not change the value of the RF level at the RF output. It only changes the RF level displayed in the display header. The value of the RF level in the header corresponds to the level at the output of the downstream instrument.

Remote-control command:
`SOUR:POW:LEV:IMM:OFFS 0`

The attenuator mode is set in the **Attenuator Settings** section.

Attenuator Mode - RF Signal

Sets the attenuator mode at the RF output.

Auto

Standard mode. The electronically switching attenuator switches with a 5 dB step width at fixed switching points.

Remote-control command:
`OUTP:AMOD AUTO`

Fixed

The level settings are made without switching the attenuator. When this operating mode is switched on, the attenuator and the option are fixed in their current positions and the resulting variation range is defined. The range is displayed under **Attenuator Fixed Range**.

If automatic level control is activated (**ALC State = On**), the level settings are made without interruption.

If the normal variation range is overranged or underranged, level errors increase considerably and the warning **Level under/overrange** appears in the info line. The spectral purity of the output signal decreases with high attenuation.

Remote-control command:
`OUTP:AMOD FIX`

Fixed Range (PEP) In

Displays the level range in which the level is set without interruption for the **Attenuator Mode fixed** setting.

Remote-control commands:
`OUTP:AFIX:RANG:UPP?`
`OUTP:AFIX:RANG:LOW?`

If the level is set using the rotary knob, the step width is defined in the **User Variation** section.

Variation Active - RF Level

Activates the user-defined step width used when varying the level value with the rotary knob.

ON

The level value set with the rotary knob is varied using the user-defined step width which is entered under **Variation Step**.

Remote-control command:
`SOUR:POW:STEP:MODE USER`

OFF

The level value set with the rotary knob is varied in steps of one unit at the cursor position (standard operating mode).

Remote-control command:
`SOUR:POW:STEP:MODE DEC`

Variation Step - RF Level

Sets the user-defined step width for entering the RF level using the rotary knob. Level variation with this step width must also be activated with **Variation Active**.

Remote-control command:
`SOUR:POW:STEP:INCR  1dBm`

The power-on behavior of the R&S Signal Generator and the level display in the display header are set in the **Power-On / EMF Settings** section.

Power-On State - RF Signal

Selects the state which the RF output is to assume after the instrument is switched on.

RF Off

The output is deactivated when the instrument is switched on.

Remote-control command:
`OUTP:PON OFF`

Previous Setting

When the instrument is switched on, the output assumes the same state as it had when the instrument was switched off.

Remote-control command:
`OUTP:PON ON`

Display Level as Voltage of EMF - RF Level

Activates display of the signal level as voltage of the EMF (no-load voltage). If this setting is deactivated, the level is displayed as a voltage over a 50 Ohm load (preset state).

Remote-control command: n.a.

Automatic Level Control - ALC

Automatic level control (**A**utomatic **L**evel **C**ontrol) can be used with almost all applications, especially I/Q modulation and amplitude modulation. It only has to be deactivated for certain settings in the baseband and when I/Q impairments (**Impairments State On**) are activated. This is indicated under the respective function.

The level control status is permanently displayed as a status message in the info line.

The standard operating status is level control **On**. This provides the highest level accuracy. The preset is **Auto**. In this mode the level control is automatically adapted to the operating conditions.

Level control can be switched to **Sample&Hold** or **On** for particular applications. The **Sample&Hold** state (level control Off) is recommended if in CW mode the signal/intermodulation ratio is to be improved for multi-transmitter measurements.

If **Sample&Hold** is selected, the level is recalibrated for every level and frequency setting. For this purpose, level control is activated briefly at a defined signal, the level adjuster is then held at the attained value and level control is activated.

If **On** and **Attenuator Mode Fixed** is selected, the level is recalibrated for every level and frequency setting. For this purpose, level control is activated briefly at a defined signal, the level adjuster is then held at the attained value and level control is activated the uninterrupted level settings are made.

Note:

*When pulse modulation is activated, the ALC state of the R&S Signal Generator is automatically changed to **ALC OFF (Sample & Hold)**. In this state, the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting.*
*The level is decreased by 30 dB during **Sample&Hold** measurement.*

Automatic Level Control Menu

The **Automatic Level Control** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.

The top sections of the combined menu **Level / EMF / ALC /UCOR** provide access to the level and attenuator settings (see section *"*RF Level/EMF - Level / EMF*"*, page *4.66*). The lower sections provide access to the automatic level control settings and to function User Correction, see section "User Correction", page 4.72.

Note:
External Level Control is possible using R&S NRP power sensors, see following section "Power Sensors", on page 4.60.

This menu is used to activate level control.

State - ALC

Activates/deactivates internal level control.

Off (Sample & Hold)

Internal level control is deactivated.

Remote-control command:
`SOUR:POW:ALC OFF`
`SOUR:POW:ALC:OMOD SHOL`

Off (Table)

Internal level control is performed according to the ALC table.

Remote-control command:
`SOUR:POW:ALC OFF`
`SOUR:POW:ALC:OMOD TAB`

Auto

Default state. Level control is automatically adapted to the operating states.

Remote-control command:
`SOUR:POW:ALC AUTO`

On

Internal level control is permanently activated.

Remote-control command:
`SOUR:POW:ALC ON`

Search Once - ALC

Manually activates level control briefly to allow the level to be calibrated (the **Sample&Hold** setting must be selected).

Remote-control command:
`SOUR:POW:ALC:SONC`

Adjust ALC Table - ALC

Performs ALC adjustments according to the predefined values in the ALC table.

Remote-control command:
`CAL:LEV:ALCT:MEAS?`

User Correction

The "User Correction" function is used to create and activate lists in which level correction values predefined by the user are freely assigned to RF frequencies. Correction is performed by the user-defined table values being added to the output level for the respective RF frequency.

With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

The lists are created in the List Editor. Each list is stored in its own file with the predefined file extension ***. uco**. The name of the User Correction file can be freely selected. The files are loaded from the **Lists...** file manager. Externally created tables with pairs of frequency and level values can be converted into User Correction files using the import function. The external files must have the file extension *.txt or *.csv. These file formats are provided e.g. by the Microsoft Excel program. The separators for table columns and for decimal floating-point numerals can be set. In addition, internally created User Correction data can be exported into ASCII files using the export function.

The amplitude can also be linearized automatically by means of an R&S NRP power sensor connected to one of the generator output signals. With the aid of the **Fill with Sensor** function, a table with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables. The User Correction list with the correction values acquired by the sensor is generated in the **Edit User Correction List** menu. The correction values can be acquired any time irrespective of the modulation settings of the generator.

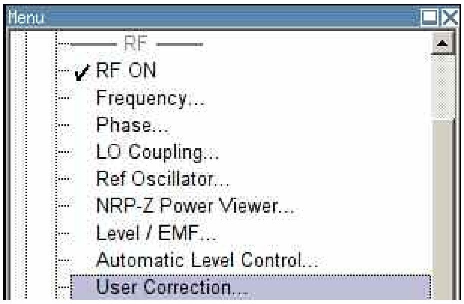
If user correction is activated, the **UCOR** display (User Correction) is shown in the header together with the **Level** display. The RF output level is the sum of both values.

Level + UCOR = Output level

If activated, user correction is effective in all operating modes.

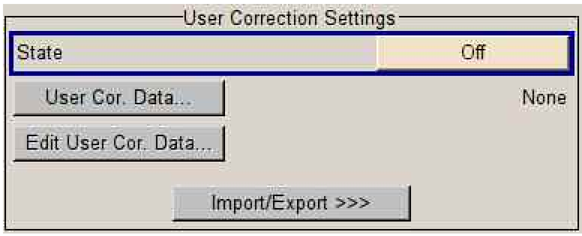
User Correction Menu

The **User Correction** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.



The combined menu Level / EMF / ALC /UCOR provides access to the automatic level control settings in the bottom section. The top sections provide access to the level and attenuator settings, see section "RF Reference Frequency - Reference Oscillator", page 4.56, and to the automatic level control settings, see section "Automatic Level Control - ALC", page 4.70.

The menu is used to activate/deactivate user correction, and to create, select and activate the lists.



State - User Correction

Activates/deactivates user correction.

The **UCOR** status message appears in the frequency and level display.

Remote-control command:
`SOUR:CORR:STAT ON`

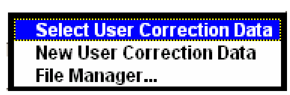
User Correction Value - User Correction

Indicates the current value for level correction.

Remote-control command:
`SOUR:CORR:VAL?`

User Cor. Data - User Correction

Calls the **File Select** menu for selecting and creating a list or the **File Manager**.



Remote-control command:
`MMEM:CDIR 'var/smbv/USER/CSET'`
`SOUR:CORR:CSET:CAT?`
Response:
`'Ucor1', 'Ucor2'`

`SOUR:CORR:CSET:SEL 'Ucor1'`

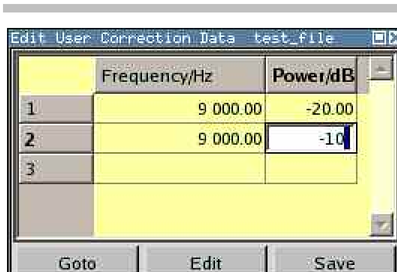
`SOUR:CORR:CSET:DEL 'Ucor2'`

Edit User Cor. Data - User Correction

Calls the editor for editing the selected user correction list.
A list consists of any number of frequency/level value pairs. The currently selected list is displayed.

Each list is saved as a separate file with extension ***.uco**. The file name and the directory to which the file is saved are user-selectable.

Important:
Save list only after filling both columns (frequency and level), otherwise the entries are lost.



Frequency /Hz

Enters the frequency to which the level correction value applies.

Note:
*The **Fill..** function allows to automatically enter any number of frequencies with freely selectable range and increment.*
*Using the **Fill With Sensor** function of the **Edit** sub menu requires only the entry of the frequency values. The level values are automatically acquired by the connected power sensor.*

Remote-control command:
`SOUR:CORR:CSET:SEL 'Ucor1'`
`SOUR:CORR:CSET:DATA:FREQ 100MHz,...`

Power / dB

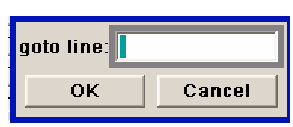
Enters the level correction value to which the specified frequency applies. The values can be entered manually or automatically with the **Fill With Sensor** function (available in the **Edit** sub menu).

Remote-control command:
`SOUR:CORR:CSET:SEL 'Ucor1'`
`SOUR:CORR:CSET:DATA:POW 1dB,0.8dB,…`

Goto

Selects row for editing.

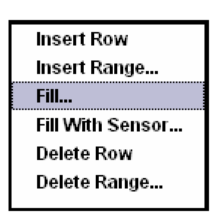
If Goto row is selected, a window opens for entering the requested row.



Remote-control command: n.a.
(it is not possible to change individual positions of the list)

Edit

Calls a selection of possible actions described below.



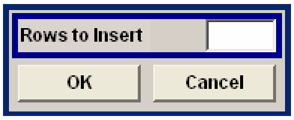
Insert Row

Insert a new row before the marked row.

Remote-control command: n.a.

Insert Range

Insert new rows before the marked row. The number of rows to be inserted can be defined in an entry window.



Remote-control command: n.a.

Fill....

Opens a sub menu for defining a set of list values to be automatically entered in the ucor list (see section *"*Filling the Correction List automatically*"*).

Remote-control command: n.a.

Fill With Sensor

Calls the menu to activate the filling of the user correction list with level values acquired by the selected power sensor (see section "Filling the Correction List with Power Sensor Measurement Data").

Remote-control command: n.a.

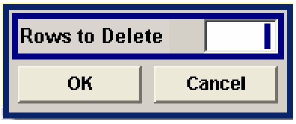
Delete Row

Deletes the marked row.

Remote-control command: n.a.

Delete Range...

Allows to delete any number of rows starting with the marked row. The number of rows to be deleted can be defined in an entry window.



Remote-control command: n.a.

Save as

Open the file menu to save the list under a new name.

Important:
Save list only after filling both columns (frequency and level), otherwise the entries are lost.

Each list is saved to the R&S Vector Signal Generator hard disk as a separate file with the file prefix ***.uco**. The file name and the directory to which the file is saved are user-selectable.

Remote-control command: -

Save

The list is saved under its current name.

Remote-control command: -
(the list is automatically saved after the values have been entered)

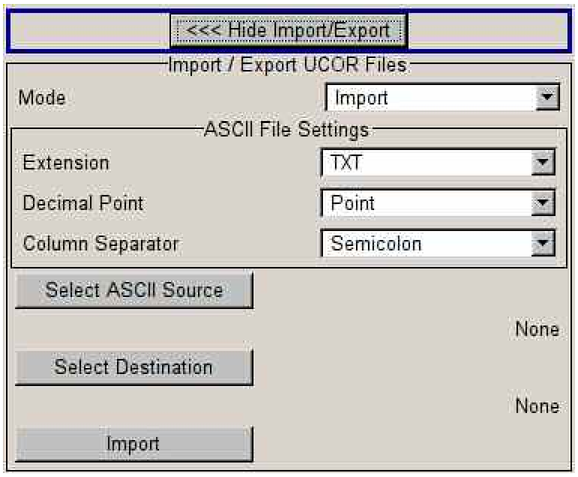
User correction list can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the **Import/Export** button.

Import/Export - User Correction

Expands the menu with the area for import and export of user correction files.

Externally edited Excel tables with any number of frequency/level value pairs can be imported as text or CSV-files and used for user correction.

On the other hand, internally created user correction list can be exported as text or CSV-files.



Mode - User Correction

Selects if user correction lists should be imported or exported. The settings offered depend on the selected mode.

Remote-control command:
`SOUR:CORR:DEXC:MODE IMP`

Extension - User Correction

Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Remote-control command:
`SOUR:CORR:DEXC:AFIL:EXT TXT`

Decimal Point - User Correction

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Remote-control command:
`SOUR:CORR:DEXC:AFIL:SEP:DEC DOT`

Column Separator- User Correction

Selects the separator between the frequency and level column of the ASCII table the user correction list is exported to or imported from.

Remote-control command:
`SOUR:CORR:DEXC:AFIL:SEP:COL TAB`

Select ASCII Source / Destination - User Correction

Calls the **File Manager** for selecting the ASCII file to be imported into a user correction list (source) or the ASCII file the user correction list is exported (destination) in.

Remote-control command:
`SOUR:CORR:DEXC:AFIL:SEL "var/smbv/user/ucor/list1.txt"`

Destination / Source - User Correction

Calls the **File Manager** for selecting the user correction list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

Remote-control command:
`SOUR:CORR:DEXC:SEL "var/smbv/user/ucor/list1.txt"`

Import / Export - User Correction

Starts the export or import of the selected file.

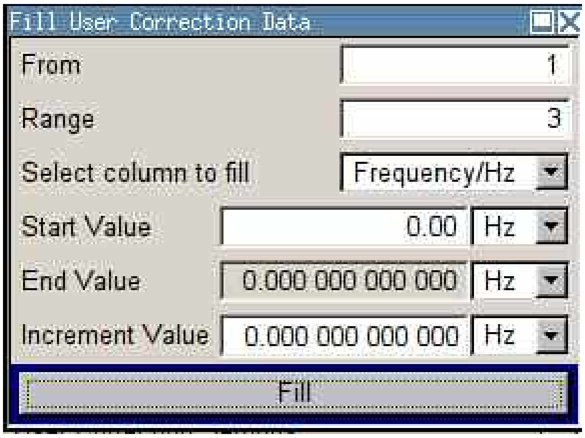
When import is selected, the ASCII file is imported as user correction list.

When export is selected, the user correction list is exported into the selected ASCII file.

Remote-control command:
`SOUR:CORR:DEXC:EXEC`

Filling the Correction List automatically

The **Fill Table** menu enables you to automatically set the level correction values.



The start line and the number of rows to be filled are defined under **From** and **Range**.

The column to be filled is selected under **Select column to fill**. Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters.

The filling of the column with the selected value settings is started with button **Fill**.

Note:
*The correction list entries are only computed when the **Fill** button is pressed.*

From

Sets the start value of the index range.

Remote-control command: n. a.

Range

Sets the range for filling the table.

Remote-control command: n. a.

Select column to fill

Selects either the frequency or the level column to be filled with the value defined below.

Remote-control command: n. a.

Start value

Sets the start value for the frequency or the level entries.

Remote-control command: n. a.

End value

Sets the end value for the frequency or the level entries.

Remote-control command: n. a.

With increment

Sets the increment for the frequency or the level entries.

Remote-control command: n. a.

Fill

Fills the selected column in the set range with values, starting with the start value and using the set increment.

Remote-control command: n. a.

Filling the Correction List with Power Sensor Measurement Data

The level correction values for the user correction list can be acquired by means of R&S NRP power sensors. The R&S NRP sensors are connected to either the SENSOR connector or to one of the USB interfaces. Configuration of the connection is performed in the **Power Sensor** menu (see "Power Sensors"). The filling of the ucor list with measurement data is performed in the ucor list editor (see above "Edit User Cor. Data - User Correction").

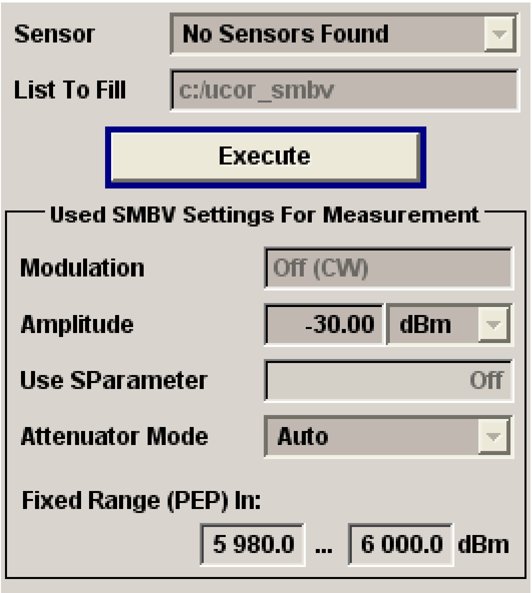
In the editor, the frequencies for which the correction values are to be acquired are entered in the frequency column (either manually or by means of the **Fill…** menu).

Important:

Do not save the list at this point, because the frequency entries are lost as long as there are no entries for the level column also. In the following these entries are automatically acquired by the connected power sensor.

All level correction values for the given frequency values are measured using the Power sensor and automatically filled in the selected list. The list is automatically stored and recalled again after filling.

The **Fill with Sensor** button of the **Edit User Correction Data** menu opens the associated menu.



The menu indicates the relevant generator settings.

All settings are read-only, except the **Sensor** .
In case more than one sensors are connected to the instrument, the sensor can be selected in the **Sensor** field of the menu.

The **Execute** button is only enabled if a sensor is detected and the user correction list contains at least one frequency value.

Remote-control command:
`SOUR:CORR:CSET:DATA:SENS1:POW:SONC`

(the power sensor used is selected by the suffix in key word SENSe of the command header. Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor connected first to one of the USB interfaces and suffix 3 the sensor connected second to one of the USB interfaces.)

Overvoltage Protection

The R&S Vector Signal Generator (all frequency options) is equipped against overloading by an external signal applied to the RF output.

The overload protection is tripped when the power of the external signal becomes too high. A relay opens and interrupts the connection between the RF output and attenuator. This condition is indicated in the display header by the 'OVERLOAD' status message.

- Reset the overload protection by pressing the RF ON/OFF key. The RF input is activated when the overload protection is reset.

Remote-control commands:
```
OUTP:PROT:TRIP?
OUTP:PROT:CLE
OUTP:STAT ON
```

List Mode - List

Similar to a sweep, a series of previously defined frequency and level points is processed in List mode. In contrast to a sweep, however, a list with freely selectable value pairs (frequency and level) can be created. The value range for frequency and level covers the entire configurable value range of the instrument.

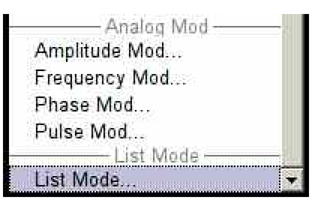
Note:
List mode and sweeps can not be activated simultaneously, they deactivate each other.

The lists can be created in the List Editor. Each list is stored in its own file with the predefined file extension ***. lsw**. The name of the List file can be freely selected. The files are loaded from the **Lists...** file manager. Externally created tables with pairs of frequency and level values can be converted into List files using the import function. The external files must have the file extension *.txt or *.csv. These file formats are provided e.g. by the Microsoft Excel program. The separators for table columns and for decimal floating-point numerals can be set. In addition, internally created List data can be exported into ASCII files using the export function.

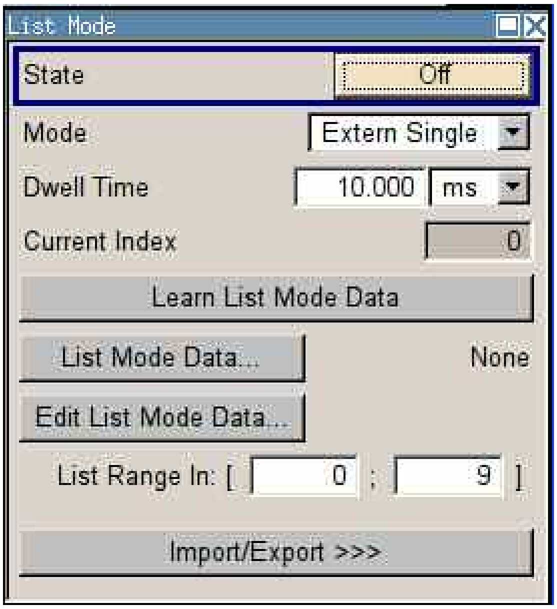
The necessary hardware settings are calculated the first time a list is processed. With long dwell times, this calculation can be performed while the list is being processed; the entered dwell times are observed. With very short dwell times, calculation of the hardware settings increases the dwell time for the initial processing cycle; the entered value is only observed from the second processing cycle onwards. In this case a message appears to inform the user that there is a deviation between the current and set dwell times. No further calculations are required after the first run through a list. The current dwell times will definitely no longer deviate from the set dwell times.

The list is processed from the beginning to the end of the list (modes **Auto**, (**External**) **Single**, (**External**) **Step**).

The **List Mode** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.



The menu is used to activate/deactivate operating mode List, to create, select and activate the lists, and to select the trigger mode and the dwell time.



State - List Mode

Activates/deactivates the List mode. The currently selected list is processed.

In case of a new or modified list, the necessary hardware settings are automatically determined on activation of the list mode. The data determined in this way is stored along with the list and is available whenever the list is used again.

This means that when activating the list mode, the system checks whether any hardware settings are present. If so, the list is started immediately, but if not they are automatically determined (the list is learnt).

A **Learn List Mode Data** button is available for deliberately activating list learning.

Note:

Activating the list mode automatically deactivates all sweeps.
During list mode the frequency and level indications do not display the currently set values.

Remote-control command:
`SOUR:FREQ:MODE LIST`

Mode - List Mode

Selects the cycle mode of the List mode.

Auto

Cycle from the beginning to the end of the list with automatic restart at the beginning. If a different mode was activated prior to the Auto mode, the cycle continues from the beginning of the list. The duration of a list step is determined by the set dwell time.

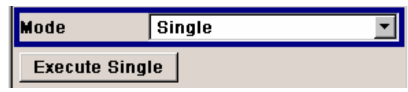
Button **Reset** restarts the list at the starting point.

Remote-control command:
```
SOUR:FREQ:MODE LIST
SOUR:LIST:MODE AUTO
SOUR:LIST:TRIG:SOUR AUTO
```

Single

Single cycle from the beginning to the end of the list. If **Single** is selected, the cycle is not started immediately. The **Execute Single** button appears under the **Mode** line. The cycle is started with this button. The duration of a list step is determined by the set dwell time.

Button **Reset** restarts the list at the starting point.



Remote-control command:
```
SOUR:FREQ:MODE LIST
SOUR:LIST:MODE AUTO
SOUR:LIST:TRIG:SOUR SING
SOUR:LIST:TRIG:EXEC
```

Step

Manual, step-by-step processing of the list. Activating **Step** stops the current list and the cursor moves to the value displayed for **Current Index**. It is now possible to scroll up and down in the list in discrete steps by varying the index. The duration of a list step is determined by the time between two index entries.

Button **Reset** restarts the list at the starting point.

Remote-control command:
```
SOUR:FREQ:MODE LIST
SOUR:LIST:MODE STEP
SOUR:LIST:TRIG:SOUR SING
```

Extern Single

Single cycle from the beginning to the end of the list as with **Single**, but started by an external trigger.

The external trigger signal is input at the BNC connector INST TRIG on the rear of the instrument.

Button **Reset** restarts the list at the starting point.

Remote-control command:
```
SOUR:FREQ:MODE LIST
SOUR:LIST:MODE AUTO
SOUR:LIST:TRIG:SOUR EXT
```

Extern Step

Step-by-step cycle using the external trigger signal. Each trigger event starts a single step. The duration of a list step is determined by the time between two trigger events.

The external trigger signal is input at the BNC connector INST TRIG on the rear of the instrument.

Button **Reset** restarts the list at the starting point.

Remote-control command:
`SOUR:FREQ:MODE LIST`
`SOUR:LIST:MODE STEP`
`SOUR:LIST:TRIG:SOUR EXT`

Execute Single - List Mode

Triggers the list manually. This button is available only if **Mode Single** is selected.

Remote-control commands
`SOUR:FREQ:MODE LIST`
`SOUR:LIST:MODE AUTO`
`SOUR:LIST:TRIG:SOUR SING`
`SOUR:LIST:TRIG:EXEC`

Reset - List Mode

Resets the list to the starting point.

Remote-control command:
`SOUR:LIST:RES`

Dwell Time - List Mode

Enters the dwell time. The dwell time determines the duration of a list step in list operating modes **Auto**, **Single** and **Extern Single**. In these modes a complete list is processed either once or continuously.

In list operating modes **Step** and **Extern Step**, the set dwell time does not affect signal generation. In this case, the duration of a list step is determined by the time between two (internal or external) trigger events.

Remote-control command:
`SOUR:LIST:DWEL 10 ms`

Current Index - List Mode

Sets the list index in **Step** mode.

Remote-control command: n.a.

Learn List Mode Data... - List Mode

Starts the determination of the hardware setting for the selected list. The data determined in this way is stored along with the list.

It may be necessary to deliberately activate list learning in the event of greatly altered environmental conditions that require new hardware settings.

If this is not done, a previously learned hardware setting will continue to be used when list mode is switched on (**State = On**). If no setting is available, e.g. when the list is used for the first time, learning is automatically activated.

Remote-control command:
`SOUR:LIST:LEAR`

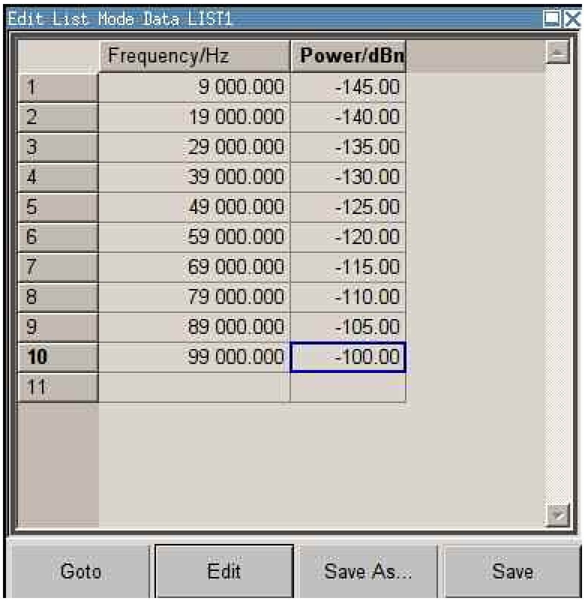
List Mode Data... - List Mode

Calls the **File Select** menu for selecting and creating a list or the **File Manager**.

Remote-control command:
```
MMEM:CDIR 'var/smbv/USER/LIST'
SOUR:LIST:CAT?
Response: 'MYLIST', 'LIST1', 'LIST2'
SOUR:LIST:SEL 'LIST2'
SOUR:LIST:DEL 'LIST1'
SOUR:LIST:DEL:ALL
```

Edit List Mode Data... - List Mode

Calls the editor for editing the selected list. A list consists of any number of frequency/level value pairs. The currently selected list is displayed.



Frequency /Hz

Enter the frequency of the frequency/power value pair.

Remote-control command:
`SOUR:LIST:FREQ 1.4GHz,1.3GHz,1GHz...`

Power /dBm

Enter the level of the frequency/power value pair.

Remote-control command:
`SOUR:LIST:POW 0dBm, 2dBm,2dBm,3dBm,...`

Goto

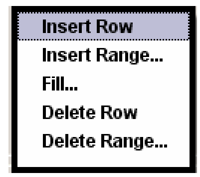
Selects row for editing.

If Goto row is selected, a window opens for entering the requested row.

Remote-control command: n.a.
(it is not possible to change individual positions of the list)

Edit

Calls a selection of possible actions described below.



Remote-control command: n.a.

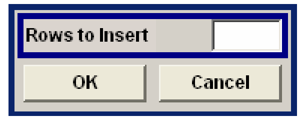
Insert Row

Inserts a new row before the marked row.

Remote-control command: n.a.

Insert Range

Inserts new rows before the marked row. The number of rows to be inserted can be defined in an entry window.



Remote-control command: n.a.

Fill....

Opens a sub menu for defining a set of list values to be automatically entered in the List Mode table (see section "Filling the List Mode Data automatically").

Remote-control command: n.a.

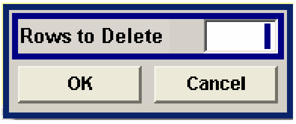
Delete Row

Deletes the marked row.

Remote-control command: n.a.

Delete Range...

Allows to delete any number of rows starting with the marked row. The number of rows to be deleted can be defined in an entry window.



Remote-control command: n.a.

Save as

Open the file menu to save the list under a new name.

Each list is saved to the R&S Signal Generator hard disk as a separate file with the file prefix ***.lsw**. The file name and the directory to which the file is saved are user-selectable.

Remote-control command: n.a.

Save

The list is saved under its current name.

Remote-control command:
(the list is saved automatically after the values have been entered)

List Range In - List Mode

Defines an index range in the current list by setting the start and stop index. Only the values in the selected index range are processed in List mode, all other list entries are ignored.

Remote-control command:
`SOUR:LIST:IND:STAR 15`
`SOUR:LIST:IND:STOP 155`

Trigger Slope - List Mode

Sets the polarity of the active slope of an applied instrument trigger. This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

Positive

The rising edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP POS`

Negative

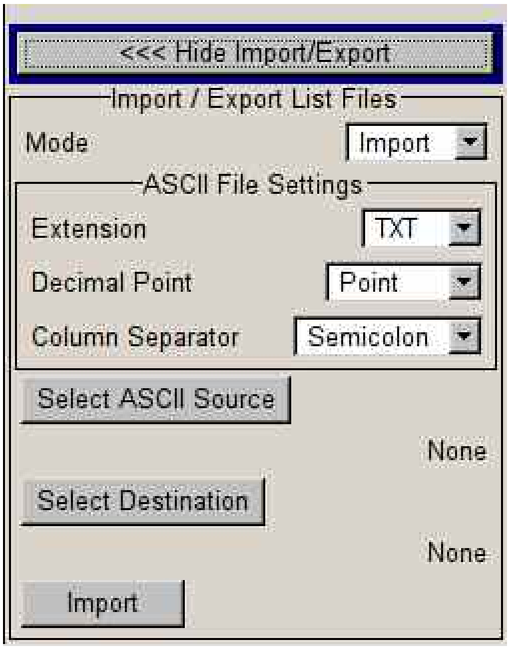
The falling edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP NEG`

User correction list can be imported from externally created files or exported into text or CSV-files. The import/export settings are available after clicking the **Import/Export** button.

Import/Export - List Mode

Expands the menu with the area for import and export of list mode files.



Externally edited Excel tables with frequency/level pairs can be imported as text or CSV-files and used for list mode.

On the other hand, internally created list mode list can be exported as text or CSV-files.

Mode - List Mode

Selects if list mode lists should be imported or exported. The settings offered below depend on the selected mode.

Remote-control command:
`SOUR:LIST:DEXC:MODE IMP`

Extension - List Mode

Selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Remote-control command:
`SOUR:LIST:DEXC:AFIL:EXT TXT`

Decimal Point - List Mode

Selects the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Remote-control command:
`SOUR:LIST:DEXC:AFIL:SEP:DEC DOT`

Column Separator- List Mode

Selects the separator between the frequency and level column of the ASCII table.

Remote-control command:
`SOUR:LIST:DEXC:AFIL:SEP:COL TAB`

Select ASCII Source / Destination - List Mode

Calls the **File Manager** for selecting the ASCII file to be imported into a list mode list (source) or the ASCII file the list mode list is exported (destination) in.

Remote-control command:
`SOUR:LIST:DEXC:AFIL:SEL "var/smbv/user/list/list1.txt"`

Destination / Source - List Mode

Calls the **File Manager** for selecting the list mode list to be exported (source) into an ASCII file or the destination for the ASCII file to be imported (destination) in.

Remote-control command:
`SOUR:LIST:DEXC:SEL "var/smbv/user/ucor/list1.txt"`

Import / Export - List Mode

Starts the export or import of the selected file.

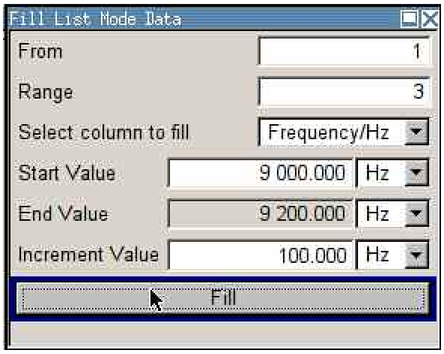
When import is selected, the ASCII file is imported as list mode list.

When export is selected, the list mode list is exported into the selected ASCII file.

Remote-control command:
`SOUR:LIST:DEXC:EXEC`

Filling the List Mode Data automatically

The **Fill List Mode Data** menu enables you to automatically set the values in the List Mode table.



The start line and the number of rows to be filled are defined under **From** and **Range**.

The column to be filled is selected under **Select column to fill**. Depending on the selection here, the default for start, end, and increment value are set. As the settings are interdependent, a change of one parameter may result in the automatic change of one or more of the other parameters.

The filling of the column with the selected value settings is started with button **Fill**.

Note:
*The list entries are only computed when the **Fill** button is pressed.*

From

Sets the start value of the index range.

Remote-control command: n. a.

Range

Sets the range for filling the table.

Remote-control command: n. a.

Select column to fill

Selects either the frequency or the level column to be filled with the value defined below.

Remote-control command: n. a.

Start value

Sets the start value for the frequency or the level entries.

Remote-control command: n. a.

End value

Sets the end value for the frequency or the level entries.

Remote-control command: n. a.

With increment

Sets the increment for the frequency or the level entries.

Remote-control command: n. a.

Fill

Fills the selected column in the set range with values, starting with the start value and using the set increment.

Remote-control command: n. a.

Sweep Mode

The R&S Vector Signal Generator offers three different sweep types (frequency sweep, level sweep and LF sweep) to be activated alternatively. Each type has 6 modes which differ with respect to the sweep cycle mode (continuous, individual and step-by-step) and triggering mode (automatic, internal and external).

Note:
Sweeps and List mode can not be activated simultaneously, they deactivate each other.

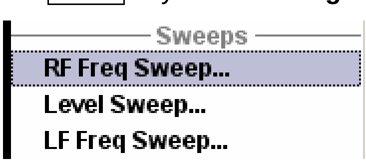
A sweep is set in five basic steps which are shown below taking a frequency sweep as an example:

1. Set the sweep range (**Start Freq** and **Stop Freq** or **Center Freq** and **Span**).
2. Select linear or logarithmic sweep spacing (**Spacing**).
3. Set the step width (**Step Lin**/**Log**) and dwell time (**Dwell Time**).
4. Activate the sweep (**Mode** to Auto, Single, Step or Extern Single, Extern Step).
5. Trigger the sweep, except for Auto mode (**Execute Single Sweep**, Current Frequency or External Trigger Signal).

Note:
It is recommended to switch off the GUI update (Setup menu) for optimum sweep performance especially with short dwell times.

Frequency Sweep Menu

The **Frequency Sweep** menu is opened either in the **RF/A Mod** function block or in the menu tree of the MENU key under **RF Signal**.



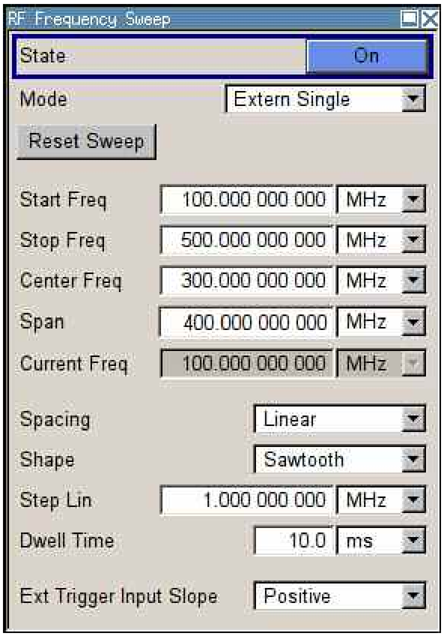
In the top section of the menu, the RF sweep mode is activated and the sweep mode is selected.

The buttons are used to reset the RF sweep (all sweep modes) or to execute the RF sweep (**Single** mode).

The sweep range, sweep spacing and dwell time are set in the bottom section.

The sweep range of the RF sweep can be entered in two ways, either by entering the **Start** and **Stop** value or by entering the **Center** and **Span**. The two sets of parameters influence each other in the following way:

Start = (**Center** - **Span**/2)
Stop = (**Center** + **Span**/2)
Center = (**Start** + **Stop**)/2
Span = (**Stop** - **Start**)



In the top section of the menu, the RF sweep mode is activated and the sweep mode is selected. The buttons are used to reset the RF sweep (all sweep modes) or to execute the RF sweep (**Single** mode).

State - Frequency Sweep

Activates/deactivates RF sweep mode.

> ***Note:***
> *Activating the RF sweep automatically deactivates the list mode, level sweep and LF sweep.*

Remote-control commands:
`SOUR:FREQ:MODE SWE`

Mode - Frequency Sweep

Selects the Sweep instrument operating mode and the Sweep mode.

Auto

Sets an automatic repeated sweep cycle. If a different sweep mode was activated prior to the **Auto** mode, the cycle continues from the current sweep setting.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
`SOUR:SWE:FREQ:MODE AUTO`
`TRIG:FSW:SOUR AUTO`
`SOUR:FREQ:MODE SWE`

Single

Sets a single sweep cycle. The sweep is triggered by the **Execute Single Sweep** button.

If a different sweep mode was activated prior to the **Single** mode, the current sweep is stopped. The **Single** sweep always starts at the start frequency when triggered.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
```
SOUR:SWE:FREQ:MODE AUTO
TRIG:FSW:SOUR AUTO
SOUR:FREQ:MODE SWE
SOUR:SWE:FREQ:EXEC
```

Step

Sets a step-by-step sweep cycle.

If this mode is activated, the cursor moves to the value displayed for **Current Freq**. Any variation to the **Current Freq** value triggers a sweep step.

If a different sweep mode was activated prior to the **Step** mode, the current sweep is stopped. The **Step** sweep starts at the current RF frequency when triggered.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
```
SOUR:SWE:FREQ:MODE MAN
SOUR:FREQ:MODE SWE
SOUR:SWE:FREQ:SPAC LIN
SOUR:SWE:FREQ:STEP:LIN 0.5E4
SOUR:FREQ:MAN 1GHz
```

(the value entered with command `SOUR:SWE:FREQ:STEP:LIN|LOG` sets the step width. The value entered with command `SOUR:FREQ:MAN` has no effect, the command only triggers the next sweep step. However, the value has to be in the currently set sweep range (start to stop). In remote control only a step-by-step sweep from start to stop frequency is possible).

Extern Single

Sets a single sweep cycle. The sweep is triggered by an external trigger signal.

If a different sweep mode was activated prior to the **Extern Single** mode, the current sweep is stopped. The **Extern Single** sweep always starts at the start frequency when triggered.

The external trigger signal is input at the BNC connector INST TRIG on the rear of the instrument.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
```
SOUR:SWE:FREQ:MODE AUTO
TRIG:FSW:SOUR EXT
SOUR:FREQ:MODE SWE
(External trigger)
```

Extern Step

Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under **Extern Single**).

If a different sweep mode was activated prior to the **Extern Step** mode, the current sweep is stopped. The **Extern Step** sweep always starts at the start frequency when triggered.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
```
SOUR:SWE:FREQ:MODE STEP
SOUR:SWE:FREQ:SPAC LIN
SOUR:SWE:FREQ:STEP:LIN 1 MHz
TRIG:FSW:SOUR EXT
SOUR:FREQ:MODE SWE
(External trigger)
```

The sweep range, sweep spacing and dwell time are set in the bottom section.

Execute Single Sweep - Frequency Sweep

Triggers the sweep manually. A manual sweep can only be triggered if **Mode Single** is selected.

Remote-control commands
```
SOUR:SWE:FREQ:MODE AUTO
TRIG:FSW:SOUR SING
SOUR:FREQ:MODE SWE
SOUR:SWE:FREQ:EXEC
```

Reset Sweep - Frequency Sweep

Resets the sweep. The start frequency is set and the next sweep starts from there.

Remote-control command:
```
SWE:RES:ALL
```

Start Freq - Frequency Sweep

Sets the start frequency.

Remote-control command:
```
SOUR:FREQ:STAR 100MHz
```

Stop Freq - Frequency Sweep

Sets the stop frequency.

Remote-control command:
`SOUR:FREQ:STOP 500MHz`

Center Freq - Frequency Sweep

Sets the center frequency.

Remote-control command:
`SOUR:FREQ:CENT 300MHz`

Span - Frequency Sweep

Sets the span.

Remote-control command:
`SOUR:FREQ:SPAN 400MHz`

Current Freq - Frequency Sweep

Displays the current frequency.

If **Step** is set, the frequency for the next frequency step of the sweep is entered here.

Remote-control command
`SOUR:FREQ:MAN 300MHz`

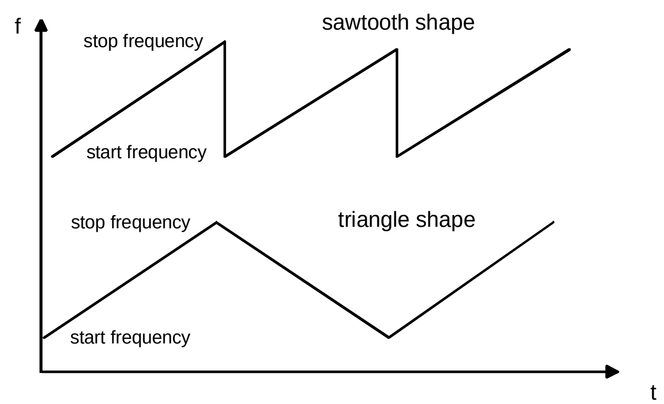
Spacing - Frequency Sweep

Selects linear or logarithmic sweep spacing.

Remote-control command:
`SOUR:SWE:FREQ:SPAC LIN | LOG`

Shape - RF Frequency Sweep

Selects the cycle mode for a sweep sequence (shape) .



Sawtooth One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

Remote-control command:
`SOUR:SWE:FREQ:SHAP SAWT`

Triangle One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

Remote-control command:
`SOUR:SWE:FREQ:SHAP TRI`

Step Lin/Log - Frequency Sweep

Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

Step Lin or **Step Log** is displayed depending on whether **Spacing Lin** or **Log** is selected.

Step Lin

With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The linear step width is entered in Hz.

Remote-control command:
`SOUR:SWE:FREQ:STEP:LIN 1 MHz`

Step Log

With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

Remote-control command:
`SOUR:SWE:FREQ:STEP:LOG 1 PCT`

Dwell Time - Frequency Sweep

Sets the dwell time. The dwell time determines the duration of the individual sweep steps.

Note:
It is recommended to switch off the GUI update (Setup menu) for optimum sweep performance especially with short dwell times.

Remote-control command:
`SOUR:SWE:FREQ:DWEL 10ms`

Trigger Slope - Frequency Sweep

Sets the polarity of the active slope of an applied instrument trigger. This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

Positive

The rising edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP POS`

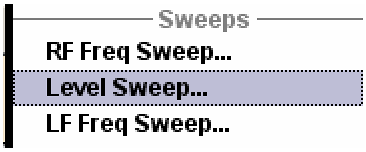
Negative

The falling edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP NEG`

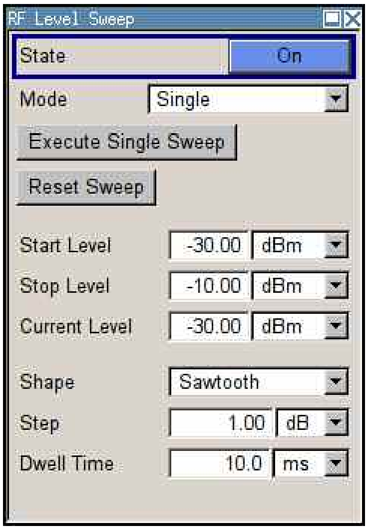
Level Sweep Menu

The **Level Sweep** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.



In the top section, the Level Sweep mode is activated and the sweep mode is selected. The buttons are used to reset the level sweep (all sweep modes) or to execute the level sweep (**Single** mode).

The sweep range, sweep spacing and dwell time are set in the bottom section.



State - Level Sweep

Activates Level Sweep mode.

Note:
Activating the level sweep automatically deactivates the list mode, RF sweep and LF sweep.

Remote-control commands:
`SOUR:POW:MODE SWE`
`SOUR:POW:MODE CW`

Mode - Level Sweep

Selects the Level Sweep instrument operating mode and the Sweep mode.

Auto

Sets an automatic repeated sweep cycle. If a different sweep mode was activated prior to the **Auto** mode, the cycle continues from the current sweep setting.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
`SOUR:SWE:POW:MODE AUTO`
`TRIG:PSW:SOUR AUTO`
`SOUR:POW:MODE SWE`

Single

Sets a single sweep cycle. The sweep is triggered by the **Execute Single Sweep** button.

If a different sweep mode was activated prior to the **Single** mode, the current sweep is stopped. The **Single** sweep always starts at the start level.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
`SOUR:SWE:POW:MODE AUTO`
`TRIG:PSW:SOUR SING`
`SOUR:POW:MODE SWE`
`SOUR:SWE:POW:EXEC`

Step

Sets a step-by-step sweep cycle.

If this mode is activated, the cursor moves to the value displayed for **Current Level**. Each sweep step is triggered by a variation of the value in the **Current Level** entry window. The step width is set below at entry field **Step**.

If this mode is activated, the cursor moves to the value displayed for **Current Level**. If a different sweep mode was activated prior to the **Step** mode, the current sweep is stopped. The **Step** sweep starts at the current level value.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
`SOUR:SWE:POW:MODE MAN`
`SOUR:SWE:POW:STEP 0.5`
`SOUR:POW:MODE SWE`
`SOUR:POW:MAN -16`
(the value entered with command `SOUR:SWE:POW:STEP` sets the step width. The value entered with command `SOUR:POW:MAN` has no effect, the command only triggers the next sweep step. However, the value has to be in the sweep range (start to stop value) In remote control only a step-by-step sweep from start to stop level is possible)

Extern Single

Sets a single sweep cycle. The sweep is triggered by an external trigger signal.

If a different sweep mode was activated prior to the **Extern Single** mode, the current sweep is stopped. The **Extern Single** sweep always starts at the start level.

The external trigger signal is input at the BNC connector INST TRIG on the rear of the instrument.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
```
SOUR:SWE:POW:MODE AUTO
TRIG:PSW:SOUR EXT
SOUR:POW:MODE SWE
```
(External trigger)

Extern Step

Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under **Extern Single**). The step width corresponds to the step width of the rotary knob.

If a different sweep mode was activated prior to the **Extern Step** mode, the current sweep is stopped. The **Extern Step** sweep always starts at the start level.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
```
SOUR:SWE:POW:MODE STEP
SOUR:SWE:POW:STEP 0.5
TRIG:PSW:SOUR EXT
SOUR:POW:MODE SWE
```
(External trigger)

Reset Sweep - Level Sweep

Resets the sweep. The start level is set and the next sweep starts from there.

Remote-control command:
```
SWE:RES:ALL
```

Execute Single Sweep - Level Sweep

Triggers the sweep manually. A manual sweep can only be triggered if **Mode Single** is selected.

Remote-control commands
```
SOUR:SWE:POW:MODE AUTO
TRIG:PSW:SOUR SING
SOUR:POW:MODE SWE
SOUR:SWE:POW:EXEC
```

The sweep range, sweep spacing and dwell time are set in the bottom section.

Start Level - Level Sweep

Sets the start level.

Remote-control command:
`SOUR:POW:STAR -100`

Stop Level - Level Sweep

Sets the stop level.

Remote-control command:
`SOUR:POW:STOP -10`

Current Level - Level Sweep

Displays the current level.

If **Step** is set, the level for the next level step of the sweep is entered here.

Remote-control command
`SOUR:POW:MAN -30`

Shape - RF Level Sweep

Selects the cycle mode for a sweep sequence (shape) .

Sawtooth

One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

Remote-control command:
`SOUR:SWE:POW:SHAP SAWT`

Triangle

One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start level again.

Remote-control command:
`SOUR:SWE:POW:SHAP TRI`

Step - Level Sweep

Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

With the level sweep, the logarithmic step width is a constant fraction of the current level. This fraction is added to the current level. The logarithmic step width is entered in dB.

Remote-control command:
`SOUR:SWE:POW:STEP 3`

Dwell Time - Level Sweep

The enter the dwell time. The dwell time determines the duration of the individual sweep steps.

Note:
It is recommended to switch off the GUI update (Setup menu) for optimum sweep performance especially with short dwell times.

Remote-control command:
`SOUR:SWE:POW:DWEL 10ms`

Trigger Slope - Level Sweep

Sets the polarity of the active slope of an applied instrument trigger. This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

Positive

The rising edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP POS`

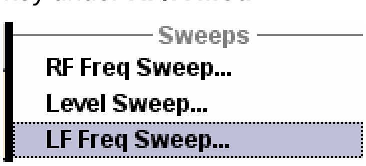
Negative

The falling edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP NEG`

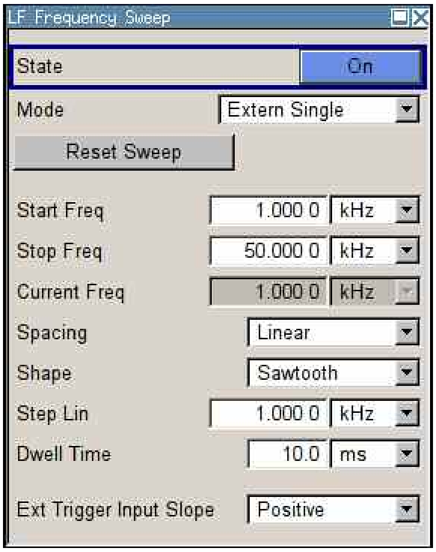
LF Frequency Sweep Menu

The **LF Frequency Sweep** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.



In the top section, the LF Sweep mode is activated and the sweep mode is selected. The buttons are used to reset the LF sweep (all sweep modes) or to execute the level sweep (**Single** mode).

The LF sweep range, LF sweep spacing and dwell time are set in the bottom section.



State - LF Sweep

Activates LF Sweep mode.

Note:
Activating the LF sweep automatically deactivates the list mode, RF sweep and level sweep.

Remote-control commands:
`SOUR:LFO:FREQ:MODE SWE`
`SOUR:LFO:FREQ:MODE CW`

Mode - LF Sweep

Selects the Sweep instrument operating mode and Sweep mode.

Auto

Sets am automatic repeated sweep cycle. If a different sweep mode was activated prior to the **Auto** mode, the cycle continues from the current sweep setting.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
`SOUR:LFO:SWE:FREQ:MODE AUTO`
`TRIG0:SWE:SOUR AUTO`
`SOUR:LFO:FREQ:MODE SWE`

Single

Sets a single sweep cycle. The sweep is triggered by the **Execute Single Sweep** button.

If a different sweep mode was activated prior to the **Single** mode, the current sweep is stopped. The **Single** sweep always starts at the start frequency.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control commands:
`SOUR:LFO:SWE:FREQ:MODE AUTO`
`TRIG0:SWE:SOUR SING`
`SOUR:LFO:FREQ:MODE SWE`
`SOUR:LFO:SWE:FREQ:EXEC`

Step

Sets a step-by-step sweep cycle. Each sweep step is triggered by a variation of the value in the **Current Freq** entry window.

If this mode is activated, the cursor moves to the value displayed for **Current Freq**. If a different sweep mode was activated prior to the **Step** mode, the current sweep is stopped. The **Step** sweep starts at the current LF frequency.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
`SOUR:LFO:SWE:FREQ:MODE MAN`
`SOUR:LFO:FREQ:MODE SWE`
`SOUR:LFO:SWE:FREQ:SPAC LIN`
`SOUR:LFO:SWE:FREQ:STEP:LIN 1E3`
`SOUR:LFO:FREQ:MAN 12 kHz`

(the value entered with command `SOUR:LFO:SWE:FREQ:STEP:LIN|LOG` sets the step width. The value entered with command `SOUR:LFO:FREQ:MAN` has no effect, the command only sets the next sweep step. In remote control only a step-by-step sweep from start to stop frequency is possible)

Extern Single

Sets a single sweep cycle. The sweep is triggered by an external trigger signal.

If a different sweep mode was activated prior to the **Extern Single** mode, the current sweep is stopped. The **Extern Single** sweep always starts at the start frequency.

The external trigger signal is input at the BNC connector INST TRIG on the rear of the instrument.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
`SOUR:LFO:SWE:FREQ:MODE AUTO`
`TRIG0:SWE:SOUR EXT`
`SOUR:LFO:FREQ:MODE SWE`
(External trigger)

Extern Step

Sets a step-by-step sweep cycle. Each sweep step is triggered by an external trigger signal (trigger source as described under **Extern Single**). The step width corresponds to the step width set for the rotary knob.

If a different sweep mode was activated prior to the **Extern Step** mode, the current sweep is stopped. The **Extern Step** sweep always starts at the LF start frequency.

The **Reset Sweep** button resets the sweep to the start frequency.

Remote-control command:
```
SOUR:LFO:SWE:FREQ:MODE STEP
SOUR:LFO:SWE:FREQ:SPAC LIN
SOUR:LFO:SWE:FREQ:STEP LIN 1E3
TRIG0:SWE:SOUR EXT
SOUR:LFO:FREQ:MODE SWE
```
(External trigger)

Execute Single Sweep - LF Sweep

Triggers the sweep manually. A manual sweep can only be triggered if **Mode Single** is selected.

Remote-control commands
```
SOUR:LFO:SWE:FREQ:MODE AUTO
TRIG0:SWE:SOUR SING
SOUR:LFO:FREQ:MODE SWE
SOUR:LFO:SWE:FREQ:EXEC
```

Reset Sweep - LF Sweep

Resets the sweep. The start frequency is set and the next sweep starts from there.

Remote-control command:
```
SWE:RES:ALL
```

The sweep range, sweep spacing and dwell time are set in the bottom section.

Start Freq - LF Sweep

Sets the start frequency.

Remote-control command:
```
SOUR:LFO:FREQ:STAR 100kHz
```

Stop Freq - LF Sweep

Sets the stop frequency.

Remote-control command:
```
SOUR:LFO:FREQ:STOP 50kHz
```

Current Freq - LF Sweep

Displays the current frequency.

If **Step** is set, the frequency for the next frequency step of the sweep is entered here.

Remote-control command:
```
SOUR:LFO:FREQ:MAN  15 kHz
```

Spacing - LF Sweep

Selects linear or logarithmic sweep spacing.

Remote-control command:
`SOUR:LFO:SWE:FREQ:SPAC LIN | LOG`

Shape - LF Frequency Sweep

Selects the cycle mode for a sweep sequence (shape) .

Sawtooth

One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

Remote-control command:
`SOUR:LFO:SWE:FREQ:SHAP SAWT`

Triangle

One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

Remote-control command:
`SOUR:LFO:SWE:FREQ:SHAP TRI`

Step Lin/Log - LF Sweep

Sets the step width for the individual sweep steps. This entry is effective for all sweep modes.

Step Lin or **Step Log** is displayed depending on whether **Spacing Lin** or **Log** is selected.

Step Lin

With the linear sweep, the step width is a fixed frequency value which is added to the current frequency. The linear step width is entered in Hz.

Remote-control command:
`SOUR:LFO:SWE:FREQ:STEP:LIN 1 kHz`

Step Log

With the logarithmic sweep, the step width is a constant fraction of the current frequency. This fraction is added to the current frequency. The logarithmic step width is entered in %.

Remote-control command:
`SOUR:LFO:SWE:FREQ:STEP:LOG 1 PCT`

Dwell Time - LF Sweep

Sets the dwell time. The dwell time determines the duration of the individual sweep steps.

Note:
It is recommended to switch off the GUI update (Setup menu) for optimum sweep performance especially with short dwell times.

Remote-control command:
`SOUR:LFO:SWE:FREQ:DWEL 10ms`

Trigger Slope - Level Sweep

Sets the polarity of the active slope of an applied instrument trigger. This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

Positive

The rising edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP POS`

Negative

The falling edge of the trigger signal is active.

Remote-control command:
`SOUR:INP:TRIG:SLOP NEG`

LF Generator and LF Output - LF Output

An LF generator providing sinusoidal + square signals in the frequency range 0.1 Hz to 1 MHz is available for the basic unit without additional equipment options.

The internal LF generator is available as the internal source for the analog modulations AM, FM / PM and Pulse, and also as the signal source for the LF output at the rear of the instrument.

The frequency setting for the LF generator can be made both in the modulation menus and in the LF Output menu.

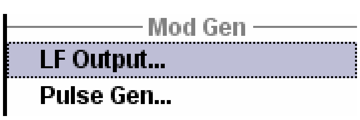
A change to the frequency of the LF generator automatically has an effect on modulation if the LF generator is selected as the modulation source (i.e. **Internal** is selected as **Source**).

The LF Sweep mode is activated in the **LF Sweep** menu. **RF frequency** and **RF level** sweeps are activated in the respective menus of the RF block.

The option Pulse Generator, R&S SMBV-K23, enables the generation of single and double pulse signals. The generator is activated and configured in the **Pulse Generator** menu of the **LF output** block or in the **Pulse Modulation** menu of the **RF/A Mod** block (**Pulse Generator** is selected as **Source**).

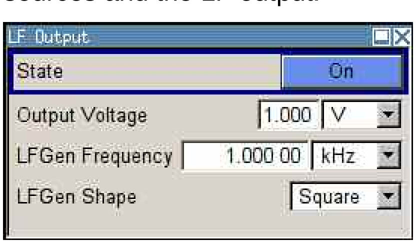
LF Output Menu

The **LF Output** menu is opened either in the **RF/A Mod** function block or using the [MENU] key under **RF/A Mod**.



The **LF Output** menu provides access to the configuration of the internal modulation generators. In addition, the LF output is configured in this menu. The available settings depend on the source selected and on the installed options.

In the upper section of the menu, the LF output is switched on. The configuration of the internal source is performed in the lower section of the **LF Output** menu or in the individual modulation menus (e.g. Amplitude Modulation menu). These settings affect all modulations which use the same modulation sources and the LF output.



State - LF Output

Activates/deactivates the LF output.
This setting has no effect on the modulations.

The modulation signal is output at the LF output connector at the rear of the instruments.

Remote-control command:
`SOUR:LFO:STAT ON | OFF`

Output Voltage - LF Output

Sets the output voltage of the LF output. The entered value determines the peak voltage.

Remote-control command:
`SOUR:LFO:VOLT 1 V`

LF Gen Frequency - LF Output

Sets the frequency of the LF generator. This setting affects all analog modulations which use the LF generator as the internal modulation source.

Remote-control command:
`SOUR:LFO:FREQ 1 kHz`

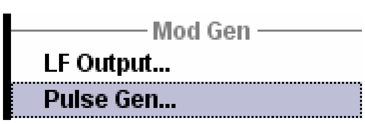
LF Gen Shape - LF Output

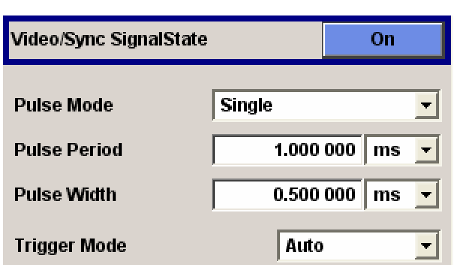
Selects the shape of the LF generator.

Remote-control command:
`SOUR:LFO:SHAP SQU`

Pulse Generator Menu

The **Pulse Generator** menu is opened in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**. The same settings can be made in the **Pulse Modulation** menu of the **RF/A Mod** block. Please refer to the description of the menu in section *"Pulse Modulation"*, page 4.1.





Video Sync Signal State - Pulse Generator

Switches on/off the output of the video/sync signal at the **PULSE VIDEO** connector. Pulse modulation of the RF carrier is activated in the **Pulse modulation** menu of the **Modulation** block..

Remote-control command:
`SOUR:PGEN:STAT ON`

Analog Modulations

The R&S Signal Generator provides the analog modulations amplitude modulation (AM), frequency modulation (FM), phase modulation (PhiM) and pulse modulation (PM). In addition, the RF signal can be modulated with internal modulations waveforms, e.g. sine waves and rectangular signals.

Amplitude, frequency and phase modulation are available for the basic unit (R&S SMBV + frequency option R&S SMBV-B10x) without additional equipment options. A standard LF generator is provided for internal modulation.

Pulse modulation and a pulse generator are provided by options R&S SMBV-K22, Pulse Modulator and R&S SMBV-K23, Pulse Generator, respectively.

Settings for the modulation are made in separate modulation menus. These menus can be accessed in the block diagram by way of the **RF/A Mod** function block, or by means of the menu with the same name which is opened using the MENU key.

Note:
*The **MOD ON/OFF** key switches the modulations on and off. Pressing the key again restores the status that was active before the last switch-off. **MOD OFF** is displayed in the info line of the header next to the **Level** field.*

Remote-control command:
`SOUR:MOD:ALL:STAT OFF`

Modulation Sources

For amplitude, pulse, frequency and phase modulation the internal and external modulation source can be used.

Internal Modulation Sources

An LF generator and a pulse generator are available as internal modulation sources for a fully equipped instrument. The LF generator supplies sinusoidal or rectangular signals (see also the section "LF Generator and LF Output - LF Output", page 4.106). The optional pulse generator provides single and double pulse modulation with selectable pulse widths and periods.

External Modulation Sources

The modulation inputs MOD EXT and PULSE EXT at the rear of the instrument are provided as the external modulation source for amplitude, pulse, frequency and phase modulation.

The external modulation signal at the EXT MOD input must have a voltage of U_S = 1 V (U_{eff} = 0.707 V) in order to achieve the displayed modulation depth and range. The input voltage should not exceed 1.1 V_s, otherwise modulation distortions might occur. With external pulse modulation, the switching point is max. 2.4 V and the voltage at the input should not exceed 5 V. The maximum modulation frequency is 10 MHz for frequency and phase modulation.

Simultaneous Operation of Several Modulations or Other Operating Modes

The table shows the modulations and operating modes which can be activated simultaneously (+) or which deactivate each other (-).

	AM	FM	PHiM	Pulse	I/Q Modulation
Amplitude modulation (AM)	/	+	+	(+)*	-
Frequency modulation (FM)	+	/	-	+	+
Phase modulation (PhiM)	+	-	/	+	+
Pulse modulation	(+)*	+	+	/	+
I/Q Modulation	-	+	+	+	/

* (+) = compatible with reduced AM modulation performance

Amplitude Modulation - AM

An internal or external source can be selected for amplitude modulation. The LF GEN modulation generator is available as the internal source. The I/Q modulator is used for amplitude modulation. Two-tone AM is possible by simultaneously switching on the external and internal source.

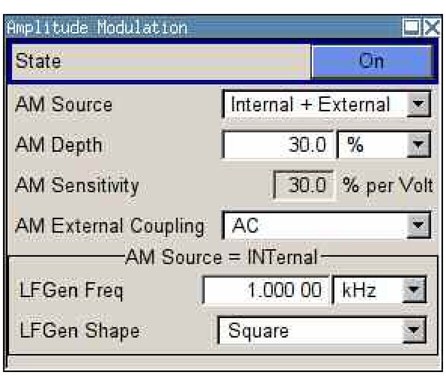
The EXT MOD input connector for external feed of analog modulation signals is at the rear of the instrument. The coupling mode of the input (AC or DC) can be selected.

Note:
It is not possible to use AM simultaneously with I/Q modulation, arbitrary waveform generation, digital modulation and digital standards.
The AM modulation depth is limited by the maximum peak envelope power (PEP).

Amplitude Modulation Menu

The **Amplitude Modulation** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.

In the upper section of the menu, the modulation source is selected and the modulation switched on. The modulation source can be selected independently for the different modulation types and the LF output. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu or in the **LF Output** menu (internal source only). These settings affect all modulations which use the same modulation source.



State - AM

Activates/deactivates AM modulation.

Activation of AM deactivates I/Q modulation, digital modulation and digital standards.

Remote-control command:
`SOUR:AM:STAT ON`

AM Source - AM

Selects the source for the AM signal.

Internal

Selects the internal LF generator as the source for AM modulation.

Remote-control command:
`SOUR:AM:SOUR INT`

External

Selects the external source. The external signal is input via the EXT MOD connector.

Remote-control command:
`SOUR:AM:SOUR EXT`

Intern + Extern

Selects the internal and external source at the same time. This setting enables two-tone AM modulation.

Remote-control command:
`SOUR:AM:SOUR INT,EXT`

AM Depth

Sets the modulation depth in percent.

Note:
With two-tone modulation please observe that the set modulation depth is valid for both signals and the sum modulation depth is determined by doubling the set modulation depth. This results in overmodulation if the maximal value for modulation depth is exceeded (see data sheet).

Remote-control command:
`SOUR:AM:DEPT  20PCT`

AM Sensitivity

(Source External only)

Displays the input sensitivity of the EXT MOD input in %/V. The display only appears in the case of external modulation.

The modulation depth entered under **AM Depth** is reached with 1 volt modulation of the input.

Remote-control command:
`SOUR:AM:SENS?`
Response: `"30"`

AM External Coupling

(Source External only)

Selects the coupling mode (AC or DC) for external feed.

Note:
Coupling for external feed via input EXT MOD can be set independently for modulations AM, FM and PhiM.

Remote-control command:
`SOUR:AM:EXT:COUP AC`

LF Gen Frequency - AM

(Source Internal only)

Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source..

Remote-control command:
`SOUR:LFO:FREQ 1E3`

LF Gen Shape - AM

Selects the shape of the LF generator.

Remote-control command:
`SOUR:LFO:SHAP SQU`

Frequency Modulation - FM

An internal and/or external source can be selected for frequency modulation. The LF GEN modulation generator is available as the internal source. Two-tone FM is possible by simultaneously switching on the external and internal source.

The EXT MOD input connector for external feed is at the rear of the instrument. The coupling mode of the input (AC or DC) can be selected.

Selection between three modulation modes is possible:

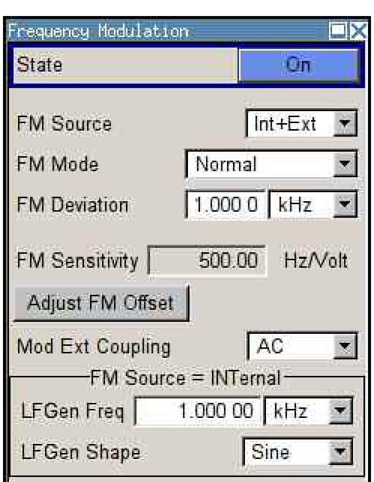
- **Normal** mode with full setting range for modulation bandwidth and FM deviation.
- **Low Noise** mode with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation (see data sheet)
- **High Deviation** mode with full setting range for FM deviation and a reduced setting range for modulation bandwidth (see data sheet).

Note:
It is not possible to use frequency modulation simultaneously with phase modulation.

Frequency Modulation Menu

The **Frequency Modulation** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.

In the upper section of the menu, the modulation source is selected and the modulation is switched on. The modulation source can be selected independently for the different modulation types and the LF output. The configuration of the selected external and/or internal modulation source is performed in the lower section of the **LF Output** menu (internal source only). These settings affect all modulations which use the same modulation sources.



State - FM

Activates/deactivates FM modulation.

Activation of FM deactivates phase modulation.

Remote-control command:
`SOUR:FM:STAT ON`

FM Source - FM

Selects the source for the FM signal.

Internal

Selects the internal LF generator as the source for FM modulation.

Remote-control command:
`SOUR:FM:SOUR INT`

External

Selects the external source. The external signal is input via the EXT MOD connector.

Remote-control command:
`SOUR:FM:SOUR EXT`

Internal + External

Selects the internal and external source at the same time.

Remote-control command:
`SOUR:FM:SOUR INT,EXT`

FM Mode - FM

Selects the mode for the frequency modulation.

Normal

The maximum range for modulation bandwidth and FM deviation is available.

Remote-control command:
`SOUR:FM:MODE NORM`

Low Noise

Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

Remote-control command:
`SOUR:FM:MODE LNO`

High Deviation

Frequency modulation with full setting range for FM deviation. The range for modulation bandwidth is reduced (see data sheet).

Remote-control command:
`SOUR:FM:MODE HDEV`

FM Deviation - FM

Sets the modulation depth in Hz.

The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

The deviation of the internal source must not exceed the deviation of the external source in case of modulation source **Int+Ext**.

Remote-control command:
`SOUR:FM:DEV 10kHz`

FM Sensitivity - FM

(Source External only)

Displays the input sensitivity of the EXT MOD input in Hz/V. The display only appears in the case of external modulation.

The modulation depth entered under **FM Depth** is reached with 1 volt (= U_{peak}) of the input signal.

Note:
The input voltage should not exceed 1.1 V_p otherwise modulation distortions might occur.

Remote-control command:
`SOUR:FM:SENS?`
Response: `"1E3"`

Adjust FM Offset - FM

Starts the adjustment for the FM/PhiM modulator. The option is adjusted with respect to DC-offset.

Remote-control command:
`CAL:FMOF?`

FM External Coupling - FM

(Source External only)

Selects the coupling mode (AC or DC) for external feed.

Note:
Coupling for external feed via input EXT MOD can be set independently for modulations AM, FM and PhiM.

AC

The d.c. voltage content is separated from the modulation signal.

Remote-control command:
`SOUR:FM:EXT:COUP AC`

DC

The modulation signal is not altered.

Remote-control command:
`SOUR:FM:EXT:COUP DC`

LF Gen Frequency - FM

(Source Internal only)

Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source..

Remote-control command:
`SOUR:LFO:FREQ 1E3`

LF Gen Shape - FM

(Source Internal only)

Selects the shape of the LF generator.

Remote-control command:
`SOUR:LFO:SHAP SQU`

Phase Modulation - PhiM

Note:
It is not possible to use phase modulation simultaneously with frequency modulation.

An internal and/or external source can be selected for phase modulation. The LF GEN modulation generator is available as the internal source.

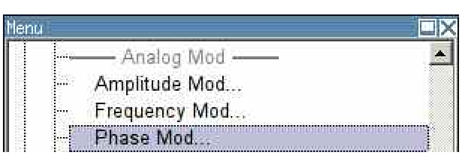
The EXT MOD input connector for external feed is at the rear of the instrument. The coupling mode of the input (AC or DC) can be set.

Selection between three modulation modes is possible:

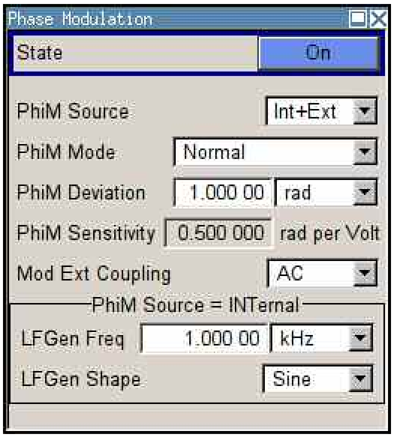
- **Normal** mode with full setting range for modulation bandwidth and PhiM deviation.
- **Low Phase** noise mode with better signal/noise ratio, but reduced setting range for modulation bandwidth and deviation (see data sheet)
- **High Deviation** mode with full setting range for PhiM deviation and a reduced setting range for modulation bandwidth. Phase noise is reduced in the lower modulation frequency range (compared to **Normal** mode).

Phase Modulation Menu

The **Phase Modulation** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.



In the upper section of the menu, the modulation source is selected and the modulation switched on. The modulation source can be selected independently for the different modulation types and the LF output. The configuration of the selected external and/or internal modulation source is performed in the lower section of the **LF Output** menu (internal source only). These settings affect all modulations which use the same modulation sources. For a fully equipped instrument two LF generators and a noise generator are available as internal sources.



State - PhiM

Activates/deactivates PhiM modulation.

Activation of PhiM deactivates frequency modulation.

Remote-control command:
`SOUR:PM:STAT ON`

PhiM Source

Selects the source for the PhiM signal.

Internal
Selects the internal LF generator as the source for PhiM modulation.

Remote-control command:
`SOUR:PM:SOUR INT`

External
Selects the external source. The external signal is input via the EXT MOD connector.

Remote-control command:
`SOUR:PM:SOUR EXT`

Internal + External
Selects the internal and external source at the same time.

Remote-control command:
`SOUR:PM:SOUR INT,EXT`

PhiM Mode

Selects the mode for the phase modulation.

Normal
The full range for modulation bandwidth and PM deviation is available.

Remote-control command:
`SOUR:PM:MODE NORM`

High Deviation
The maximum range for PhiM deviation is available. Phase noise is improved for low frequencies compared to **Normal** mode. The range for modulation frequency is limited (see data sheet).

This mode is recommended for low modulation frequencies and/or high PhiM deviation.

Remote-control command:
`SOUR:PM:MODE HDEV`

Low Noise

Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PM deviation is reduced (see data sheet).

Remote-control command:
`SOUR:PM:MODE LNO`

PhiM Deviation

Sets the modulation depth in RAD or degrees.

The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet). It is possible to enter a deviation that is too high for a certain RF frequency or to vary the RF frequency to a range in which the deviation can no longer be set. In this case the maximally possible deviation is set and an error message is displayed.

Remote-control command:
`SOUR:PM:DEV 10`

PhiM Sensitivity

Displays the input sensitivity of the EXT MOD input in RAD/V. The display only appears in the case of external modulation.

The modulation depth entered under **PhiM Depth** is reached with 1 volt (=U_{peak}) of the input signal.

Note:
The input voltage should not exceed 1.1 V_p otherwise modulation distortions might occur.

Remote-control command:
`SOUR:PM:SENS?`

Mod External Coupling

Selects the coupling mode (AC or DC) for external feed.

Note:
Coupling for external feed via input EXT MOD can be set independently for modulations AM, FM and PhiM.

AC

The d.c. voltage content is separated from the modulation signal.

Remote-control command:
`SOUR:PM:EXT:COUP AC`

DC

The modulation signal is not altered.

Remote-control command:
`SOUR:PM:EXT:COUP DC`

LF Gen Frequency - PhiM

(Source Internal only) Sets the frequency of the LF generator.

This setting affects all analog modulations which use the LF generator as the internal modulation source.

Remote-control command:
`SOUR:LFO:FREQ 1E3`

LF Gen Shape - PhiM

Selects the shape of the LF generator.

Remote-control command:
`SOUR:LFO:SHAP SQU`

Pulse Modulation

External and internal Pulse modulation requires options R&S SMBV-K22, Pulse Modulator and R&S SMBV-K23, Pulse Generator.

An internal or external source can be selected for pulse modulation. In case of external source, the external signal is input via the PULSE EXT connector at the rear of the instrument. In case of internal source, this connector can be used as external trigger or gate signal input for internal pulse modulation. The polarity and input impedance of the connector can be selected.

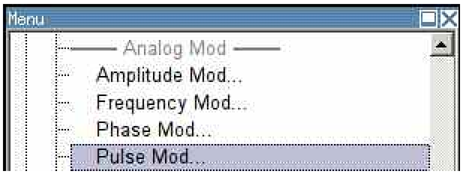
The pulse signal is output at the PULSE VIDEO connector at the rear of the instrument.

Note:

When pulse modulation is activated, the ALC state of the R&S SMBV is automatically changed to ALC OFF (Sample & Hold). In this state the ALC loop is opened and the output level is not regulated but the level modulator is set directly. In order to set the correct output level, a sample & hold measurement is executed after each frequency or level setting. The level is decreased by 30 dB during ***Sample&Hold*** *measurement.*

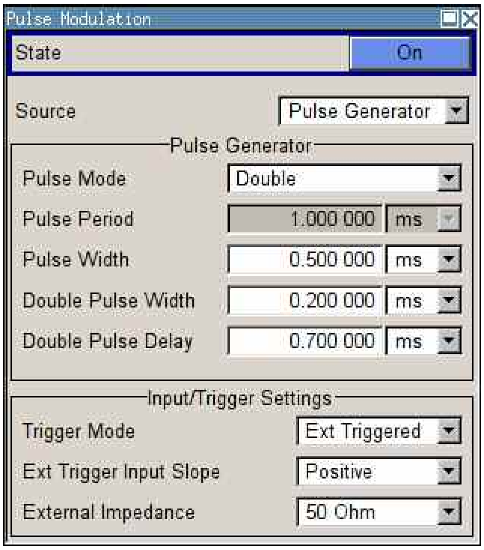
Pulse Modulation Menu

The **Pulse Modulation** menu is opened either in the **RF/A Mod** function block or using the MENU key under **RF/A Mod**.



In the upper section of the menu, the modulation source is selected and the modulation switched on. The configuration of the selected external and/or internal modulation source is performed in the lower section of the menu.

The menu differs according to the selected internal or external modulation source.



State - Pulse Modulation

Activates/deactivates pulse modulation. Activation of pulse modulation deactivates ALC and power ramping.

When the internal modulation source (pulse generator) is selected, the pulse generator is switched on automatically and the video/sync signal is output at the PULSE VIDEO output at the rear of the instrument. Signal output can be switched off in the **Pulse Generator** menu.

Remote-control command:
`SOUR:PULM:STAT ON | OFF`

Source - Pulse Modulation

Selects the source for the pulse modulation signal.

Internal

Selects the internal source. The LF generator generates a rectangular pulse with the set frequency.

Remote-control command:
`SOUR:PULM:SOUR INT`

External

Selects the external source. The external modulation signal is input via the PULSE EXT connector.

Remote-control command:
`SOUR:PULM:SOUR EXT`

Polarity - Pulse Modulation

(External Source only)

Selects the polarity of the modulation signal.

Normal

The RF signal is ON while the level is HIGH.

Remote-control command:
`SOUR:PULM:POL NORM`

Inverted

The RF signal is ON while the level is LOW.

Remote-control command:
`SOUR:PULM:POL INV`

In case of modulation source pulse generator, the settings for the pulse characteristics and the trigger are offered in the **Pulse Generator** section of the **Pulse Modulation** menu. Option R&S SMBV-K23 offers a variety of features, e.g. generation of double pulse or selection of trigger mode. The output of the video/sync signal at the PULSE VIDEO output is automatically switched on when activating pulse modulation. It can be switched off in the **Pulse Generator** menu.

Pulse Mode - Pulse Generator

Sets the mode of the pulse generator.

Single

Enables single pulse generation.

Remote-control command:
`SOUR:PULM:MODE SING`

Double

Enables double pulse generation. The two pulses are generated in one pulse period.

Remote-control command:
`SOUR:PULM:MODE DOUB`

Pulse Period - Pulse Generator

Sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Remote-control command:
`SOUR:PULM:PER 0.05ms`

Pulse Width - Pulse Generator

Sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20 ns less than the set pulse period.

Remote-control command:
`SOUR:PULM:WIDT 22ms`

Pulse Delay - Pulse Generator

(External trigger only)

Sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

Remote-control command:
`SOUR:PULM:DEL 22us`

Double Pulse Width - Pulse Generator

(Double Pulse only)

Sets the width of the second pulse in case of double pulse generation.

Remote-control command:
`SOUR:PULM:DOUB:WIDT 33 us`

Double Pulse Delay - Pulse Generator

(Double Pulse only)

Sets the delay from the start of the first pulse to the start of the second pulse.

Remote-control command:
`SOUR:PULM:DOUB:DEL 22us`

Trigger Mode - Pulse Generator

Selects the trigger mode for pulse modulation.

Auto

The pulse generator signal is generated continuously.

Remote-control command:
`SOUR:PULM:TRIG:MODE  AUTO`

Ext Triggered

The pulse generator signal is triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

Remote-control command:
`SOUR:PULM:TRIG:MODE  EXT`

Ext Gated

The pulse generator signal is gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

Remote-control command:
`SOUR:PULM:TRIG:MODE EGAT`

External Trigger Input Slope - Pulse Generator

(External Trigger only)

Sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

Positive

The pulse generator is triggered on the positive slope of the external trigger signal.

Remote-control command:
`SOUR:PULM:TRIG:EXT:SLOP POS`

Negative

The pulse generator is triggered on the negative slope of the external trigger signal.

Remote-control command:
`SOUR:PULM:TRIG:EXT:SLOP NEG`

Gate Input Polarity - Pulse Generator

(Trigger Mode External Gated only)

Selects the polarity of the Gate signal. The signal is supplied via the PULSE EXT connector.

Positive

The pulse signal is generated while the gate signal is high.

Remote-control command:
`SOUR:PULM:TRIG:EXT:GAT POS`

Negative

The pulse signal is generated while the gate signal is low.

Remote-control command:
`SOUR:PULM:TRIG:EXT:SLOP NEG`

External Impedance - Pulse Generator

(External trigger or gate only)

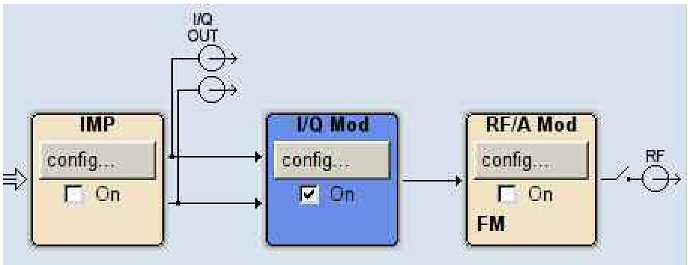
Selects the input impedance for the external trigger and gate signal input PULSE EXT.

Remote-control command:
`SOUR:PULM:TRIG:EXT:IMP G50`

I/Q Modulation

Introduction - I/Q Modulation

The R&S Vector Signal Generator offers I/Q modulation with external analog I/Q signals as well as internal digital signals.



I/Q modulation with an external analog I/Q signal is possible for the basic unit (R&S SMBV with the frequency option R&S SMBV-B10x) without additional equipment options.

Baseband signals to be generated by an arbitrary waveform generator the instrument can be equipped with an ARB module (option R&S SMBV-B50/-B51).

The basic equipment configuration for generating an internal baseband signal includes the option R&S SMBV-B10 (Baseband Generator and ARB Module).

The external signal is input via the **I** and **Q** connector and transferred directly to the I/Q modulator (**I/Q Mod** function block).

The internally generated baseband signal is configured in the **Baseband** function block (see the section "*Baseband Signal - Baseband*"). Before the signal is fed into the I/Q modulator, noise can be added and/or the signal can be impaired. Impairment at this point along the signal flow is offered to allow a signal to be output at the I/Q-OUT outputs (a signal which, for example, compensates signal distortion in a connected test object (DUT)).

The input signal of the I/Q modulator is selected in the **I/Q Mod** function block (see the following section "I/Q Modulator - I/Q MOD Function Block", page 4.125).

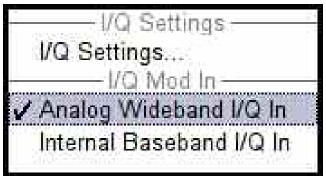
If the external analog signal is fed into the I/Q modulator, the source "**Analog Wideband I/Q In**" must be selected. The maximum available RF bandwidth is described in the instruments specifications (see data sheet).

If the internally generated baseband signal is used, the source "**Internal Baseband I/Q In**" must be selected. The RF bandwidth is reduced (see data sheet).

Impairments can also be set in the I/Q Mod menu to allow an externally applied analog I/Q signal to be impaired. An internal baseband signal can thus be impaired both digital (in the Impairment block in the Impairment menu) and analog in the I/Q modulator. If impairments are set in both menus, they superimpose each other in the signal.

I/Q Modulator - I/Q MOD Function Block

The input signal of the I/Q modulator is selected and the **I/Q Settings** menu opened in the **I/Q Mod** function block.



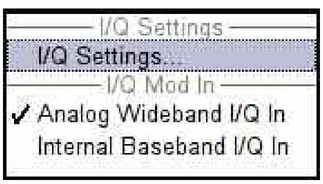
The **I/Q Settings** menu containing the modulation settings is opened in the top section.

The input signal is selected either in the **I/Q Mod In** section or in the **I/Q Settings** menu.

See following section "I/Q Settings Menu", page *4.125*

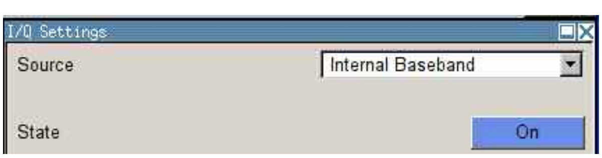
I/Q Settings Menu

The menu for setting the I/Q modulation parameters is opened either in the **I/Q Mod** function block or in the menu with the same name which is opened using the MENU key.

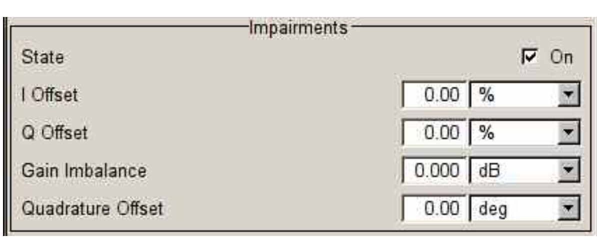


Notes:

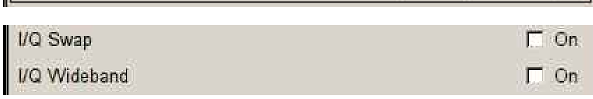
*It is not possible to use I/Q modulation with an external analog signal (**Analog Wideband I/Q In**) simultaneously with AM, digital modulation and digital standards, noise, arbitrary waveform generation and multi carrier CW.*
*System error correction of the I/Q modulator permits precise and repeatable measurements. The correction routine should be called in the case of temperature fluctuations of several degrees. The routine is called in the **Internal Adjustment** submenu, SETUP key - **System** menu.*



I/Q modulation is activated and the source entered in the top section of the menu



I/Q impairment for specific impairment of the I/Q modulation is set in the **Impairments** section.



I/Q control can be swapped in the lower section of the menu and the optimized settings for wideband modulation signals can be activated.

The bottom section of the menu differs depending on the selected input signal (**Analog Wideband I/Q Input** or **Internal Baseband**).

The crest factor is input for the external signal.

I/Q modulation is activated and the source entered in the top section of the menu.

IQ Source - I/Q Mod

Selects the input signal for the I/Q modulator.

Analog Wideband I/Q In

Selects an external analog signal as the input signal. The signal must be applied at the inputs I and Q.

Remote-control command:
`SOUR:IQ:SOUR ANAL`

Internal Baseband I/Q In

Selects the internal baseband signal as the input signal. This setting requires the additional equipment options for generating the various baseband signals.

Remote-control command:
`SOUR:IQ:SOUR BAS`

State - I/Q Mod

Activates/deactivates I/Q modulation.

If **Analog Wideband I/Q In** is selected, the I/Q modulator is also deactivated and activated.

If **Internal Baseband I/Q In** is selected, the I/Q modulator is always activated automatically as soon as signal generation is activated in the **Baseband** block. It can, however, be deactivated later, e.g. if only the baseband signal which is output at the I/Q outputs is relevant.

Remote-control command:
`SOUR:IQ:STAT ON | OFF`

I/Q impairment for specific impairment of the I/Q modulation is set in the **Impairments** section.

State - Impairments I/Q Mod

Activates/deactivates I/Q impairment.

If activated, the settings for leakage, I/Q imbalance and quadrature offset become effective.

Whether or not I/Q impairment is activated is indicated in the function block.

Note:
It is advisable to switch automatic level control to the Sample&Hold mode, as otherwise level errors may occur (see Automatic Level Control Menu, on page 4.70).

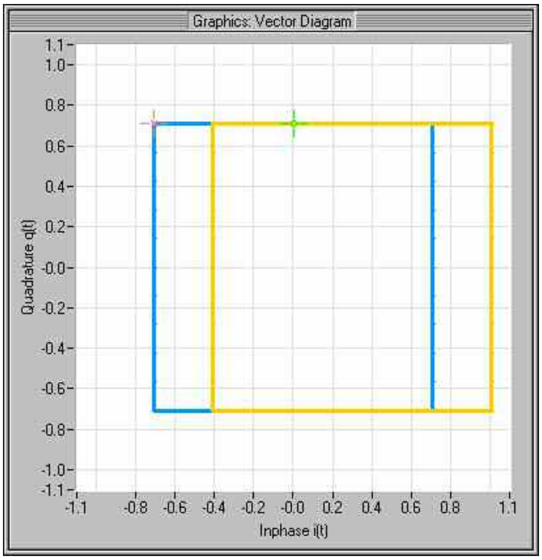
Remote-control command:
`SOUR:IQ:IMP:STAT ON | OFF`

Offset - I/Q Mod

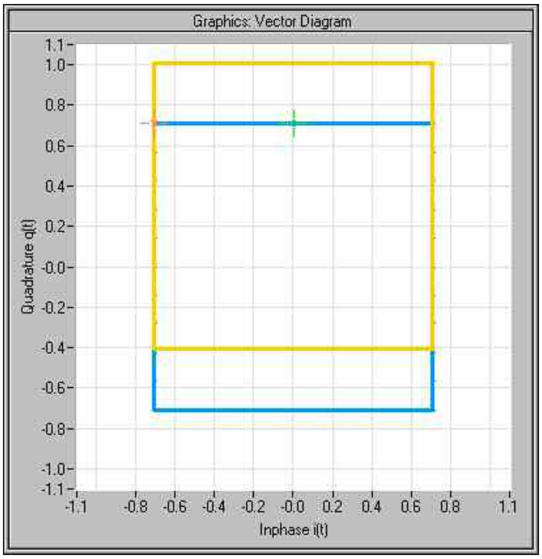
Sets the carrier offset (in percent) of the amplitudes (scaled to the peak envelope power (PEP) for the I and/or Q signal component.

An ideal I/Q modulator suppresses the carrier offset completely (offset = 0 percent). If an offset value is entered for a component, a carrier offset with fixed amplitude is added to the signal. In the diagram, all I values or Q values are offset by a fixed amplitude value depending on the entered percentage.

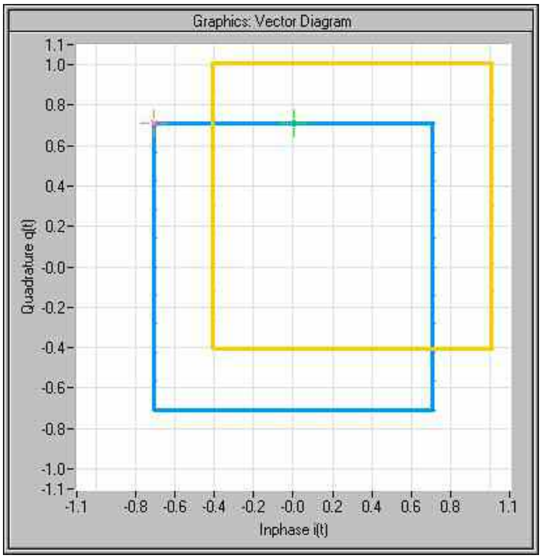
Effect of offset for the I component:



Effect of offset for the Q component:



Effect of an identical offset for both signal components:



Remote-control command:
`SOUR:IQ:IMP:LEAK:I 10PCT`
`SOUR:IQ:IMP:LEAK:Q 10PCT`

Gain Imbalance - I/Q Mod

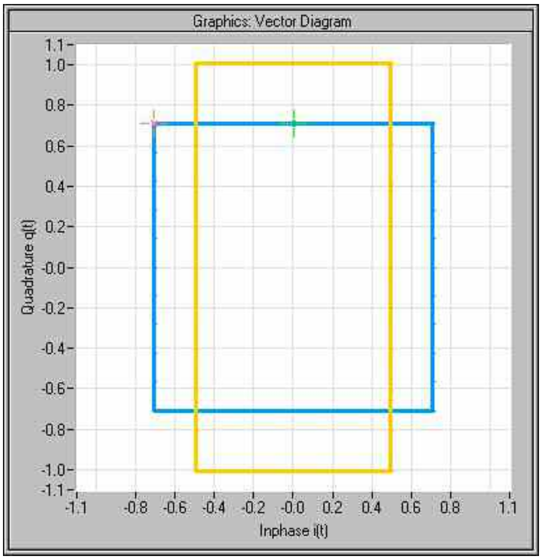
Sets the imbalance of the I and Q vector.

The entry is made in dB (default) or %, where 1 dB offset is roughly 12 % according to the following:

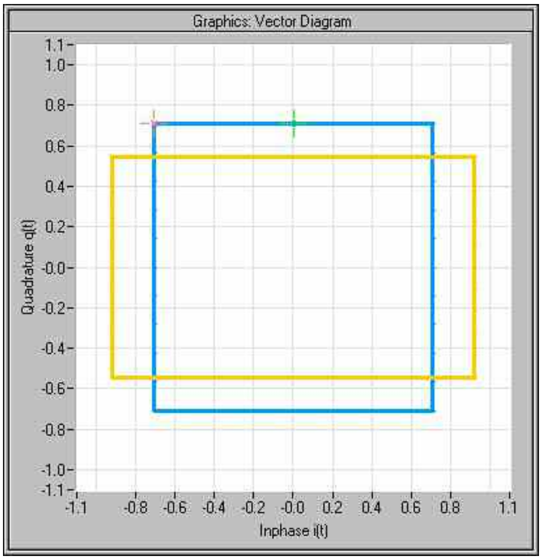
Imbalance [dB] = 20log (| $Gain_Q$ | / | $Gain_I$ |)

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

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



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

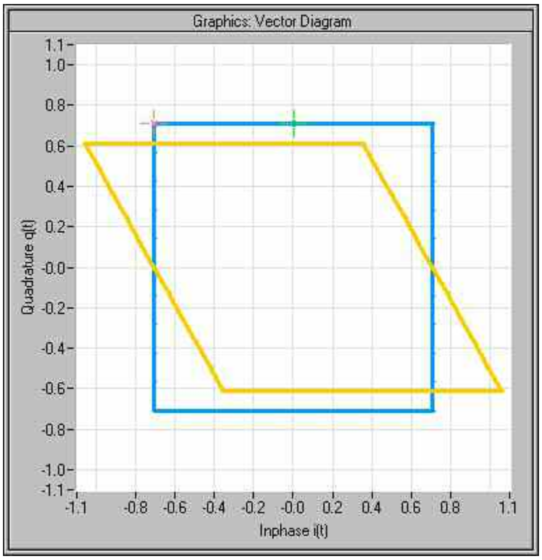


Remote-control command:
`SOUR:IQ:IMP:IQR:MAGN –5PCT`

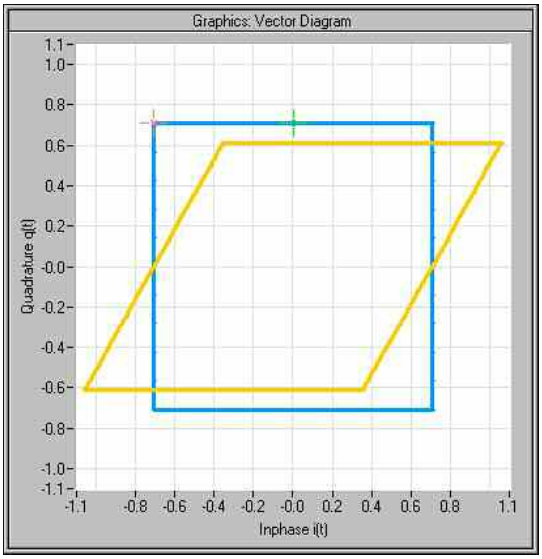
Quadrature Offset - I/Q Mod Sets the quadrature offset.

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

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



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



Remote-control command:
`SOUR:IQ:IMP:QUAD:ANGL 4DEG`

The I/Q control can be swapped and the optimized setting for wideband signals can be selected in the middle section of the menu.

I/Q-Swap - I/Q Mod

Selects normal or swapped I/Q control for an external analog signal. The modulation sidebands are inverted by swapping the I and Q signals.

This parameter enables I/Q modulation to be performed on signals according to IS2000 (cdma2000 standard) and the majority of all other standards. As a result, an I/Q demodulator defined according to IS2000 can also be used for demodulating the generated signals.

The I/Q modulator defined in the IS2000 standard differs from the definition in the R&S Vector Signal Generator. The definition on which the R&S Vector Signal Generator is based is used by virtually all digital communication standards (except IS95 and IS2000).

In the final step, the filtered I/Q signal is modulated to the desired RF in a different way in the I/Q modulator:

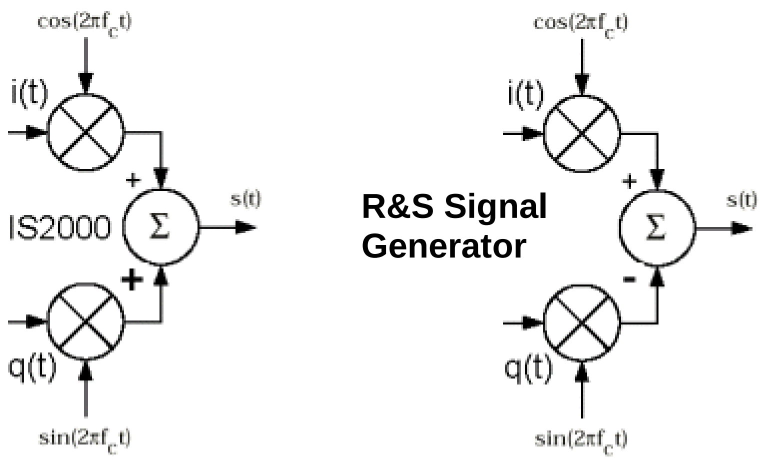


Figure 4-1 Definition of I/Q modulator in IS2000 and R&S Vector Signal Generator

According to IS2000, the RF signal s(t) is derived from the baseband I/Q signal as follows:

$$\mathbf{s(t) = i(t)\cos(2\pi f_c t) + q(t)\sin(2\pi f_c t)}$$

The R&S Vector Signal Generator is based on the following definition:

$$\mathbf{s(t) = i(t)\cos(2\pi f_c t) - q(t)\sin(2\pi f_c t)}$$

I/Q Swap must now be set to **On** so that an I/Q modulator defined according to IS2000 can cope with the RF signal generated by the R&S Vector Signal Generator.

Off

I/Q control is normal.

Remote-control command:
`SOUR:IQ:SWAP:STAT OFF`

On

The I and Q signals are swapped.

Remote-control command:
`SOUR:IQ:SWAP:STAT ON`

I/Q-Wideband - I/Q Mod

Optimized setting for wideband modulation signals (>5 MHz).

The modulation frequency response is decreased at the expense of poorer harmonic suppression. This is achieved by shifting the switching frequencies of the lowpass filters in the output section.

Remote-control command:
`SOUR:IQ:WBST ON`

In the bottom section of the menu the crest factor is input for the external signal (**Analog Wideband I/Q Input**).

Crest Factor - I/Q Mod

(Analog Wideband I/Q Input only)

Sets the crest factor of the external analog signal.

The crest factor gives the difference in level between the peak envelope power (PEP) and average power value (RMS) in dB.

This value is necessary to allow the correct output power to be generated at the RF output. When the set output power is generated, the R&S Vector Signal Generator uses this value to compensate the average power which is lower compared to the peak power.

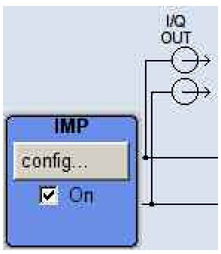
The maximum input voltage at the I/Q input is equated to the peak power and is used as the "reference" for setting the level of the output signal. Since the signal does not usually supply the peak power at a constant level and instead supplies a lower average power, the crest factor specifies how many dB have to be added internally so that the correct output power is achieved.

Remote-control command:
`SOUR:IQ:CRES 10`

Impairment of Digital I/Q Signal - IMP Block

The R&S Vector Signal Generator allows the digital I/Q signal to be impaired before it is passed on to the I/Q modulator.

These settings are available in the block diagram in the **IMP** function block as well as in the menu with the same name which is opened using the MENU key.



Selecting the menu item **I/Q Impairments (Digital Baseband)...** the I/Q impairment settings dialog opens. This dialog covers the settings for I/Q impairment, like carrier leakage, imbalance and quadrature offset, as well as the settings for correcting signal distortions for the RF output.

I/Q Out Settings..., in section I/Q Out opens the analog I/Q Output dialog for setting the parameters of the I/Q output signal.

The equipment options for the basic unit (R&S SMBV with frequency option R&S SMBV-B10x) include the **Impairments** functionality.

The single ended or differential analog output is configured in the **I/Q Out Settings...** dialog.

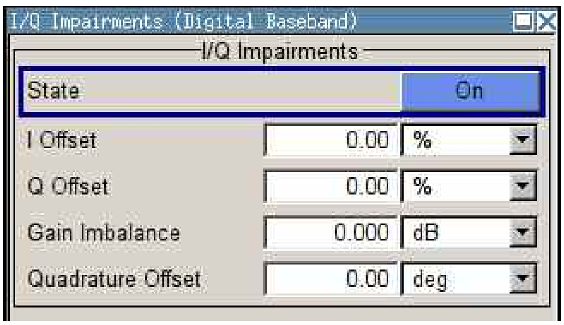
Introduction - Impairments

Impairment of the digital I/Q signal prior to input into the I/Q modulator can be used, for example, to compensate the distortion of a test object or to check the effect of a disturbed signal on a test object. For this purpose, the I/Q signal can be output at the **I/Q Out** outputs. On the other hand, the I/Q impairments used internally for compensating signal distortion can be deactivated by the I/Q modulator in order to, for example, test its own baseband components.

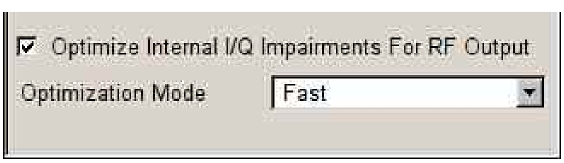
Note:
In addition to impairment of the digital I/Q signal, the R&S Vector Signal Generator also allows impairment of the analog signal to be set in the I/Q modulator. The relevant settings are made in the ***I/Q Mod*** *function block (see the section "I/Q Modulation", on page 4.125).*

Impairment Settings Menu

The **Impairment Settings** menu for setting the digital I/Q impairments is opened either in the **IMP** function block or using the MENU key under **IMP**.



I/Q impairment is activated and set in the I/Q Impairments section.



Internal compensation of signal distortions **of the RF output** can be activated or deactivated.

In the **I/Q Impairments** section the parameters for carrier leakage, imbalance and quadrature offset can be set and I/Q impairment is activated.

State - Digital Impairments

Activates/deactivates digital I/Q impairment.

When activated, the settings for carrier leakage, I/Q imbalance and quadrature offset become effective.

Internal predistortion for compensating the I/Q modulator is not influenced by this setting.

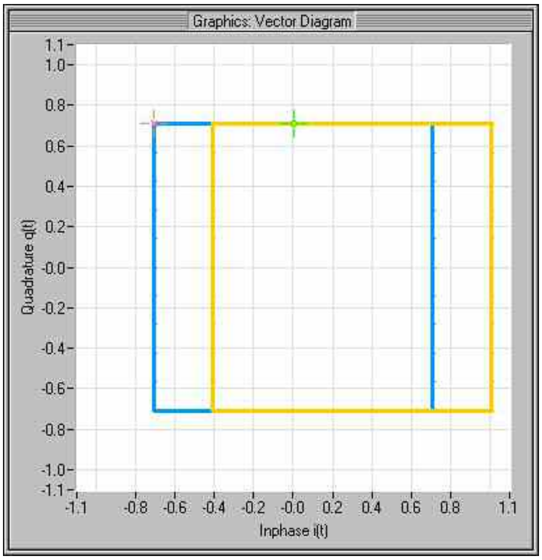
Remote-control command:
`SOUR:BB:IMP:STAT ON`

I/Q Offset - Digital Impairments

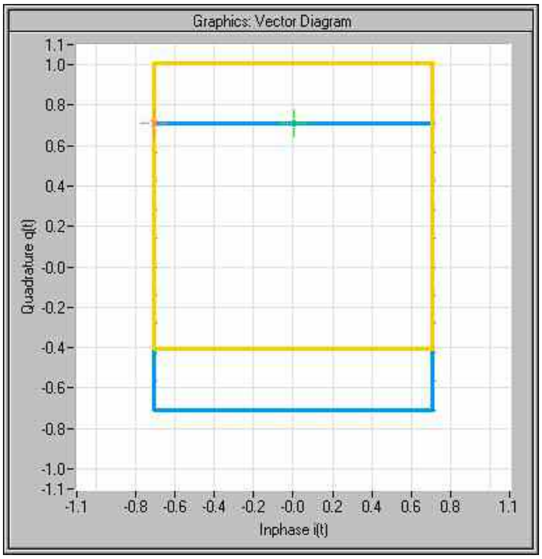
Sets the carrier leakage (in percent) of the amplitudes (scaled to the peak envelope power (PEP)) for the I and/or Q signal component.

An ideal I/Q modulator suppresses the carrier leakage completely (offset = 0 percent). If an offset is entered for a component, a carrier leakage with fixed amplitude is added to the signal. In the diagram, all I values or Q values are offset by a fixed amplitude value depending on the entered percentage.

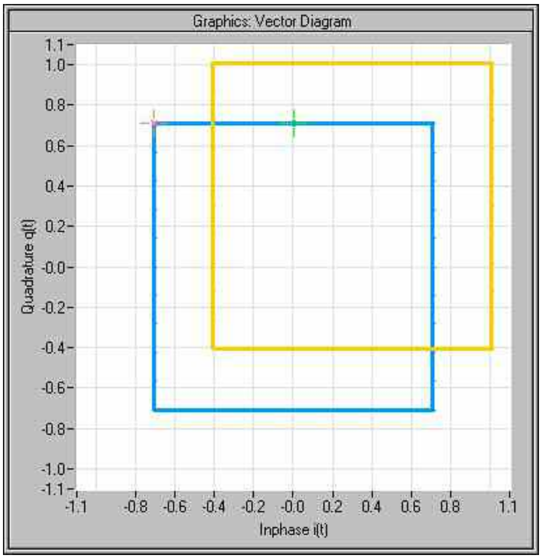
Effect of offset for the I component:



Effect of offset for the Q component:



Effect of an identical offsets for both signal components:



Remote-control commands:
`SOUR:BB:IMP:LEAK:I 6PCT`
`SOUR:BB:IMP:LEAK:Q 6PCT`

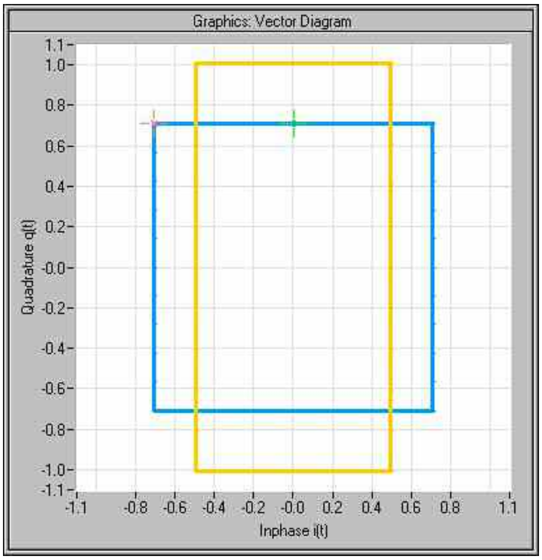
Gain Imbalance - Digital Impairments

Sets the imbalance of the I and Q vector.

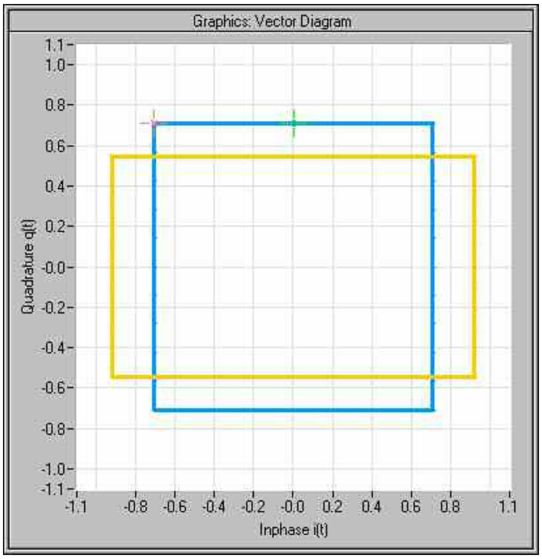
The entry is made in dB (default) or %, where 1 dB offset is roughly 12 % according to the following:
Imbalance [dB] = 20log (| $Gain_Q$ | / | $Gain_I$ |)

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

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



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

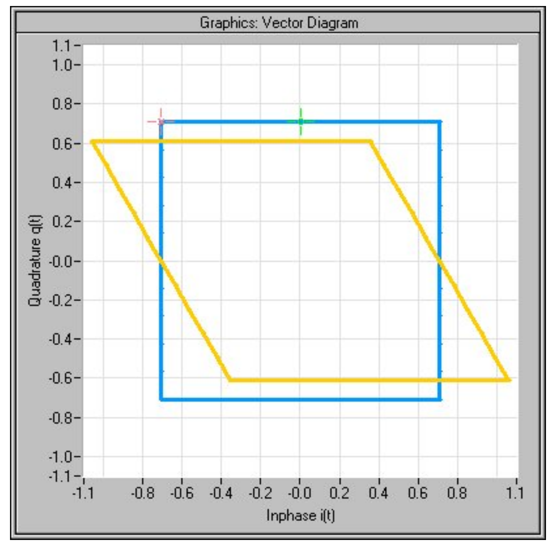


Remote-control command:
`SOUR:BB:IMP:IQR 0.1`

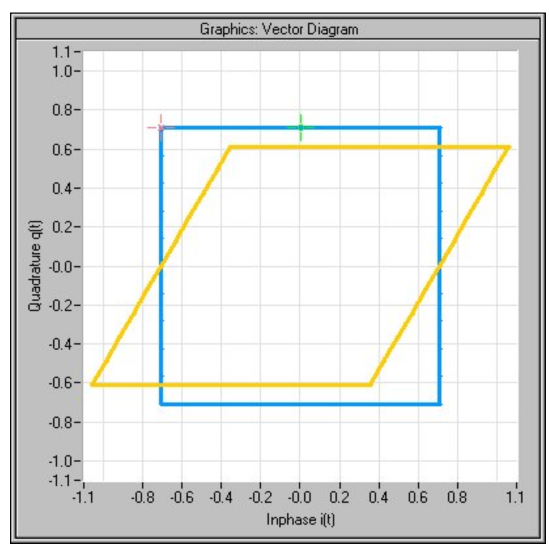
Quadrature Offset - Digital Impairments

Sets the quadrature offset.

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



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



Remote-control command:
`SOUR:BB:IMP:QUAD:ANGL 5DEG`

I/Q Skew - Digital Impairments

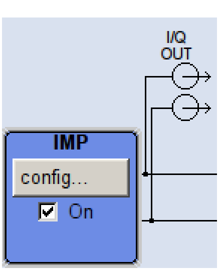
Sets the time offset between the I and Q vectors.
In an I/Q modulator without I/Q skew, the I and Q vectors are aligned to the marker. With an I/Q skew, both vectors are shifted relative to the marker so that the offset of each of the vectors to the marker will be the half of the I/Q skew value.
A positive I/Q skew means that the Q vector delays relative to the I vector and vice versa.
Remote-control command:
`SOUR:BB:IMP:SKEW 410.0E-9`

I/Q Delay - Digital Impairments	Sets the time delay of both I and Q vectors relative to the selected trigger and marker or relative the other instrument(s) working in the master-slave synchronous mode (see section "Synchronous Signal Generation"). A positive value means that the I and Q vectors delay relative to the marker/trigger or to the other instrument and vice versa. Remote-control command: `SOUR:BB:IMP:DEL 32.0E-9`
Optimize internal IQ-Impairments for RF Output - Digital Impairments	Activates or deactivates internal compensation of signal distortions of the RF output. Signal distortions can be either optimized for the RF output (active) or for the differential I/Q output (not active). Remote-control command: `SOUR:BB:IMP:OPT:STAT ON`
Optimization Mode - Digital Impairments	Selects the optimization mode.

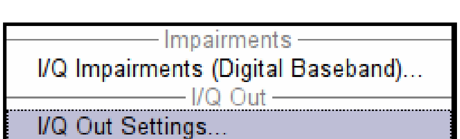
Fast	Optimization is reached by compensation for I/Q skew. Remote-control command: `SOUR:BB:IMP:OPT:MODE FAST`
High Quality	Optimization is reached by compensation for I/Q skew and frequency response correction. Remote-control command: `SOUR:BB:IMP:OPT:MODE QHIG`

Output of the Baseband Signal - I/Q Out

The R&S Signal Generator provides various outputs of the baseband signal. Converted to an **analog I/Q baseband signal** the digitally modulated signal can be output single-ended or differential (non-inverted). The signal is output at the I/Q output connectors **I OUT / I OUT BAR** and **Q OUT** / **Q OUT BAR** on the rear panel of the instrument.

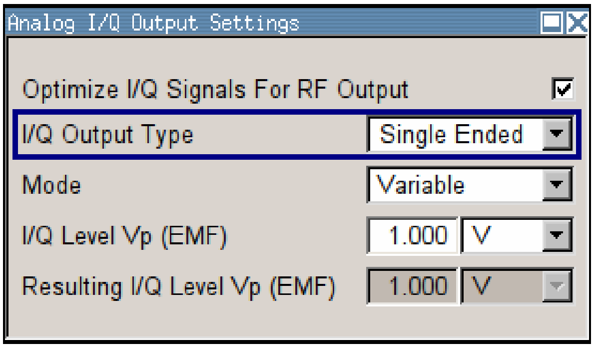


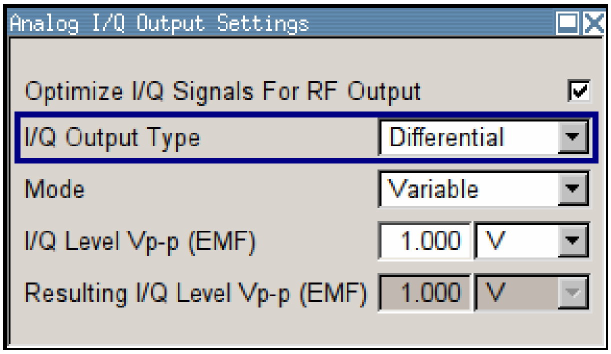
The settings dialogs for the analog and digital signal output are available in the block diagram in the **IMP** function block as well as in the menu with the same name which is opened using the MENU key.



The paramaters of the **analog signal** output are configured in the **I/Q Output Settings** dialog.

The differential output of the R&S Vector Signal Generator provides symmetrical signals for differential inputs of DUTs without the need of additional external electric network. The operating point of the inputs can be set by a definable DC-voltage (bias). In addition an offset between inverting and non-inverting output can be set to balance a difference of the best operating points.





Optimize IQ-Signals for RF Output - Differential Outputs - IMP Block

Activates/deactivates optimization of level accuracy and imbalance for RF Output.

Level accuracy and imbalance can be either optimized for RF output (active) or for differential outputs (not active).

Remote-control command:
`SOUR:IQ:OUTP:BIAS:OPT:STAT ON`

I/Q Output Type - Differential Outputs - IMP Block

Selects the type of output. The menu changes depending on the selection

Differential

Differential output at **I OUT** and **I OUT BAR** / **Q OUT** and **Q OUT BAR**. The analog I/Q signal components are output at I/Q OUT and I/Q OUT BAR.

Remote-control command:
`SOUR:IQ:OUTP:TYPE DIFF`

Single Ended

Single-ended output at **I OUT** and **Q OUT**.

Remote-control command:
`SOUR:IQ:OUTP:TYPE SING`

Output Mode - Differential Outputs - IMP Block

Selects the mode for setting the outputs - independent or together. The menu changes depending on the selection here.

Fixed

The settings for the I/Q signal components are fixed and cannot be changed.

Level Vp-p (EMF) (**Single ended**) = 1.0 V

Level Vp-p (EMF) (**Differential**) = 2.0 V

Remote-control command:
`SOUR:IQ:OUTP:MODE FIX`

Variable

The settings for the I/Q signal components are not fixed and can be modified.

Remote-control command:
`SOUR:IQ:OUTP:MODE VAR`

I/Q Level EMF - Differential Outputs - IMP Block

Variable output mode only

Sets the output voltage for both signal components. Small differences at the inputs can be taken into account via impairment settings (see section "Impairment Settings Menu").

Single ended Output:

Value range: 20 mV ... 1.5 V EMF.

Differential Output:

Value range: 40 mV ... 3 V EMF.

Remote-control commands:
`SOUR:IQ:OUTP:LEV 0.1`

Resulting I/Q Level EMF - Differential Outputs - IMP Block

Displays the resulting output off-load voltage of both signal components at the rear panel.

Remote-control command:
`SOUR:IQ:OUT:LEV:RES?`

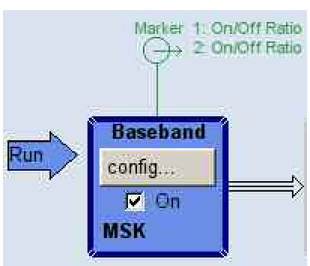
Baseband Signal - Baseband

Introduction - Baseband Signal

The R&S Signal Generator provides you with the ability to generate digital modulation signals in accordance with the definitions in the digital standards or with user-definable characteristics. Signals are generated in realtime or from a data store with the aid of external and internal data. You can also load externally computed modulation signals into the R&S Signal Generator in the form of waveform files.

Several digital standards are provided, plus digital modulation with user-definable signal characteristics, generation of waveforms with the aid of the Arbitrary Waveform Generator and generation of multi carrier CW signals with the aid of Multi Carrier CW.

The settings for digital modulation can be accessed in the block diagram via the "**Baseband**" function block or with the aid of the MENU key.



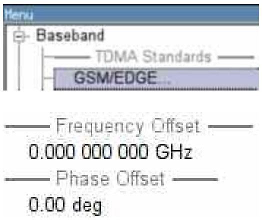
The equipment layout for generating the internal, digital modulation signals includes the options Baseband Generator (B10) and/or one of the ARB only options (B50/B55) .These two ARB options feature different ARB memory sizes (see data sheet). Apart from the memory size, however, the options offer the same functionality, either one can be installed.

In addition, the appropriate option is required for the digital standards. These options are specified in the description of the respective standard.

In the subsequent signal route the baseband signals can be frequency-shifted, detuned or loaded with noise (see sections "*Menu Impairment Settings*" and "*Noise generator - AWGN*").

Frequency and Phase Offset

Frequency and phase offset are defined at the topmost menu level in the **Baseband** block or by using the MENU button under **Baseband**.

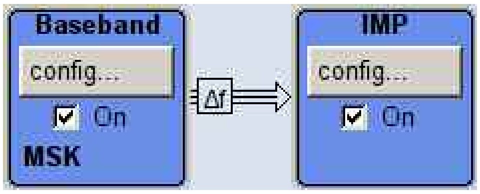


The upper part of the **Baseband** menu is used for selecting digital standards, digital modulation and waveform generation. These menus are described in the respective chapters relating to the modulation systems.

The lower part of the **Baseband** menu can be used to define a frequency and phase offset.

The **Frequency Offset** section is used to enter the frequency offset. The frequency offset shifts the baseband frequency interval and provides a quick way to shift the used frequency band in the RF frequency section without modifying the RF settings.

Wenn a frequency offset is defined, a icon is displayed between the naseband block and the Impairements block.



Frequency Offset - Baseband

Enters the frequency offset for the baseband signal.

The offset affects the signal on the **Baseband block** output**.** It shifts the useful baseband signal in the center frequency.

Note:

For sample rates of exactly 150 MHz it is not possible to enter a frequency offset. The digital signal is fed into the signal path directly and not routed to the resampler where the frequency offset takes place. This type of entry is also prohibited if the noise generator (AWGN block) is on.

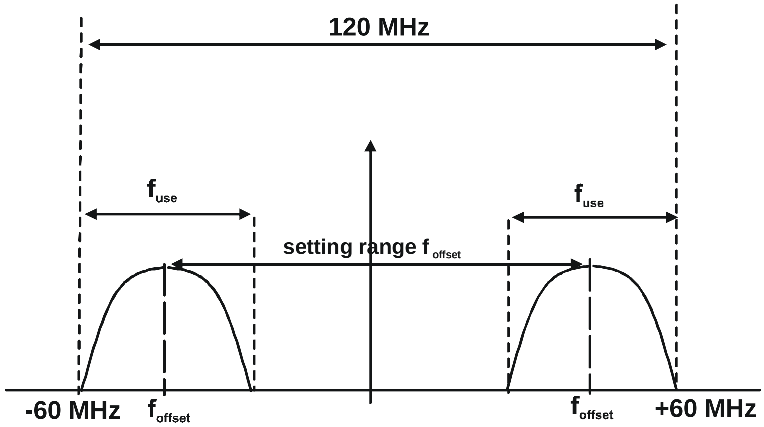
The complex I/Q bandwidth of the shifted useful signal must not exceed 120 MHz (R&S SMBV with option B10/B50) or 60 MHz (R&S SMBV with option B51) in total. The following applies:

$$f_{offset} - f_{use}/2 \geq -120/2\,\text{MHz} \quad \text{and} \quad f_{offset} + f_{use}/2 \leq +120/2\,\text{MHz}$$

f_{use} = the complex useful bandwidth of the I/Q signal before the offset.

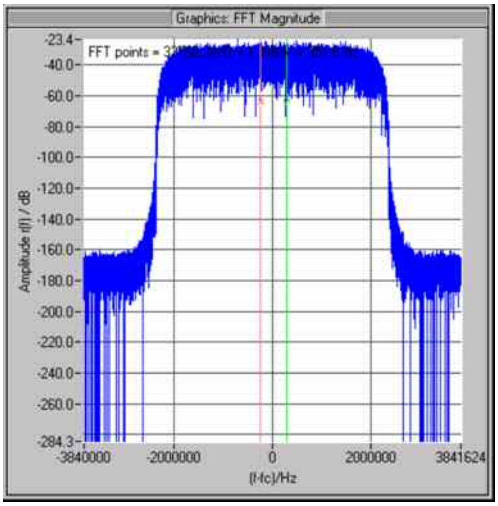
f_{offset} = frequency offset.

The following graph illustrates the setting range for the frequency offset for R&S SMBV equipped with option B10/B50. For R&S SMBV equipped with option B51, the total bandwidth is 60 MHz.



Example:

3GPP FDD signal (chip rate 3.84 Mcps, root-cosine filter 0.22).



The complex useful bandwidth of a signal which has been filtered using a root-cosine filter with roll off α is calculated as follows:

$$f_{use} = (1+\alpha) * f_{symbol}$$

f_{symbol} = the symbol rate or chip rate of the signal.

In the example the complex useful bandwidth is calculated as follows:

F_{use} = (1+ 0.22) * 3.84 MHz = 4.6848 MHz.

So as to comply with the condition requiring a maximum I/Q bandwidth of 60 MHz, the valid range of values for the frequency offset is then:

$$-60\text{MHz} + \frac{4.6848\,\text{MHz}}{2} \leq f_{offset} \leq 60\text{MHz} - \frac{4.6848\,\text{MHz}}{2} =$$

$$-57.6576\text{MHz} \leq f_{offset} \leq 57.6575\text{MHz}$$

In the case of ARB signals, the output clock rate can be used for estimating the maximum I/Q bandwidth of the waveform.

Remote-control command:
`SOUR:BB:FOFF 2MHZ`

The **Phase Offset** section is used to enter the relative phase offset.

Phase Offset - Baseband

Enters the phase offset for the baseband signal.

The phase osset affects the signal on the **Baseband block** output.

Remote-control command:
`SOUR:BB:POFF 0.4DEG`

Data and Signal Sources in Baseband

This section describes the common characteristics of the signals used for generating the baseband signal for all standards, including for example all listed data sources. The selection in the digital menus at any given time depends on the parameter and standard concerned and is clear from the selection list offered in the menu. The external data sources may therefore not be available in certain cases.

Characteristics which are uniquely specific to particular standards are described in relation to the menu concerned.

The following input signals are used when digital modulation signals are being generated:

- Modulation data
- Clock signals
- Control signals

The input signals can be both internally generated and supplied from an external source. The internally generated clock signals are output on the Clock connectors.

Likewise control signals and also trigger signals for triggering signal generation in the R&S Signal Generator can be internally generated or supplied from an external source.

Two marker output signals for synchronizing external instruments can be user-defined.

Externally computed waveform files can be loaded via one of the computer interfaces or via the IEC bus in the instrument and generated with the aid of the Arbitrary Waveform Generator (ARB, see section "Arbitrary Waveform Generator ARB", page 4.192). Internally the **Multi Carrier CW** menu for defining multi carrier waveforms is available (see *"Multi Carrier Continuous Wave"*).

Internal PRBS Data and Data Patterns

PRBS generators deliver pseudo-random binary sequences of differing length and duration. They are known as maximum length sequences, and are generated with the aid of ring shift registers with feedback points determined by the polynomial.

By way of example, the diagram below shows a 9-bit generator with feedback to registers 4 and 0 (output).

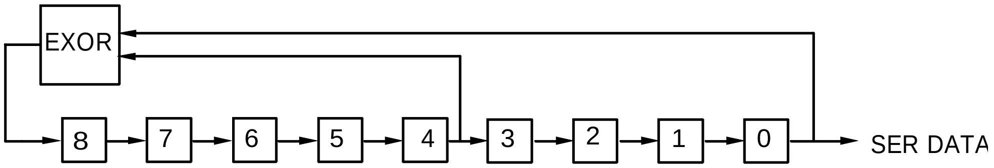
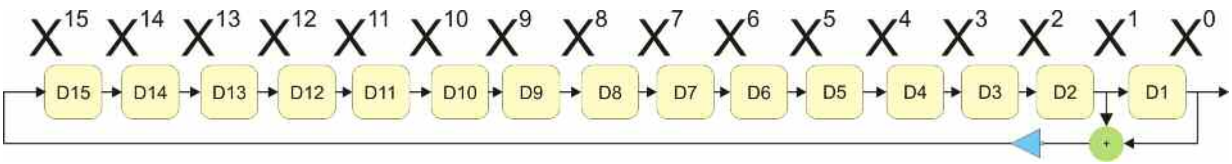


Fig. 4-1 9-bit PRBS generator

Note:
For PRBS15 and PRBS23, a CCITT V.52-compliant data inversion is performed in the feedback path automatically as shown below:



The pseudo-random sequence from a PRBS generator is uniquely defined by the register number and the feedback. The following table describes all the available PRBS generators:

Table 4-1 PRBS generators

PRBS generator	Length in bits	Feedback to	Menu selection
9-bit	2^9 -1 = 511	Registers 4, 0	PRBS 9
11-bit	2^{11} -1 = 2047	Registers 2, 0	PRBS 11
16-bit	2^{16} -1 = 65535	Registers 5, 3, 2, 0	PRBS 16
20-bit	2^{20} -1 = 1048575	Registers 3, 0	PRBS 20
21-bit	2^{21} -1 = 2097151	Registers 2, 0	PRBS 21

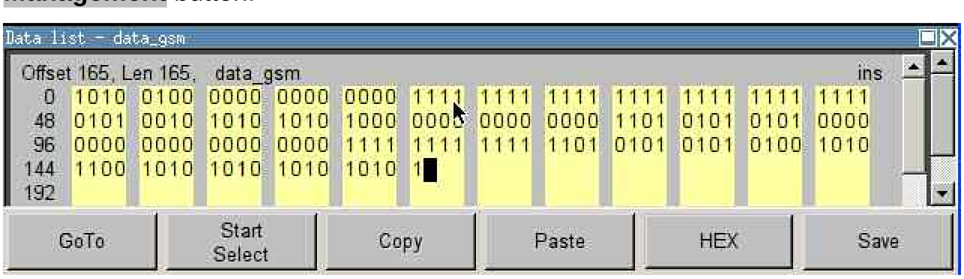
The **Data Source** selection for PRBS data from the menus is **PN09, ...**

Simple data patterns such as binary 0 strings or 1 strings can also be used as internal modulation data. The **Data Source** selection from the menus is **ALL 0**, **ALL1**. A variable bit string with a maximum length of 64 bits can be entered in an input field by selecting **Pattern**.

Internal Modulation Data from Lists

Internal modulation data can be generated and stored in the form of binary lists. A separate file is created for each list and held on the R&S Signal Generator internal flash card. The file name can be defined by the user.

The **Data Source** selection from the menus is **Data List**.When this menu item is chosen the **Select Data List** button appears; this opens the file-selection window for data lists. A list can be created and edited in the **Data List Editor**, which is accessed from the menu via the **List Management** or **Data List Management** button.



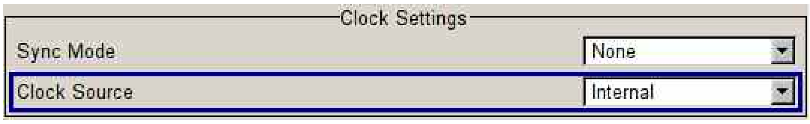
The maximum length of a data list is determined by the size of the data list memory (see data sheet). There is no restriction on the number of lists that can be stored.

Clock Signals

The clock reference used for generating the timing pulse can be either internal or external (**Clock Source** selection from the menu: **Internal** / **External**).

To enable a very precise simultaneous signal generation of two or more R&S SMBVs, two additional clock signals, Sync. Master and Sync. Slave, are available. These both clock signals are enabled only in the special synchronistion mode. See section "Synchronous Signal Generation" for information how to configure two or more instruments to work in a synchronization mode.

Internal clock reference



When the internal clock reference is selected, the clock signals generated by the R&S Signal Generator are output on the following connectors:

CLOCK OUT (rear panel)	Symbol clock

External clock reference

When the external clock reference is selected, it is always supplied via the CLOCK connector on the rear panel. The internal clocks synchronized to it are output on the following connectors:

CLOCK OUT (rear panel)	Symbol clock

The active edge of the external clock signal on the CLOCK input is selectable (menu Setup-**System-Global Trigger/Clock/External Inputs**). Internally the rising edge is always taken as the active edge. The active rising edge of the internal clocks is therefore synchronized with either the rising or the falling edge of the external clock reference. A symbol clock can be supplied externally or, if internally generated or externally asynchronous data is being fed in, a multiple of a symbol clock can be supplied.

In order for the clock synthesizer on the R&S Signal Generator to be synchronized correctly, the external clock reference must first be applied and the correct symbol rate must then be set. Until this has been done the external clock source must not be selected (**Clock Source External**).

Note:
The symbol rate set must not deviate from the symbol rate of the external signal by more than 2% (see also data sheet).

Synchronous Signal Generation

Different simulation schemes such as MIMO for instance require two or more very precise synchronized signals. To enable several R&S SMBVs to generate such a simultaneous and synchronous signal, a special synchronization mode is provided.

Synchronization mode is an instrument's configuration in which one of the instruments is used as a master and the other(s) are slave(s). The master instrument supplies the slave instrument(s) with its system and reference clock as well as with its trigger signal.

The instruments have to be configured and connected as described in the following sections.

Connecting Several R&S SMBVs for Precise Synchronous Signal Generation

For working in master-slave synchronous mode, the instruments have to be connected as follow:

- The instruments have to be connected as a chain, i.e. the inputs of each further instrument are connected to the outputs of the previous one.
- The output REF OUT of the master instrument has to be connected to the signal input REF IN of the first slave one.
- The output MARKER 1 of the master instrument has to be connected to the signal input TRIG of the slave one.
- The output CLK OUT of the master instrument has to be connected to the signal input CLK IN of the slave one.
- The connecting cables between two consecutive instruments must have the same length and type, concerning all the REF OUT to REF IN, MARKER 1 to TRIG and CLK OUT to CLK IN connection.
- Unnecessary cable lengths and branching points have to be avoided.

The figure below shows the cabling of two or more R&S SMBVs for working in master-slave synchronous mode.

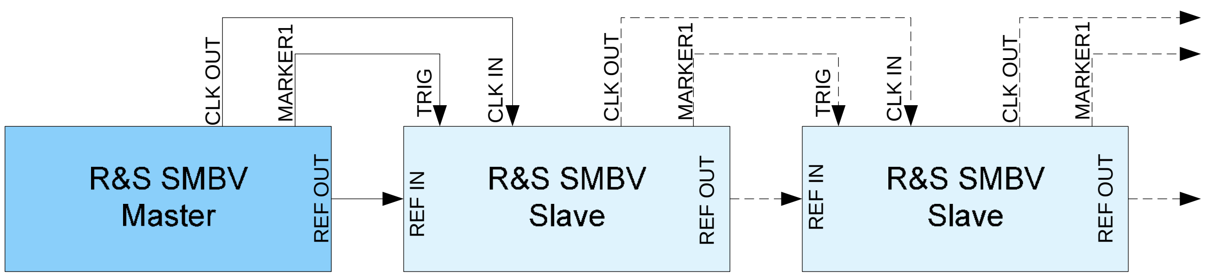


Fig. 4-2 Connection of several R&S SMBVs for synchronous signal generation

Configuring Several R&S SMBVs for Precise Synchronous Signal Generation

After the instruments had been connected as described in section "Connecting Several R&S SMBVs for Precise Synchronous Signal Generation" the instruments have to be configured. The synchronization settings are available in the **Clock Settings** section of the **Custom Digital Modulation** menu, **ARB** menu and in each of the **Clock Settings** menus of the installed digital standards.

The **Clock Settings** menu are described in the section "Trigger/Marker/Clock - Custom Digital Modulation Menu", "Trigger/Marker/Clock - ARB MOD Menu" and in the respectively section **Trigger/Marker/Clock** of the installed digital standards.

To easy the configuration, an automatically adjustment of the required synchronization settings is provided.

Master Instrument

For working in master-slave synchronous mode, the master instrument has to be configured as follow:

- Select Sync. Master **Synchronization Mode**.

Remote Control Command:
`BB:DM:SYNC:MODE MAST`

- Perform **Set Synchronization Settings.**

Remote Control Command:
`BB:DM:SYNC:EXEC`

The synchronization settings are automatically set.

The system clock, the reference clock and the trigger signal of the master instrument are output on the CLK OUT, FEF OUT and the MARKER 1 connectors respectively and supplied to the slave instrument.

Slave Instrument(s)

For working in master-slave synchronous mode, the slave instrument(s) has (have) to be configured as follow:

- Select Sync Slave **Synchronization Mode**.

Remote Control Command:
`BB:DM:SYNC:MODE SLAV`

- Perform **Set Synchronization Settings.**

Remote Control Command:
`BB:DM:SYNC:EXEC`

Following parameters are set automatically:

– The **Reference Oscillator** source is set to external

– The **Trigger Mode** is set to retrigger and an external **Trigger Source** is selected

– The **Clock Source** is set to external

The slave instrument receives the system clock, the trigger signal and the reference clock of the master one.

Control Signals

The following control signals are processed in the R&S Signal Generator:

- **Burst Gate** and **Level Attenuation** for power ramping
- **CW** for controlling the CW (continuous wave) mode
  The **CW** signal turns off digital modulation. The RF signal is output in unmodulated form.
  In case of standards in which it is possible to switch between different modulation modes, the signal is output only and cannot be supplied from an external source. In such cases it indicates the modulation mode internally (standard GSM: signal high (1) = modulation mode GMSK and signal low (0) = modulation mode 8PSK EDGE).

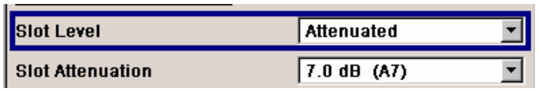
The CW control signal is generated internally and fed to the AUX I/O interface. The control signals for power ramping can be provided externally for **Custom Digital Modulation** only. When generated internally the signals are output on the AUX I/O interface.
A dedicated internal **Control Data Editor** is provided for defining the control signals. This editor with its intuitive graphical interface can be used to define and save control signals. Definition by generating or editing a binary list is no longer necessary (though it is still possible via the IEC bus).
A separate file with the file extension ***.dm_iqc** is created for each defined control signal and held on the R&S Signal Generator hard disk.
If the **Component Data Editor** is used, the **Control Data Editor** is integrated with it. The defined control data is not held separately, but stored with the data structure. This applies both to signals of the Data Editor Realtime and the Data Editor Offline.

Power Ramping and Level Attenuation

In TDMA radio networks it is necessary to control the RF output signal envelope synchronously for the purpose of digital modulation. The signals **Burst** Gate and **Lev Att** are used for this.

When power ramping is enabled, a ramp is generated whenever there is a data switch on the **Burst** signal (from high to low or low to high). The steepness of this ramp can be adjusted. Power ramping is enabled and configured in the **Power Ramp Control** submenu.

The **Lev_Att** signal is used to control a defined level attenuation. If level attenuation is enabled, the modulation signal level is attenuated by a defined value if the **Lev Att** signal is high. The level attenuation value is defined in the **Power Ramp Control** menu. For the **GSM/EDGE** standard a maximum of 7 different level attenuation values can be defined and allocated separately to the 8 slots quite independently of one another. Level attenuation is enabled either in the **Power Ramp Control** menu (Custom Digital Modulation) or in the Burst Editor (GSM/EDGE).



Level attenuation enables to simulate radio stations located at various distances.
The diagram below shows an example of how the power ramping signals work.

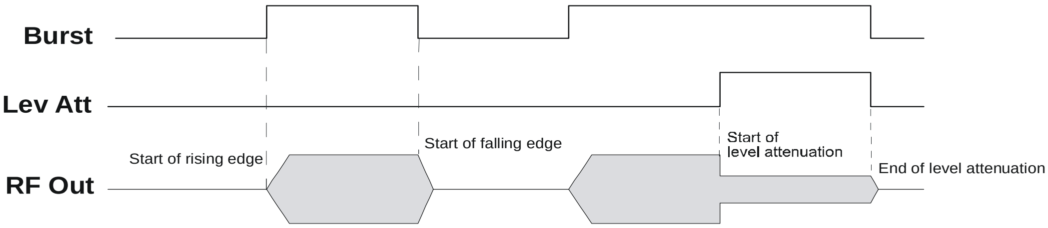


Fig. 4-3 Signal behavior when power ramping is enabled. The **Burst** Gate signal defines the start of the rising and falling edges of the envelope, and the **Lev Att** signal defines the start and end of level attenuation. The level attenuation value is defined in the **Power Ramp Control** menu.

Trigger Signals

In the R&S Signal Generator, trigger signals are internally generated or externally supplied signals which start signal generation at a particular point in time.

Signal generation can also take place without triggering, in which case the signal is then generated in full after modulation is powered up. A trigger event either has no effect on signal generation (menu setting **Trigger Mode Auto**) or triggers a signal restart (menu setting **Trigger Mode Retrigger**).

If signal generation is triggered, the signal is continuously generated after the first trigger. In the **Armed_Auto** mode, a further trigger event has no effect. In the **Armed_Retrig** mode, every additional trigger event triggers a restart of the signal. In both cases, triggering can be reset to the initial state (**armed**), i.e. signal generation is stopped and the instrument waits for the next trigger to start signal generation anew.

The status of signal generation (**Running** or **Stopped**) is displayed for all trigger modes in the corresponding trigger menu of the digital standard currently switched on. The signal generation status particularly with an external trigger can thus be checked.

Internal and external trigger sources are available for triggering.

- Internally, triggering is carried out manually by pressing the **Execute Trigger** button (menu selection **Internal**).
- External trigger signals can be fed in via the TRIGGER connector on the rear panel (menu selection **External**).

  The effect of a restarted trigger signal in the **Retrigger** trigger mode can be suppressed for a definable number of symbols (menu setting (**External) Trigger Inhibit**). By this means the trigger can be suppressed for a definable number of frames, for example in the course of base station tests, and yet the signal can still be generated synchronously. In each frame the base station generates a trigger which would cause a signal generation restart every time but for the suppression.

  Example: Entering 1000 samples means that after a trigger event, any subsequent trigger signal is ignored for the space of 1000 samples.

Marker Output Signals

The R&S Signal Generator generates user-definable marker output signals which can be used to synchronize external instruments. By this means a slot clock or frame clock can be set, for instance, or the start of a particular modulation symbol can be marked.

Two marker outputs are available.

Markers 1/2	MARKER 1 / 2 BNC connectors on the rear panel

Digital Modulation - Custom Digital Modulation

The R&S Signal Generator can generate digital modulation signals with user-definable characteristics. Baseband filtering and the symbol rate can be set within wide limits.

Introduction - Custom Digital Modulation

The equipment layout for generating the digital modulation signals includes the option Baseband Generator (R&S SMBV-B10).

When modulation is ON, a two-part level indication is shown in the header section of the display. This displays both the average power (LEVEL) and the peak envelope power (PEP) of the modulated output signal.

The difference between PEP and LEVEL depends on the modulation type and the filtering: Both values are pre-measured internally so that the displayed values match the true values in the signal. When external signals are used, they are replaced by PRBS data during pre-measurement.

Modulation Types - Custom Digital Mod

The available predefined modulation types are ASK (amplitude shift keying), FSK (frequency shift keying), PSK (phase shift keying) and QAM (quadrature amplitude modulation). Additionally, a user defined modulation mapping can be applied (see "User Mapping").

The actual modulation procedure is described by mapping, which assigns I and Q values (PSK and QAM) or frequency shifts (FSK) to every modulation symbol that occurs. This is represented graphically in the constellation diagrams.

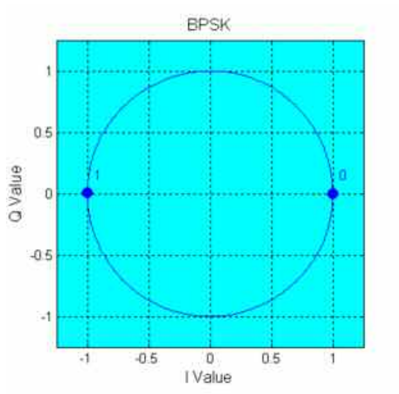
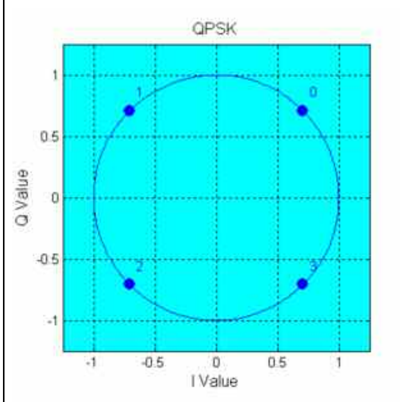
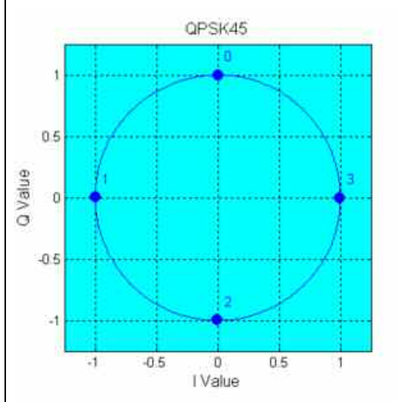
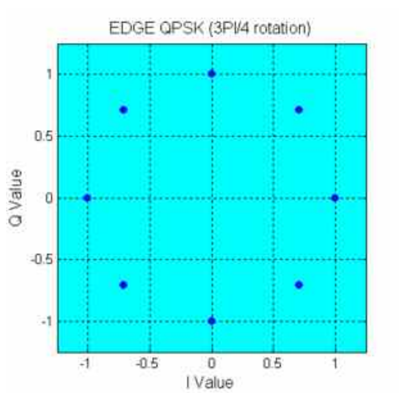
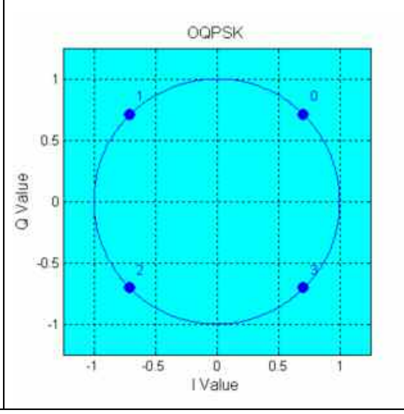
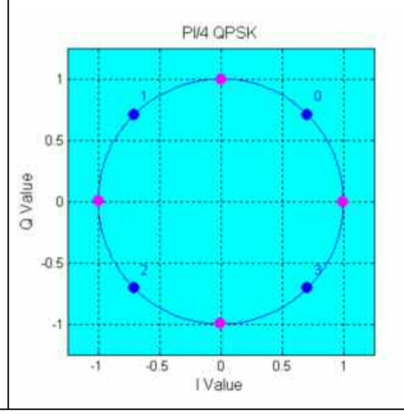
The mapping for the selected modulation type is displayed in the **More..**. submenu in the **Modulation** menu section (see "More - Modulation Type - Digital Modulation", page *4.171*)

The QAM procedures 16QAM, 32QAM, 64QAM have been produced in accordance with ETSI standard ETS 300429 for digital video broadcasting (DVB). The QAM procedures 256QAM and 1024QAM are not specified in this standard, but have been produced according to the same basic principles.

In the case of all FSK procedures, the user can set the symbol rate f_{SYMB} up to a maximum value (see data sheet). If MSK is selected, the frequency deviation (**FSK deviation**) cannot be set since it is permanently set to ¼ of the symbol rate.

Table 4-1 Modulation type and associated mapping

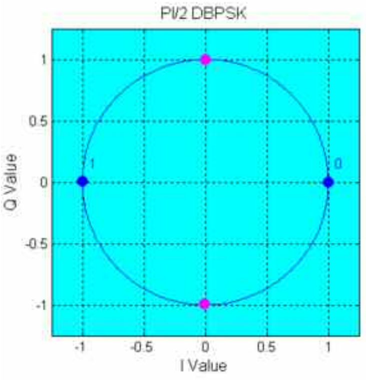
PSK

<table>
<tr>
<td>BPSK
1 bit per symbol
<code>SOUR:BB:DM:FORM BPSK</code>
</td>
<td>QPSK
2 bits per symbol
<code>SOUR:BB:DM:FORM QPSK</code>
</td>
<td>QPSK 45° Offset
2 bits per symbol
45° rotation
<code>SOUR:BB:DM:FORM QPSK45</code>
</td>
</tr>
<tr>
<td>QPSK EDGE
2 bits per symbol
3pi/4 rotation
<code>SOUR:BB:DM:FORM QEDGe</code>
</td>
<td>OQPSK
2 bits per symbol
Q offset
<code>SOUR:BB:DM:FORM OQPSK</code>
</td>
<td>pi/4-QPSK
2 bits per symbol
pi/4rotation
<code>SOUR:BB:DM:FORM P4QP</code>
</td>
</tr>
</table>

pi/2-DBPSK

1 bit per symbol
Differential coding, pi/2 rotation

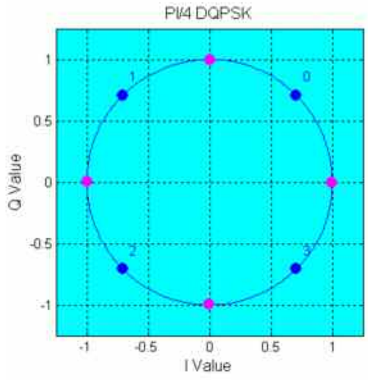
`SOUR:BB:DM:FORM P2DB`



pi/4-DQPSK

2 bits per symbol
Differential coding, pi/4 rotation

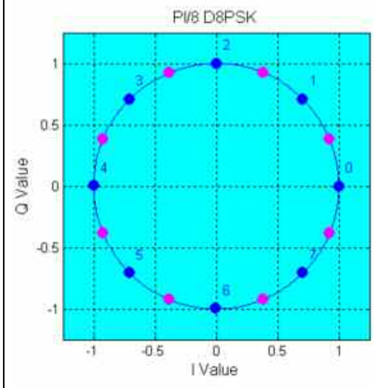
`SOUR:BB:DM:FORM P4DQ`



pi/8-D8PSK

3 bits per symbol
Differential coding, pi/8 rotation

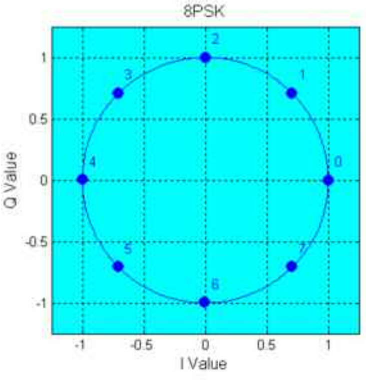
`SOUR:BB:DM:FORM P8D8`



8PSK

3 bits per symbol

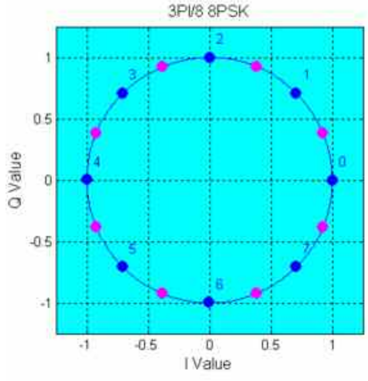
`SOUR:BB:DM:FORM PSK8`



8PSK EDGE (3pi/8 8PSK)

3 bits per symbol
Edge coding, 3pi/8 rotation

`SOUR:BB:DM:FORM P8ED`

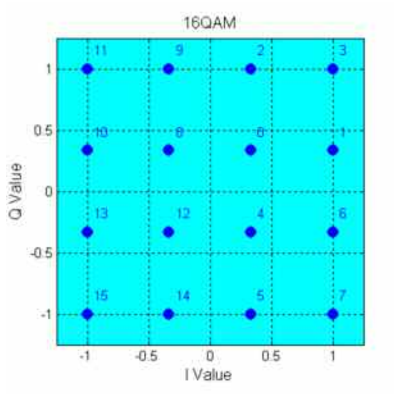


QAM

16QAM

4 bits per symbol

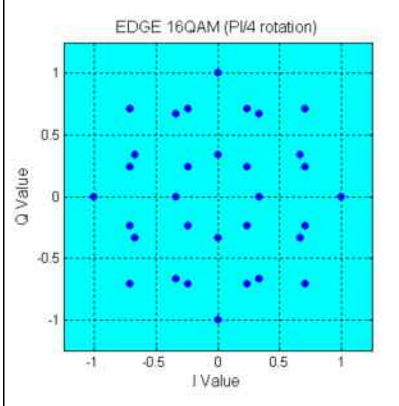
`SOUR:BB:DM:FORM QAM16`



16QAM EDGE

4 bits per symbol, pi/4 rotation

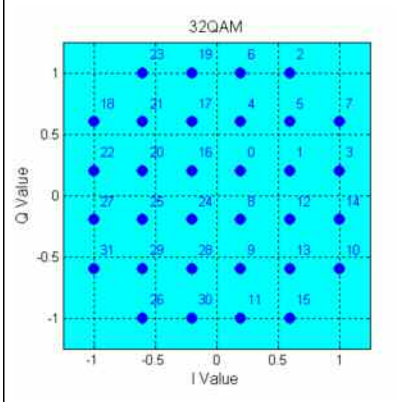
`SOUR:BB:DM:FORM QAM16EDge`



32QAM

5 bits per symbol

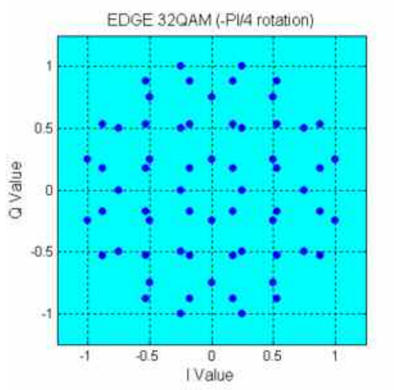
`SOUR:BB:DM:FORM QAM32`



32QAM EDGE

5 bits per symbol, -pi/4 rotation

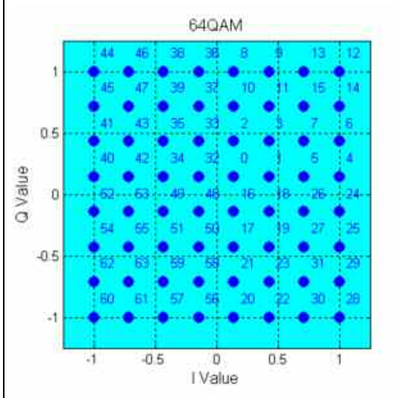
`SOUR:BB:DM:FORM QAM32EDge`



64QAM

6 bits per symbol

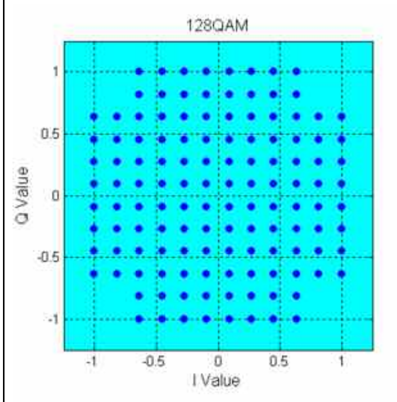
`SOUR:BB:DM:FORM QAM64`



128QAM

7 bits per symbol

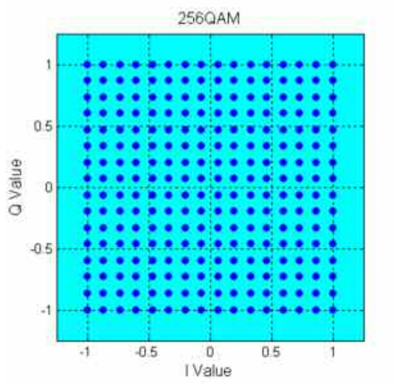
`SOUR:BB:DM:FORM QAM128`



256QAM

8 bits per symbol

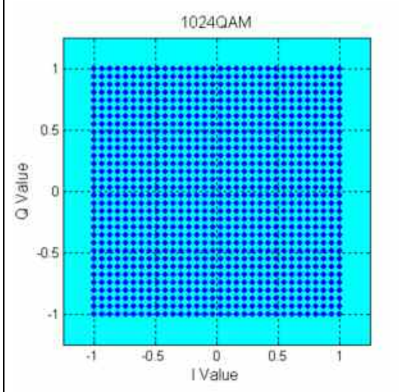
`SOUR:BB:DM:FORM QAM256`



1024QAM

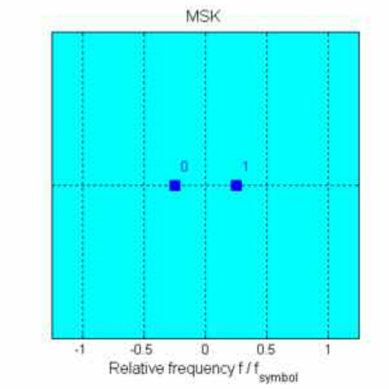
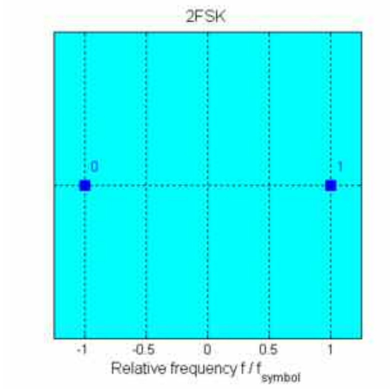
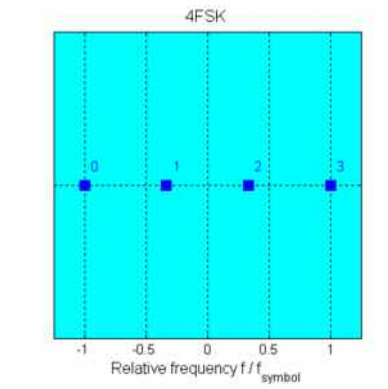
10 bits per symbol

`SOUR:BB:DM:FORM QAM1024`



FSK

Note:
In addition to the following FSK modulations, a variable FSK modulation with definable deviation per symbol is available.

MSK	2FSK	4FSK
1 bit per symbol FSK deviation	1 bit per symbol	2 bits per symbol
`SOUR:BB:DM:FORM MSK` `SOUR:BB:DM:FSK:DEV 0.1 MHz`	`SOUR:BB:DM:FORM FSK2`	`SOUR:BB:DM:FORM FSK4`
		

User Mapping

A user defined modulation mapping file can also be selected as modulation mapping source. The user modulation mapping file must have extension ***.vam** and can be created with the R&S mapping wizard. The mapping wizard (mapwiz) is a tool from Rohde & Schwarz designed for editing modulation schemes (e.g. QPSK, 32QAM). Its main purpose is the assignment of logical symbol numbers to constellation points and the selection of modulation specific parameters.
Beyond this it supports the creation of nearly any arbitrarily chosen constellation diagram. The output of mapwiz is a mapping file (*.vam) that can be imported on a R&S Signal Generator.
The program was developed on a 32-bit Microsoft Windows platform under MATLAB.
For more information, refer to the description "Introduction to "mapwiz" Mapping Editor" on the Rohde&Schwarz Internet page.

Coding - Custom Digital Mod

Modulation symbols are coded directly before I and Q values or frequency shifts are assigned. Coding is thus directly related to modulation methods, which is the reason why codings are not freely combinable with modulation methods. The following table shows which of the coding combinations are available and defines the modulation types for which the various coding procedures can be used.

In the notation used below a_n denotes the n-th input symbol and b_n denotes the correspondingly coded output symbol. Individual bits in the symbols from the LSB (least significant bit) to the MSB (most significant bit) are denoted by a_{0n}, a_{1n} and so on. The same applies to the output symbols.

Table 4-1 Permissible coding combinations for modulation symbols and modulation type

	OFF	**Differ-ence**	**Phase differ-ence**	**Differ-ence + Gray**	**Gray**	**GSM**	**NADC, PDC, PHS, TETRA, APCO25 (PSK), PWT**	**TFTS/ TETRA**	**INMARSAT, ICO, WCDMA 3GPP, cdma2000**	**VDL**	**APCO25 (FSK)**
ASK	X	X		X	X						
BPSK	X	X		X	X						
pi/2 DBPSK	X				X						
QPSK	X	X		X	X				X		
QPSK 45° Offset	X	X		X	X				X		
Pi/4 QPSK	X	X			X						
Pi/4 DQPSK	X				X		X	X			
8PSK	X	X		X	X					X	
8PSK_EDGE	X										
Pi/8 D8PSK	X				X						
MSK	X	X		X	X	X					
2FSK	X	X		X	X	X					
4FSK	X	X		X	X						X
16QAM	X	X	X	X	X						
32QAM	X	X	X	X	X						
64QAM	X	X	X	X	X						
256QAM	X	X	X	X	X						
1024QAM	X	X	X	X	X						

Modulation type pi/4DQPSK

With differential coding switched on at the same time, a constellation diagram is obtained for pi/4DQPSK which is similar to that obtained for 8PSK. Phase shifts are however assigned to the individual modulation symbols. The following tables show the assignment of modulation symbols to phase shifts of the I/Q vector in relation to the selected coding.

Table 4-1 Phase shifts for π/4DQPSK

Modulation symbol a_n (binary indication: MSB, LSB)	00	01	10	11
Phase shifts without coding	+ 45°	+135°	- 135°	-45°
Phase shifts with coding NADC, PDC, PHS, TETRA or APCO25 (PSK)	+ 45°	+135°	-45°	- 135°
Phase shifts with coding TFTS	- 135°	+135°	-45°	+ 45°

Coding algorithms

Common coding types are listed in the following table.

Table 4-1 Coding algorithms

Coding	**Coding algorithm**	**Applicable for K bit/symbol**
NONE	$b_n = a_n$	k = 1...8
Differential	$b_n = (a_n + b_{n-1})$ modulo 2^k	k = 1...7
Differential + Gray	Gray coding with additional differential coding	k = 1...7
GSM	dc_n = not (d_n exor d_{n-1})	k = 1

Example 1: Differential coding for QPSK modulation with K = 2 bit/symbol

Decimal display; value range for modulation symbols

$$a_n \in \{0; 1; 2; 3\}$$

Recursive coding is defined as follows: $b_n = (a_n + b_{n-1})$ modulo 4.

Depending on the state of a preceding modulation symbol b_{n-1} the coded modulation symbol b_n is obtained for example from modulation symbol a_n = 2 as follows:

a_n = 2	**b_{n-1}**	**b_n**
	0	2
	1	3
	2	0
	3	1

By means of differential coding, the assignment between modulation symbols and phase differences shown in the following table is generated:

Modulation symbol a_n (binary, MSB, LSB)	00	01	10	11
Phase difference	0°	90°	180°	270°

Example 2: Gray and differential coding for 8PSK modulation

First, a gray coding is performed according to the gray code. Afterwards, a differential coding is performed according to the recursive coding algorithm quoted above. The assignment between modulation symbols and phase differences shown in the following table is generated:

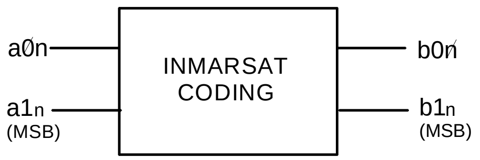
Modulation symbol a_n (binary, MSB, LSB)	000	001	010	011	100	101	110	111
Phase difference	0°	45°	135°	90°	270°	315°	225°	180°

Differential coding according to VDL can be used for modulation types with 3 bits/symbol, e.g. 8PSK.

Table 4-1 Differential coding according to VDL

Modulation symbol d_n (binary, MSB, LSB)	000	001	010	011	100	101	110	111
Phase difference	0°	45°	135°	90°	315°	270°	180°	225°

Phase differential coding INMARSAT and PHASE DIFF correspond to system standards Inmarsat-M and DVB according to ETS 300 429. The INMARSAT coding can generally be used for modulation types with 2 bits/symbol, such as QPSK. It uses the following algorithm.



b_{1n} = [NOT (a_{1n} EXOR a_{0n}) AND (a_{1n} EXOR $b_{1(n-1)}$)] OR [(a_{1n} EXOR a_{0n}) AND (a_{1n} EXOR $b_{0(n-1)}$)]

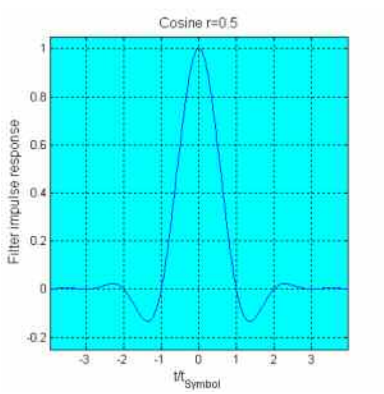
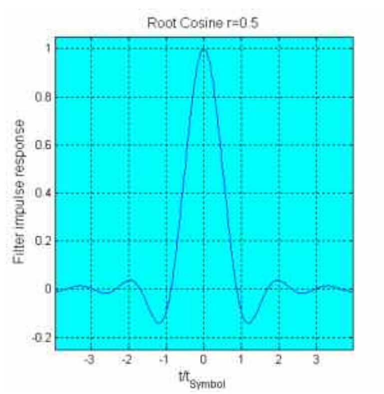
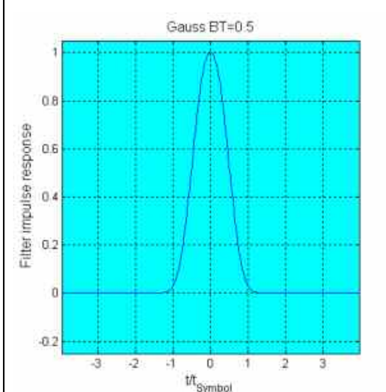
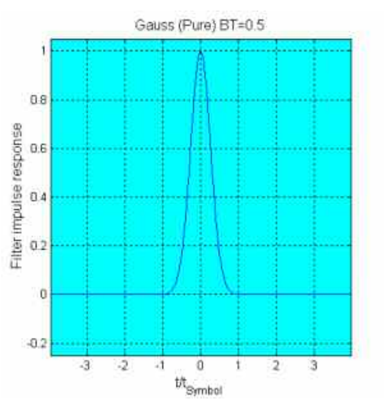
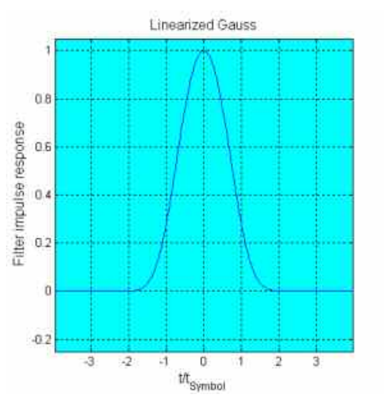
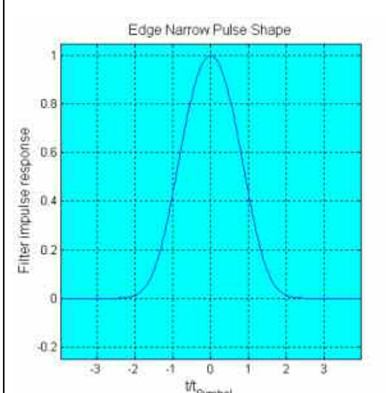
b_{0n}= [NOT (a_{1n} EXOR a_{0n}) AND (a_{0n} EXOR $b_{0(n-1)}$)] OR [(a_{1n} EXOR $a_{0(n-1)}$) AND (a_{0n} EXOR $b_{1(n-1)}$)]

Baseband Filter - Custom Digital Mod

The R&S Signal Generator offers a wide selection of predefined baseband filters. The filter characteristic for the selected filter is displayed in the **More..**. submenu in the **Filter** menu section (see "More - Filter - Digital Modulation", page 4.173). Additionally, a user defined filter can be selected (see "User filter").

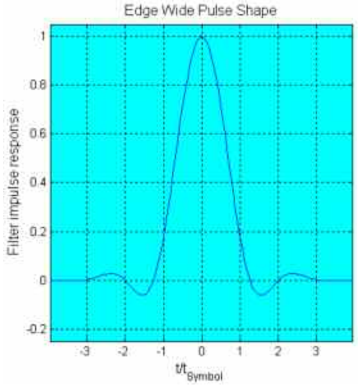
The following table shows the filters that are available, together with the associated parameters and IEC bus commands. The filter characteristic is displayed in graphical form.

Table 4-2 Baseband filter

<table>
<tr>
<td>Cosine
Roll Off Factor
<code>SOUR:BB:DM:FILT:TYPE COS</code>
<code>SOUR:BB:DM:FILT:PAR:COS 0.99</code>

</td>
<td>Root Cosine ($\sqrt{\cos}$)
Roll Off Factor
<code>SOUR:BB:DM:FILT:TYPE RCOS</code>
<code>SOUR:BB:DM:FILT:PAR:RCOS 0.99</code>

</td>
<td>Gauss (FSK)
B x T
<code>SOUR:BB:DM:FILT:TYPE GAUS</code>
<code>SOUR:BB:DM:FILT:PAR:GAUS 2.5</code>

</td>
</tr>
<tr>
<td>Pure Gauss
B x T
<code>SOUR:BB:DM:FILT:TYPE PGA</code>
<code>SOUR:BB:DM:FILT:PAR:PGA 2.5</code>

</td>
<td>Gauss Linearized
<code>SOUR:BB:DM:FILT:TYPE LGA</code>

</td>
<td>Edge Narrow Pulse Shape
<code>SOUR:BB:DM:FILT:TYPE ENPShape</code>

</td>
</tr>
</table>

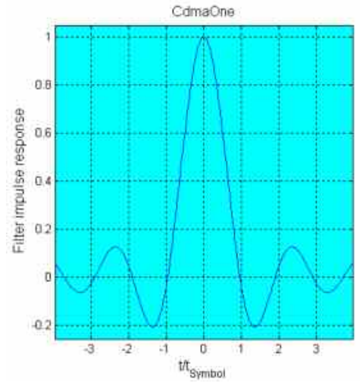
Edge Wide Pulse Shape

`SOUR:BB:DM:FILT:TYPE EWPShape`



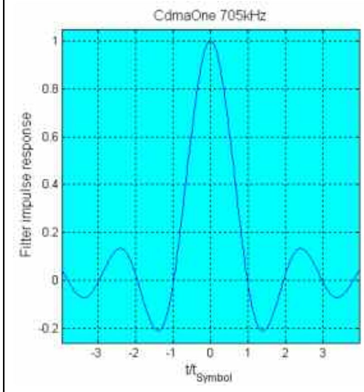
cdmaOne

`SOUR:BB:DM:FILT:TYPE CONE`



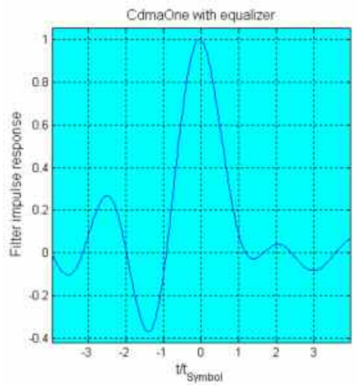
cdmaOne 705 kHz

`SOUR:BB:DM:FILT:TYPE COF705`



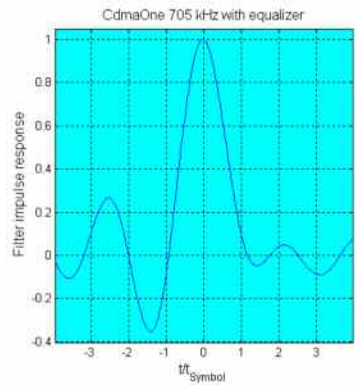
cdmaOne + Equalizer

`SOUR:BB:DM:FILT:TYPE COE`



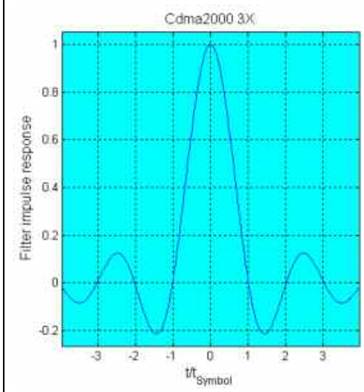
cdmaOne 705 kHz + Equalizer

`SOUR:BB:DM:FILT:TYPE COFE`



cdma2000 3X

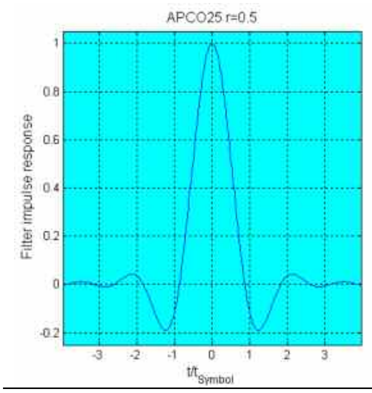
`SOUR:BB:DM:FILT:TYPE DM3x`



APCO25

Roll Off Factor

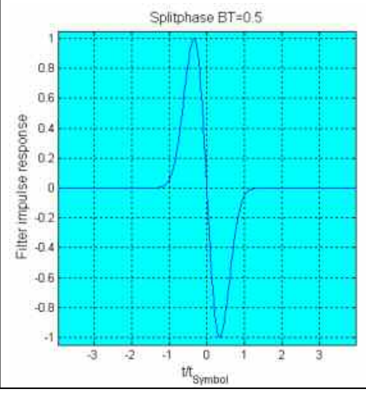
```
SOUR:BB:DM:FILT:TYPE APCO25
SOUR:BB:DM:FILT:PAR:APC 0.5
```



Split Phase

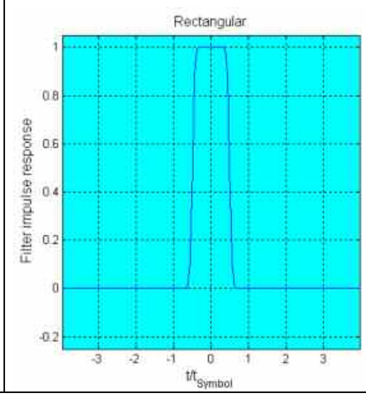
BxT

```
SOUR:BB:DM:FILT:TYPE  SPH
SOUR:BB:DM:FILT:PAR:SPH 0.15
```



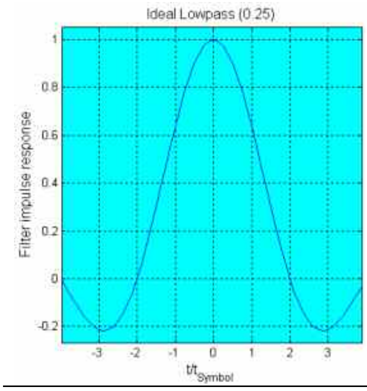
Rectangular

`SOUR:BB:DM:FILT:TYPE RECT`



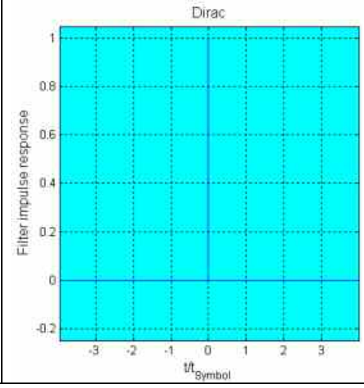
<table>
<tr><td>Lowpass

`SOUR:BB:DM:FILT:TYPE LPASs`



</td><td>Dirac

`SOUR:BB:DM:FILT:TYPE DIRac`



</td></tr>
</table>

User filter

The user filter file must have extention ***.vaf** and can be created with the R&S filter wizard.

The filter wizard (filtwiz) is a tool from Rohde & Schwarz designed for creating filter files that can be imported on a R&S Signal Generator. Its main purpose is the conversion of user-defined finite impulse response (FIR) filters into the filter format (*.vaf).

Beyond this filtwiz provides designs for standard filters (e.g. Root Raised Cosine, Gaussian) as well as a tool to automatically derive a receiver filter from a given transmitter filter with respect to the Nyquist condition for zero intersymbol interference (ISI).

The program was developed on a 32-bit Microsoft Windows platform under MATLAB.

For more information, refer to the description "Introduction to "filtwiz" Filter Editor" on the Rohde&Schwarz Internet page.

Conflicting Settings - Custom Digital Mod

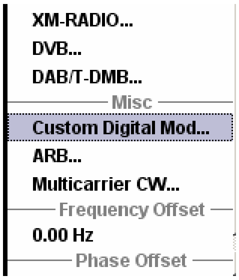
Having selected a modulation procedure, not every combination is possible when selecting the settings for the modulation parameters **Symbol Rate** and **Coding**. These restrictions inevitably give rise to conflicting settings if a parameter is changed and leads to a prohibited combination.

A conflicting setting is indicated by a message on the Info line in the display. The R&S R&S Signal Generator displays the setting entered by the user, but the modulation signal actually generated does not correspond to this display. A conflict of settings can be triggered if the user changes a parameter inappropriately. The message disappears as soon as a conflict-free setting is entered.

A list of the possible settings conflicts and messages in digital modulation can be found in chapter 9 "*Error messages*".

Custom Digital Mod Menu

The menu for setting digital modulation can be opened either in the **Baseband** block or in the menu tree under Baseband.



The **Custom Digital Modulation** menu enables direct selection of the data source, standard, symbol rate, coding, modulation type and filter. All other settings are entered in submenus which are called via **More** buttons.

The upper part of the menu is used for powering up digital modulation as well as for calling the default settings and user-defined standards.

The data source is selected and set in the **Data Source** section.

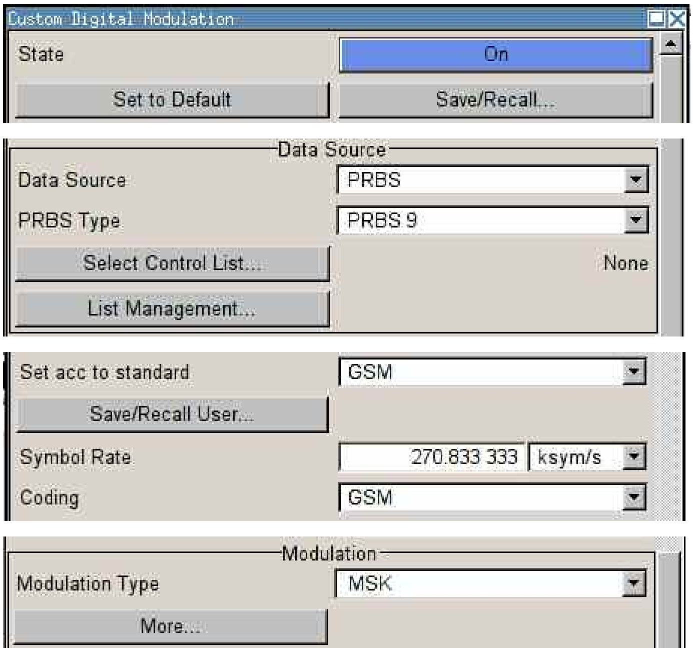
The **List Management** button opens a submenu for calling the data editor and the file manager.

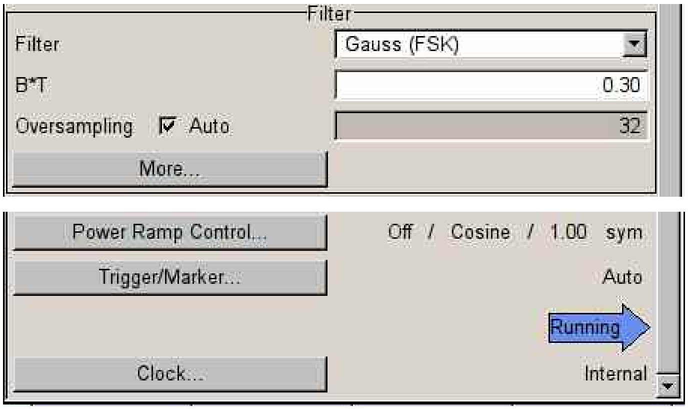
The middle part of the menu is used for selecting the standard, the symbol rate and the coding.

The modulation type is set in the **Modulation** section. The **More** button opens a submenu that displays the mapping for the selected modulation. This submenu can also be used to enable switching an RF signal between modulated and unmodulated.

The filter is set in the **Filter** section. The **More** button opens a submenu where the filter characteristic of the selected filter is displayed. The buttons in the lower part of the menu open submenus for power ramping and for configuring triggers and clocks.

In each case the current setting is displayed next to the button.





Custom Digital Modulation Main Menu

The upper part of the menu is used for powering up digital modulation as well as for calling the default settings and user-defined standards.

State - Digital Modulation

Enables/disables digital modulation.

Switching on digital modulation turns off all the other digital standards.

The digital modulation is generated in realtime (no precalculated signal), and therefore all parameter changes (in the ON state) directly affect the output signal.

Remote-control command:
`SOUR:BB:DM:STAT ON`

Set To Default - Digital Modulation

Calls default settings. The values are shown in the following table.

Remote-control command:
`SOUR:BB:DM:PRES`

Parameter	**Value**
State	Not affected by Set to Default
Data Source	PRBS 9
Standard	GSM
Symbol Rate	270.833 ksymb/s
Coding	GSM
Modulation Type	MSK
Filter	Gauss (FSK)
Filter Parameter BxT	0.3
Power Ramp Control	
Attenuation	15 dB
Ramp Time	1 sym
Ramp Function	Cosine
Fall Delay	0
Rise Delay	0
Source	Internal
State	Off

Parameter	Value
Trigger	
Mode	Auto
Source	Internal
Ext. Delay	0
Ext. Inhibit	0
Clock	
Sync. Mode	None
Source	Internal
Mode	Symbol

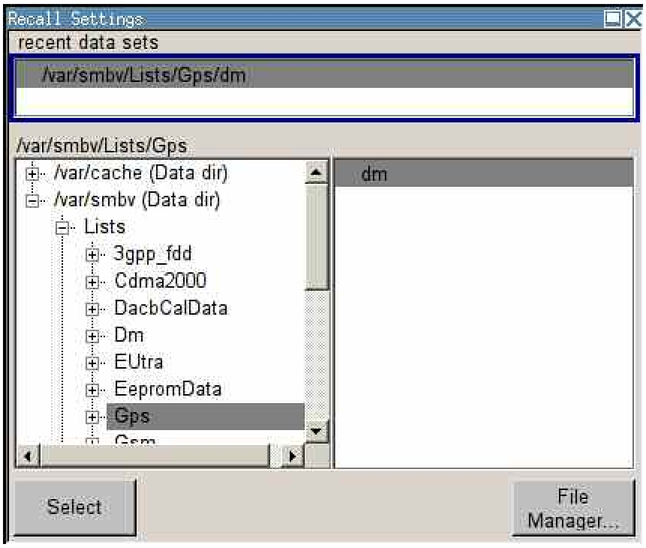
Save/Recall - Digital Modulation

Calls the **Save/Recall** menu.

From the **Save/Recall** menu the **File Select** windows for saving and recalling the complete settings in the **Custom Digital Modulation** menu can be called.

The Digital Modulation Settings are stored as files with the predefined file extension ***.dm**. The file name and the directory they are stored in are user-definable.

The complete settings in the **Custom Digital Modulation** menu are saved and recalled.



Remote-control commands:
`MMEM:MDIR 'var/smbv/dig_mod/sett'`

```
SOUR:BB:DM:SETT:CAT?
SOUR:BB:DM:SETT:DEL
SOUR:BB:DM:SETT:LOAD
SOUR:BB:DM:SETT:STOR
```

The data source is selected and set in the **Data Source** section. The parameters offered depend on the data source selected. The **More** button opens a submenu for calling the data editor and the file manager.

Data Source - Digital Modulation

Selects the data source (see also section "Data and Signal Sources in Baseband", page 4.146).

You may choose from the following data sources:

All 0

All 1

0 data or 1 data is internally generated.

Remote-control command:
`SOUR:BB:DM:SOUR ONE | ZERO`

PRBS

PRBS Type

PRBS data in accordance with the IUT-T with period lengths between 2^9-1 and 2^{23}-1 are internally generated.

The length is selected in the **PRBS Type** input box.

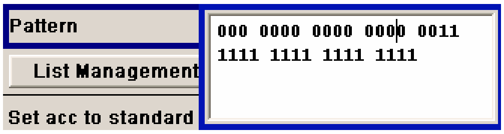
Remote-control commands:
`SOUR:BB:DM:SOUR PRBS`
`SOUR:BB:DM:PRBS 9|11|15|16|20|21|23`

Pattern

Pattern

A user-definable bit pattern with a maximum length of 64 bits is internally generated.

The bit pattern is defined in the **Pattern** input box.



Remote-control command:
`SOUR:BB:DM:SOUR PATT`
`SOUR:BB:DM:PATT #H77550,17`

Data List

...Select Data

Data lists will be used.

Data lists can be generated internally in the data editor or externally.

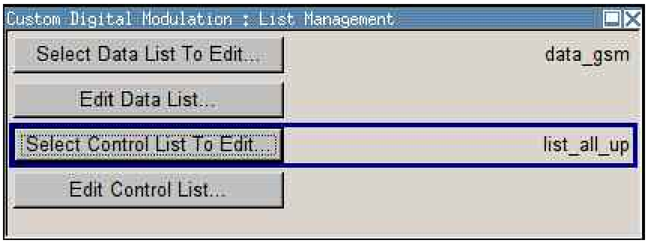
Data lists are selected in the **File Select** window, which is called by means of the **Select Data** button.

The **File Manager** is used to transmit external data lists to the R&S Signal Generator, and can be called within every File Select window by means of the **File Manager** button.

Remote-control command:
`SOUR:BB:DM:SOUR DLIS`
`SOUR:BB:DM:DLIS:SEL "d_list1"`

List Management - Digital Modulation

Calls the menu for managing data and control lists (see section "List Management - Digital Modulation Menu", page 4.175).



Remote-control command: n.a.

The middle part of the menu is used for selecting the standard, the symbol rate and the coding.

Set acc. to Standard - Digital Modulation

Selects a standard.

After selection, modulation parameters **Modulation Type**, **Symbol Rate**, **Filter** and **Coding** are automatically set in accordance with the standard.

If one of these parameters is subsequently altered, the display changes to User. The User setting can be saved to a file so that it can be recalled at some later time (**Save/Recall User..** button).

The following table shows the standards that are available, together with the associated settings of the modulation parameters.

Remote-control command:
`SOUR:BB:DM:STAN PDC`

Table 4-3 Standards - Custom Digital Modulation

Standard	**Modulation**	**Symbol Rate**	**Filter**	**Coding**	**Parameter for IEC command**
Bluetooth	2FSK, Deviation 160.0 kHz	1.0 Msym/s	Gauss, B*T = 0,5	OFF	BLUetooth
DECT	2FSK, Deviation 288.0 kHz	1.152 Msym/s	Gauss, B*T = 0,5	OFF	DECT
ETC (ARIB STD T55)	ASK, ASK Depth 100%	1.024 Msym/s	Split Phase, B*T = 2.0	OFF	ETC
GSM	MSK	270.833333 ksym/s	Gauss, B*T = 0.3	GSM	GSM
GSM EDGE	8PSK EDGE (3pi/8 8PSK)	270.833333 ksym/s	Gauss linear	OFF	GSMEdge
NADC	pi/4 DQPSK	24.3 ksym/s	SQR COS, α = 0.35	NADC	NADC
PDC	pi/4 DQPSK	21.0 ksym/s	SQR COS, α = 0.50	PDC	PDC
PHS	pi/4 DQPSK	192.0 ksym/s	SQR COS, α = 0.50	PHS	PHS
TETRA	pi/4 DQPSK	18.0 ksym/s	SQR, α = 0.35	TETRA	TETRa
WCDMA 3GPP	QPSK 45° Offset	3.84 Msym/s	SQR, α = 0.22	WCDMA 3GPP	W3GPp
TD-SCDMA	QPSK 45° Offset	1.28 Msym/s	WCDMA 0.22	OFF	TCSCdma
cdma2000 Forward	QPSK	1.2288 Msym/s	cdmaOne + Equalizer	cdma2000	CFORward
cdma2000 Reverse	Offset QPSK	1.2288 Msym/s	cdmaOne	cdma2000	CREVerse
Worldspace	QPSK	1.84 Msym/s	SQR COS, α = 0.40	OFF	WORLdspace
TFTS	pi/4 DQPSK	22.1 ksym/s	SQR COS, α = 0.40	TFTS/ TETRA	TFTS

Save/Recall User - Digital Modulation

Calls the **Save/Recall User** menu.

From the **Save/Recall** menu the **File Select** windows for saving and recalling user-defined standards and the **File Manager** can be called.

User standards are stored as files with the predefined file extension ***.dm_stu**. The file name and the directory they are stored in are user-definable.

Remote-control commands:
`MMEM:MDIR 'var/smbv/gen_lists/dm'`

```
SOUR:BB:DM:STAN:ULIS:CAT?
SOUR:BB:DM:STAN:ULIS:DEL
SOUR:BB:DM:STAN:ULIS:LOAD
SOUR:BB:DM:STAN:ULIS:STOR
```

Symbol Rate - Digital Modulation

Selects the symbol rate.

The value range is dependent on the selected modulation type.

When the modulation type changes, the range is automatically redefined. If the set symbol rate is outside this range, an error message is generated and the maximum value for the newly chosen modulation type is automatically set.

Remote-control command:
`SOUR:BB:DM:SRAT 15 MHz`

Coding - Digital Modulation

Selects the coding (see section "Coding - Custom Digital Mod", page 4.158).

The menu offers only the coding settings that are permissible for the chosen modulation type. The other coding methods are grayed out.

If the system is subsequently switched to a modulation type for which the selected coding is not available, coding is automatically set to OFF.

Remote-control command:
`SOUR:BB:DM:COD`

The modulation type is set in the **Modulation** section. The parameters offered depend on what is currently selected. The **More...** button opens a submenu for displaying the user-defined mapping.

Modulation Type - Digital Modulation

Selects a modulation type.

The associated symbol mapping is displayed in the **More...** submenu (see also table Modulation type and associated mapping*, page 4.154*).

If the coding that is set is not possible with the chosen modulation type, **coding** is set to **Off**.

You may choose from the following:

ASK, the PSK modulations BPSK, QPSK, QPSK 45° Offset, OQPSK, QPSK EDGE, pi/4-QPSK, pi/2-DBPSK, pi/4-DQPSK, pi/8-D8PSK, 8PSK, 8PSK EDGE, the QAM modulations 16QAM to 1024QAM, 16QAM EDGE, 32QAM EDGE and the FSK modulations MSK, 2FSK , 4FSK, as well as Variable FSK.

For selection "Variable FSK", the deviation of each symbol can be set in the **More...** submenu.

Remote-control command:
`SOUR:BB:DM:FORM ASK`

Load User Mapping - Digital Modulation

Selects user defined mapping table. This opens the **Select List File User Mapping** window in which the mapping table can be selected (see *"*User Mapping*"*).
The button is only available if modulation type **USER** is selected.

Remote-control command:
```
SOUR:BB:DM:FORM USER
SOUR:BB:DM:MLIS:SEL "d_mod_list1"
```

The button **File Manager** calls the **File Manager** menu. The **File Manager** menu is used to display and delete files.

Remote-control command:
```
MMEM:MDIR 'var/smbv/gen_lists/dm'

SOUR:BB:DM:MLIS:CAT?
SOUR:BB:DM:MLIS:DEL m_list1
```

ASK Depth - Digital Modulation

Sets the modulation depth for ASK modulation.

Remote-control command:
`SOUR:BB:DM:ASK:DEPT 100 PCT`

FSK Deviation - Digital Modulation

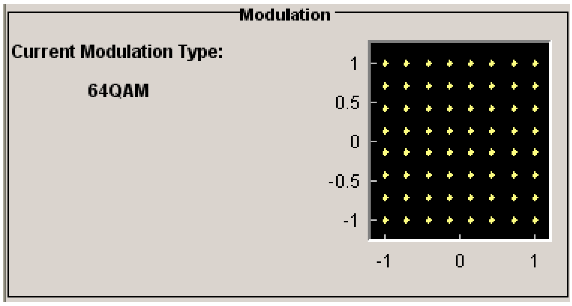
Sets the frequency deviation for FSK modulation. The range of values depends on the chosen symbol rate (see data sheet).

Whenever **MSK** is selected, the deviation corresponds to 1/4 of the symbol rate and cannot be set.

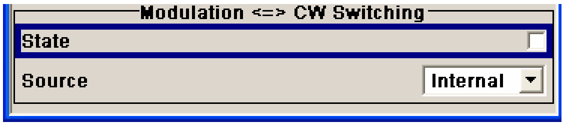
Remote-control command:
`SOUR:BB:DM:FSK:DEV 5 Hz`

More - Modulation Type - Digital Modulation

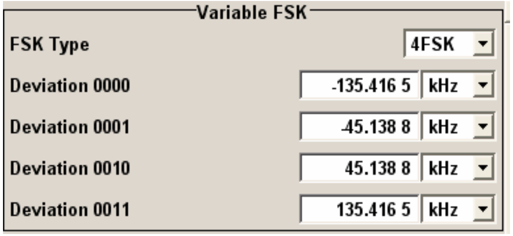
Calls the submenu which displays the mapping of the currently selected modulation type and the digital modulation delay in the case of an external data source.



The **Modulation - CW Switching** section can be used to enable switching a signal between modulated and unmodulated.



In case of selection **Variable FSK**, the FSK type and the deviation for each symbols is set in the **Variable FSK** section.



FSK Type - Digital Modulation

(Variable FSK only)

Selects the FSK modulation type for selection **Variable FSK**.

You may choose from 4FSK, 8FSK and 16FSK.

Remote-control command:
`SOUR:BB:DM:FSK:VAR:TYPE FSK8`

Deviation xxxx - Digital Modulation

(Variable FSK only)

Set the deviation of the associated symbol. The number of symbols depends on the selected modulation type. The value of each symbol is indicated in binary format.

Remote-control command:
`SOUR:BB:DM:FSK:VAR:SYMB2:DEV 13E3`

Modulation Delay - Digital Modulation

(Data Source ext serial only)

Displays the digital modulation delay from the data input to the I/Q output.

The value is displayed only if an external synchronous data source is selected. In this case the value represents the delay between the active clock edge for data and the corresponding peak I/Q value (associated with this data item) on the I/Q connectors.

Remote-control command:
`SOUR:BB:DM:MDEL?`

Current Modulation Type - Digital Modulation

Displays the currently selected modulation type together with its associated mapping.

Remote-control command: n.a.

The **Modulation ⇔ CW Switching** section is used to enable switching between modulated and unmodulated.

State Mod - CW - Digital Modulation

Enables switching between a modulated and an unmodulated RF signal.

Switching is carried out by a control signal (CW) that is defined internally in the control list or supplied from an external source via a user-defined input.

Remote-control command:

```
SOUR:BB:DM:SWIT:SOUR INT
SOUR:BB:DM:CLIS:SEL 'CLIST1'
SOUR:BB:DM:SWIT:STAT ON
SOUR:BB:DM:SWIT:SOUR EXT
SOUR:BB:DM:SWIT:STAT ON
```

Source Mod - CW - Digital Modulation

Selects the CW control signal for switching between a modulated and an unmodulated signal.

Internal

The CW signal in the control list is used for the control.

Remote-control command:
`SOUR:BB:DM:SWIT:SOUR INT`

The filter is set in the **Filter** section.

Filter - Digital Modulation

Selects the baseband filter (see also section "Baseband Filter - Custom Digital Mod", page 4.161).

Remote-control command:
`SOUR:BB:DM:FILT:TYPE COS`

Filter Parameter - Digital Modulation

Sets the filter parameter.

The filter parameter offered (Roll Off Factor or B x T) depends on the currently selected filter type.

Remote-control commands:
```
SOUR:BB:DM:FILT:PAR:APCO25 0.2
SOUR:BB:DM:FILT:PAR:COS 0.35
SOUR:BB:DM:FILT:PAR:GAUS 0.5
SOUR:BB:DM:FILT:PAR:PGA 0.5
SOUR:BB:DM:FILT:PAR:RCOS 0.35
SOUR:BB:DM:FILT:PAR:SPH 2
SOUR:BB:DM:FILT:PAR?
```

Cut Off Frequency Factor - Digital Modulation

(available for filter parameter Lowpass only.)

Sets the value for the cut off frequency factor. The cut off frequency of the lowpass filter can be adjusted to reach spectrum mask requirements.

Remote-control command:
```
SOUR:BB:DM:FILT:PAR:LPAS 0.5
```

More - Filter - Digital Modulation

Calls the menu for displaying the filter characteristic of the currently selected filter.

Load User Filter- Filter - Digital Modulation

Calls the menu **Select List File User Filter** for selecting a user-defined filter file with extension *.vaf (see "User filter").
The button is only available if filter type **USER** is selected.

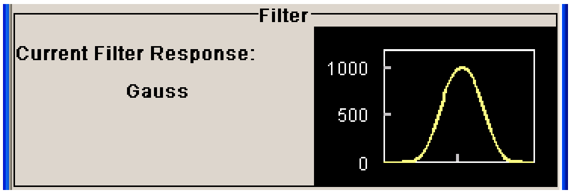
Remote-control command:
```
SOUR:BB:DM:FILT:TYPE USER
SOUR:BB:DM:FLIS:SEL user_filter3
```

The button **File Manager** calls the **File Manager** menu. The **File Manage**r menu is used to display and delete files.

Remote-control command:
```
MMEM:MDIR 'var/smbv/gen_lists/dm'
SOUR:BB:DM:FLIS:CAT?
SOUR:BB:DM:FLIS:DEL user_filter3
```

Current Filter Response

Displays the filter characteristic of the currently selected filter.



Remote-control command: n.a.

The lower part of the **Custom Digital Modulation** menu is used for setting triggers and clocks, as well as for power ramp settings.

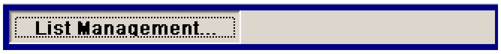
Power Ramp Control - Digital Modulation	Calls the power ramp control menu (see section "Power Ramp Control - Digital Modulation Menu", page 4.183). Remote-control command: n.a.
Trigger/Marker - Digital Modulation	Calls the **Trigger/Marker/Clock** menu. The **Trigger/Marker/Clock** menu is used to select the trigger source, set the time delay on an external trigger signal and configure the marker output signals (see section "Trigger/Marker/Clock - Custom Digital Modulation Menu", page 4.184). Remote-control command: n.a.

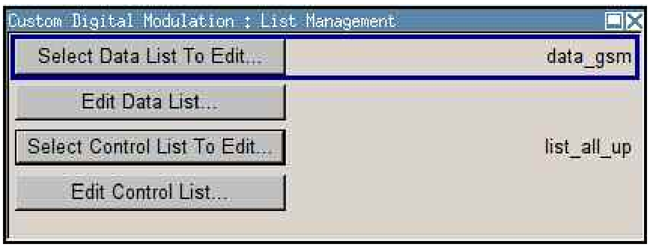
Execute Trigger - Digital Modulation	Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than Auto have been selected.
	
	Remote-control commands:
	`SOUR:BB:DM:TRIG:SOUR INT`
	`SOUR:BB:DM:SEQ RETR`
	`SOUR:BB:DM:TRIG:EXEC`

Clock - Digital Modulation	Calls the **Trigger/Marker/Clock** menu. The **Trigger/Marker/Clock** menu is used to select the clock source (see section "Trigger/Marker/Clock - Custom Digital Modulation Menu", page 4.184). Remote-control command: n.a.

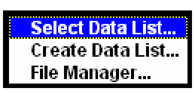
List Management - Digital Modulation Menu

The **List Management** menu is called from the **Digital Modulation** main menu.





The data and control lists are selected and created in the **File Select** menu which is called up by means of the **Data List...** and **Control List...** buttons.



The **File Manager** is used to copy, rename and delete files and to create directories (see also Chapter 3, section "*File Management*").

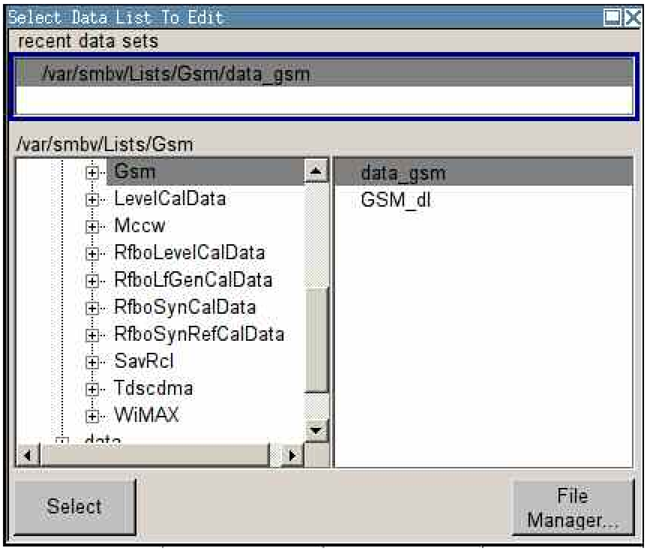
To ensure that the selected data or control list is used for generating the digital signal, the list must be selected as the data source:

Data	Parameter	Selection
Digital data	Source:	DList
Marker	Marker Mode:	CList
Control signals CW, Level Attenuation and Burst Gate	Source	Internal

The data editor is called using the **Edit Data List...** and **Edit Control List...** buttons. The contents of the selected list are displayed. Operating the list editors is described in Chapter 3, section "*List Editors*".

Select Data/Control List - Digital Modulation

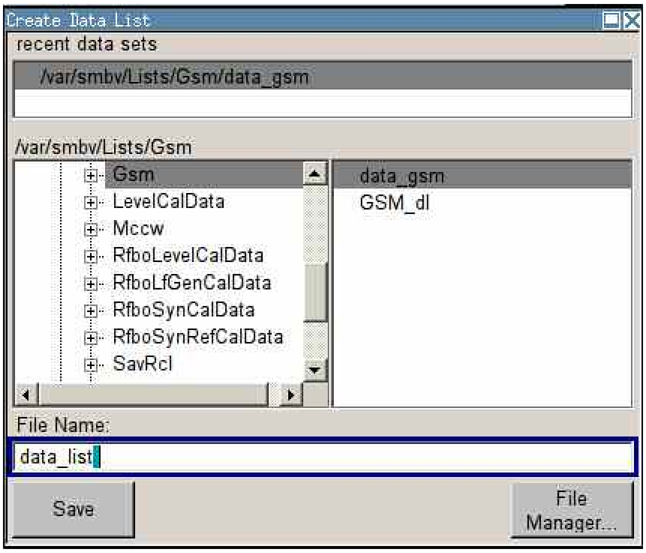
Selects data/control list. This opens the **File Select** window in which the data/control list can be selected.



Remote-control commands:
`SOUR:BB:DM:DLIS:SEL "d_list1"`
`SOUR:BB:DM:CLIS:SEL "c_list3"`

Create Data/Control List - Digital Modulation

Creates new data/control list. This opens the **File Select** window in which the data/control list can be created.



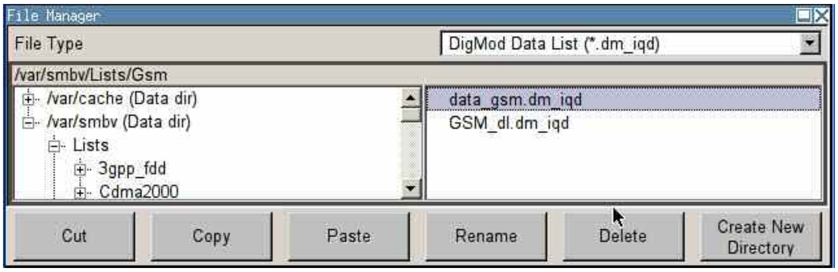
The file name has to be entered in field **File Name:**. The new list contains no data, it can be edited in the list editor.

Remote-control commands:
`SOUR:BB:DM:DLIS:SEL "d_list1"`
`SOUR:BB:DM:CLIS:SEL "c_list3"`

File Manager - Digital Modulation

Calls the **File Manager**.

The File Manager is used to copy, delete and rename files and to create new directories.



Remote-control commands:

```
SOUR:BB:DM:DLIS:SEL "d_list1"
SOUR:BB:DM:DLIS:COPY "D_list2"
SOUR:BB:DM:DLIS:DEL "c_list1"
SOUR:BB:DM:CLIS:SEL "c_list3"
SOUR:BB:DM:CLIS:COPY "c_list2"
SOUR:BB:DM:CLIS:DEL "c_list1"
MMEM:MDIR "var/smbv/user/new"
```

Data List Editor - Digital Modulation

The **Data List Editor** for editing the selected data list is called up in the **List Management** submenu of the **Custom Digital Modulation** main menu by means of the **Edit Data List...** button. Chapter 3, Section "*List Editor*" describes how to use the editor.

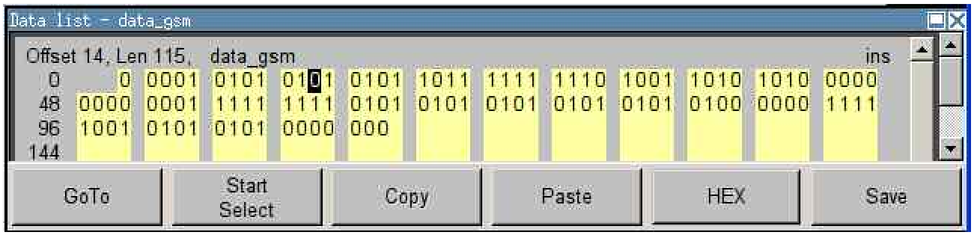
A list of binary values with a maximum length of 2^31 bits can be entered in the **Data List Editor**. This value corresponds to a file size of approx. 268 Mbyte.

To increase readability, the bits are displayed in groups of four. The current cursor position, the length of the list and the list file name are displayed above the list. The offset starts with the value 0 which corresponds to the bit position on the left side of the first row, i.e. the beginning of the list. On the left edge of the editor, the last three offset positions are specified at the beginning of the row.

An existing list can be edited in the insert or overwrite mode.

Remote-control commands:

```
SOUR:BB:DM:DLIS:SEL "d_list1"
SOUR:BB:DM:DLIS:DATA 1,1,0,1,0,1,0,1,1,1,1,0,0,0
SOUR:BB:DM:DLIS:DATA:APP 1,1,0,1,0,1,0,1,1,1,1,0,0,0
```



GoTo - Digital Modulation

Opens the entry window for the bit position. The cursor marks the bit at the selected position.

Remote-control command: n.a.

Start Select - Digital Modulation

Defines the current cursor position as the start position for the range to be marked. The stop position is defined by entering an offset under **GoTo**.

When a start position has been activated, the button will be re-labelled to **Undo Select**. When the button is clicked now, the selected range will be deactivated.

Remote-control command: n.a.

Copy - Digital Modulation

Copies the selected values.

Remote-control command: n.a.

Cut - Digital Modulation

Cuts the selected values.

Remote-control command: n.a.

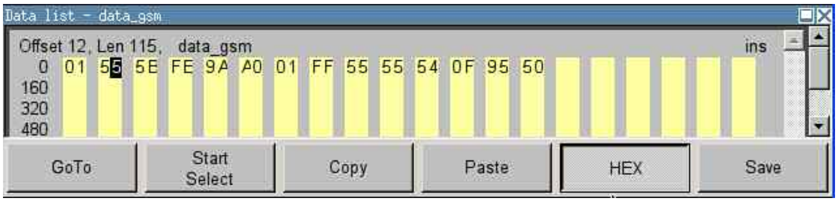
Paste - Digital Modulation

Pastes the values that have been copied or cut before.

Remote-control command: n.a.

Hex - Digital Modulation

Switchover to hexadecimal display.



Each four bits are displayed as a hexadecimal value: To increase readability, the hexadecimal values in turn are displayed in pairs of two. The hex functions are automatically assigned to the numeric keys at the front panel.

Remote-control command: n.a.

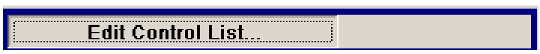
Save (Data List) - Digital Modulation

Saves the changes made to the Data List file selected for editing.

Remote-control command: n.a.

Control and Marker List Editor - Digital Modulation

The **Control and Marker List Editor** for editing the selected control list is called up in the **List Management** submenu of the **Digital Modulation** main menu by means of the **Edit Control List...** button.



The two available marker signals and the CW, Hop, Burst Gate and Level Attenuation control signals can be defined in the **Control and Marker List Editor**.

Note:

*The marker signals defined in the Control and Marker List Editor are activated by selecting the Marker mode **"CList"** in the **Trigger/Marker/Clock** menu.*
*The control signals have to be activated by selecting an "**Internal**" **Source** in the respective setting menu, e.g. the **Power Ramp Control** menu for the Burst Gate and Level Attenuation control signals.*

The configuration of the currently selected control list is displayed. This list is either selected in the **File Select** menu (**List Management** submenu by means of the **Control List...** button) or via

Remote-control commands:
```
SOUR:BB:DM:CLIS:SEL "c_list3"
SOUR:BB:DM:CLIS:DATA 0,8,8,8,8,8,8,0,0,0,...
```

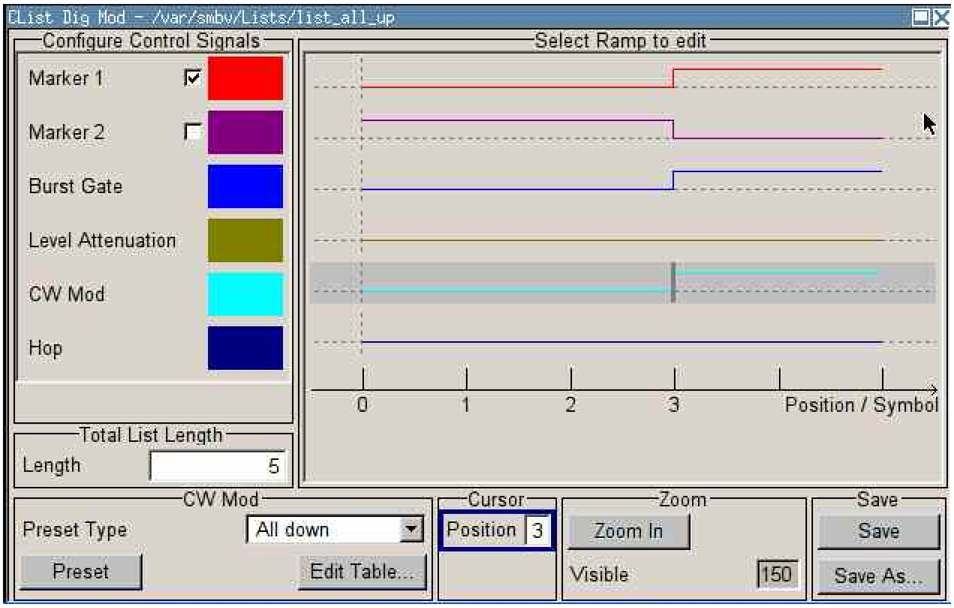
The available marker/control signals are color-coded. In the left **Configure Control Signal** section, each individual signal is assigned a colour; a check in the check box shows the marker for which the "**CList**" marker type has been selected and the control signal for which the "**Internal**" source has been selected.

In the **Select Ramp to Edit** section the signal characteristics are graphically displayed. The scaling of the x-axis is always adapted to the overall length of the control list to provide constant overview of all defined ramps.

The ramps can be assigned the exact bit position in the signal by means of

- The bit scale below the marker/control signal characteristic.
- The display of the current cursor position in the **Cursor** menu section if the cursor marks the ramp.

The ramps can be set either graphically in the **Select Ramp to Edit** section or in the table of the **Positions** <**Signal>** section in the lower right corner. To make the setting easy, a selection of preset ramp characteristics is offered in the **Preset Ramp <Signal>** section.



Configure Control Signal - Digital Modulation

Displays the colour the marker/control signal has been assigned.

Displays whether the "**CList**" marker type has been selected in the Trigger/Marker/Clock menu for this marker.

Displays whether the "**Internal**" source has been selected for this control signal in the individual setting menu. Burst Gate and Level Attenuation are set in the **Power Ramping** submenu, CW in the **Modulation** submenu.

The source "**CList/Internal**" for the individual marker/control signal can be selected here as well and will then be used in the associated menus.

Remote-control command: n.a.

Select Ramp to Edit - Digital Modulation

Graphically edit marker/control signals.

For this purpose, the cursor is set to the position where a ramp is required. The ramp is generated by pressing Enter (e.g. clicking on the rotary knob). Any number of ramps can be defined per marker. Each of the generated ramp positions will be saved even if the definition of another ramp produces a low/low or high/high transition. These ramps are displayed as dashed lines.

Existing ramps can be shifted after the cursor has been placed on the ramp and Enter has been pressed - it then changes colour twice. The ramp is shifted by using the cursor keys or the rotary knob. The new position is determined by pressing Enter again.

Ramps can be deleted by means of the BACK-SPACE key after the cursor has been placed on the ramp.

Chapter 3 describes how to operate the control and marker list editor in detail.

Remote-control command: n.a.

Total List Length - Digital Modulation

Enters the length of the definition range of the control list in bits. The starting value is always bit 0. The entire definition range is displayed, i.e. the bit scale is adapted to the entry.

With very long control lists, the displayed area can be zoomed to approx. 300 bits around the current cursor position (**Zoom in** button).

The preset functions set the ramp in the center of the currently selected area.

If the definition range is decreased, the ramps outside the range are lost.

When used, the control list is always repeated over the length of the definition range if the length of the data list exceeds the length of the control list.

Remote-control command: n.a.

Preset Ramp - Digital Modulation

Activates presetting for the ramp characteristic of the selected control signal. The presetting is selected with **Select Preset Type** and activated by means of the **Preset** button.

Remote-control command: n.a.

You can select from:

All Up	The marker/control signal is continuously high.
All Down	The marker/control signal is continuously low.
Ramp Up	The marker/control signal contains a ramp from low to high. The ramp is shifted to the center of the displayed signal area and can subsequently be shifted as required.
Ramp Down	The marker/control signal contains a ramp from high to low. The ramp is shifted to the center of the displayed signal area and can subsequently be shifted as required.
Ramp Up/Down	The marker/control signal contains a ramp from low to high and from high to low. The ramps are symmetrically shifted around the center of the displayed signal area and can subsequently be shifted as required.
Ramp Down/Up	The marker/control signal contains a ramp from high to low and from low to high. The ramps are symmetrically shifted around the center of the displayed signal area and can subsequently be shifted as required.

Cursor Position - Digital Modulation

Enters the cursor position.

In the graphic display, the cursor is positioned according to the entry.

Vice versa, graphically shifting the cursor will change the displayed value.

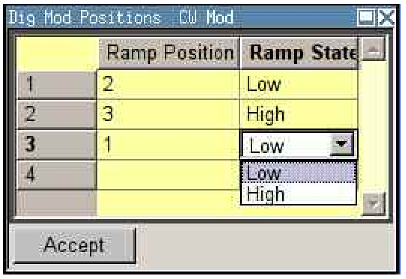
If the entered value exceeds the selected length of the definition range, the length is adjusted automatically.

Remote-control command: n.a.

Positions Control Signal - Digital Modulation

Opens table by using the **Edit Table ..** button.

The ramps of the selected signal can be edited in the table. When the table is opened, the current configuration of the selected marker/control signal is displayed.



The bit position is specified in the **Ramp Position** column, the high or low signal status in the **Ramp State** column. At the end of the list, there is always a blank row for entering new values.

The changes are accepted in the graphic display after pressing the **Accept** button.

Remote-control command: n.a.

Zoom - Digital Modulation

Zooms the displayed area of the control list. The designation of the button changes from **Zoom in** to **Zoom out**.

With very long control lists, the displayed area can be zoomed to approx. 300 bits around the current cursor position.

Ramps outside the displayed area are not lost by zooming.

Parameter Symbols visible sets the symbols to be displayed.

Remote-control command: n.a.

Save/Save As - Digital Modulation

Pressing the **Save** button saves the changes made to the CList file selected for editing.

Selecting the **Save As** button creates a new control list.
This opens the **Create Lists Files Which Name?** window in which the control list can be created.
The file name has to be entered in field **File Name.**

Remote-control command: n.a.

Power Ramp Control - Digital Modulation Menu

The Power Ramp Control menu is accessed via the **Digital Modulation** main menu.

The menu is used to set the power ramping. Control signals **Burst** and **Lev_Att** are used to control power ramping (see also section "Power Ramping and Level Attenuation", page 4.151).

Note:

Power ramping is possible up to a symbol rate of 5 MHz. If a higher symbol rate is set, power ramping is automatically switched off and an error message is output.

State - Power Ramp Control - Digital Modulation

Enables/disables power ramping.

Remote-control command:
`SOUR:BB:DM:PRAM:STAT ON`

Source - Power Ramp Control - Digital Modulation

Enters the source for the power ramp control signals.

Internal

The control signals in the internal control list are used for control purposes.

Remote-control command:
`SOUR:BB:DM:PRAM:SOUR INT`

Ramp Function - Digital Modulation

Enters the form of the transmitted power, i.e. the shape of the rising and falling edges during power ramp control.

Linear

The transmitted power rises and falls linear fashion.

Remote-control command:
`SOUR:BB:DM:PRAM:SHAP LIN`

Cosine

The transmitted power rises and falls with a cosine-shaped edge. This gives rise to a more favorable spectrum than the **Linear** setting.

Remote-control command:
`SOUR:BB:DM:PRAM:SHAP COS`

Ramp Time - Digital Modulation

Enters the power ramping rise time and fall time for a burst. The setting is expressed in symbols.

Remote-control command:
`SOUR:BB:DM:PRAM:TIME 2.5`

Rise Delay - Power Ramp Control - Digital Modulation

Sets the offset in the rising edge of the envelope at the start of a burst. A positive value gives rise to a delay (the envelope length decreases) and a negative value causes an advance (the envelope length increases). The setting is expressed in symbols.

Remote-control command:
`SOUR:BB:DM:PRAM:RDEL -1`

Fall Delay - Power Ramp Control - Digital Modulation

Sets the offset in the falling edge of the envelope at the end of a burst. A positive value gives rise to a delay (see figure), the envelope length increases) and a negative value causes an advance (the envelope length decreases). The setting is expressed in symbols.

Remote-control command:
`SOUR:BB:DM:PRAM:FDEL -1`

Attenuation - Power Ramp Control - Digital Modulation

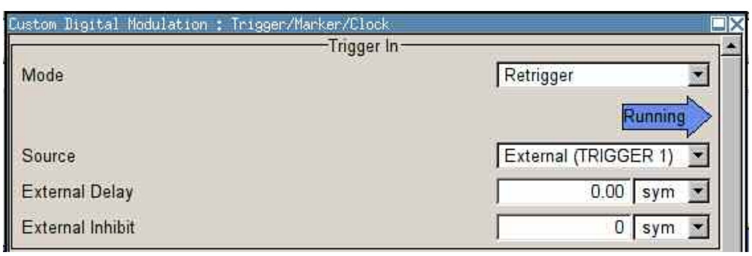
Sets the level attenuation relative to the average level for the signal ranges in which the level is set to **attenuated** (LEV_ATT control signal).

The LEV_ATT control signal is defined in the **Control Data Editor**.

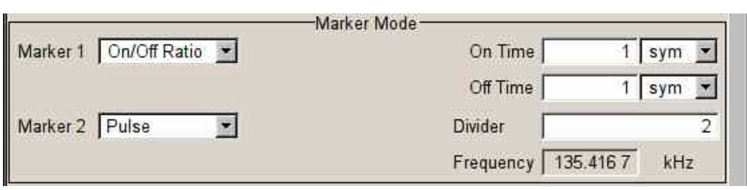
Remote-control command:
`SOUR:BB:DM:PRAM:ATT 15 dB`

Trigger/Marker/Clock - Custom Digital Modulation Menu

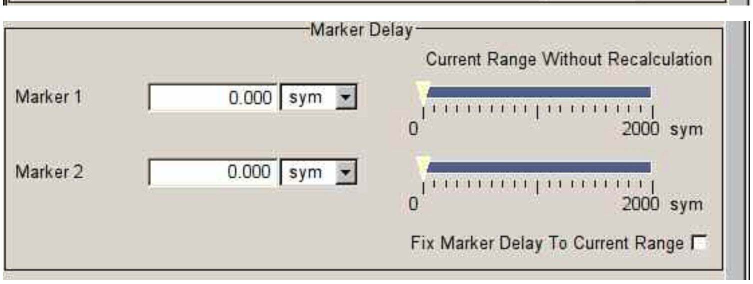
The Trigger menu is accessed via the **Digital Modulation** main menu.



The **Trigger In** section is where the trigger for the modulation signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation (Running or Stopped) is indicated for all trigger modes.



The **Marker Mode** section is where the marker signals at the MARKER output connectors are configured.



The **Marker Delay** section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e. the section in which it is possible to make settings without restarting signal and marker generation.

The **Clock Settings** section is where the clock source is selected and - in the case of an external source - the clock type.

The **Global Trigger/Clock Settings** button leads to a submenu for general trigger, clock and external input settings.

The **Trigger In** section is used to configure the trigger signal for the digital modulation. The current status of signal generation is indicated for all trigger modes.

Trigger Mode - Digital Modulation

Selects trigger mode.

Auto

The digital modulation signal is generated continuously.

Remote-control command:
`SOUR:BB:DM:SEQ AUTO`

Retrigger

The digital modulation signal is generated continuously. A trigger event (internal with **Execute Trigger** or external) causes a restart.

This trigger mode is set automatically for each slave instrument configured to work in a synchronous mode (see *"Synchronous Signal Generation"*, on page *4.149*).

Remote-control command:
`SOUR:BB:DM:SEQ RETR`

Armed_Auto

The digital modulation signal is generated only when a trigger event occurs. Then the digital modulation signal is generated continuously.

Button **Arm** stops signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:DM:SEQ AAUT`

Armed_Retrigger

The digital modulation signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

The button **Arm** stops signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:DM:SEQ ARET`

Single

The digital modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at **Signal Duration**. Every subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:DM:SEQ SING`

Trigger Signal Duration - Digital Modulation

Enters the length of the signal sequence to be output in the **Single** trigger mode. The input is to be expressed in symbols.

Remote-control commands:
`SOUR:BB:DM:TRIG:SLEN 200`

Running - Stopped - Digital Modulation

Displays the status of signal generation for all trigger modes. This display appears only when Custom Dig Mod is enabled (**State On**).

Remote-control command:
`SOUR:BB:DM:TRIG:RMOD?`
Response: `RUN` or `STOP`

Running

The digital modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode.

If Armed_Auto and Armed_Retrigger have been selected, generation of signals can be stopped with the **Arm** button. A new trigger (internally with **Execute Trigger** or externally) causes a restart.

Stopped

The signal is not generated, and the instrument waits for a trigger event (internal or external).

Arm - Digital Modulation

Stops signal generation. This button appears only with **Running** signal generation in the **Armed_Auto** and **Armed_Retrigger** trigger modes.

Signal generation can be restarted by a new trigger (internally with **Execute Trigger** or externally).

Remote-control command:
`SOUR:BB:DM:TRIG:ARM:EXEC`

Execute Trigger - Digital Modulation

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than **Auto** have been selected.

Remote-control commands:
`SOUR:BB:DM:TRIG:SOUR INT`
`SOUR:BB:DM:SEQ RETR`
`SOUR:BB:DM:TRIG:EXEC`

Trigger Source - Digital Modulation

Selects trigger source.

Internal

The trigger event is executed by **Execute Trigger**. As a precondition a trigger mode other than **Auto** must be selected.

Remote-control command:
`SOUR:BB:DM:TRIG:SOUR INT`

External (TRIGGER 1)

The trigger event is executed with the aid of the active edge of an external trigger signal. The trigger signal is supplied via the TRIGGER 1 connector.

The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the **Global Trigger Settings** menu.

This trigger source is set automatically for each slave instrument configured to work in a synchronous mode (see *"Synchronous Signal Generation"*, on page *4.149*).

Remote-control command:
`SOUR:BB:DM:TRIG:SOUR EXT`

External Delay - Digital Modulation

Sets trigger signal delay in symbols on external triggering.

This enables the R&S Signal Generator to be synchronized with the device under test or other external devices.

Remote-control command:
`SOUR:BB:DM:TRIG:EXT:DEL 3`

External Inhibit - Digital Modulation

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in symbols.

In the **Retrigger** mode every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of samples.

This parameter is only available on external triggering.

Remote-control command:
`SOUR:BB:DM:TRIG:EXT:INH 0`

The marker output signal for synchronizing external instruments is configured in the **Marker Settings** section **Marker Mode**.

Marker x - Digital Modulation

Selects a marker signal for the associated MARKER output.

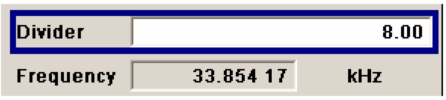
CList

A marker signal that is defined in the selected control list is generated.

Remote-control commands:
`SOUR:BB:DM:TRIG:OUTP1:MODE CLIS`
`SOUR:BB:DM:CLIS:SEL 'control_dm'`

Pulse

A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the sample rate by the divider. The input box for the divider opens when **Pulse** is selected, and the resulting pulse frequency is displayed below it.



Remote-control commands:
`SOUR:BB:DM:TRIG:OUTP1:MODE PULS`
`SOUR:BB:DM:TRIG:OUTP1:PULS:DIV 4`
`SOUR:BB:DM:TRIG:OUTP1:PULS:FREQ?`

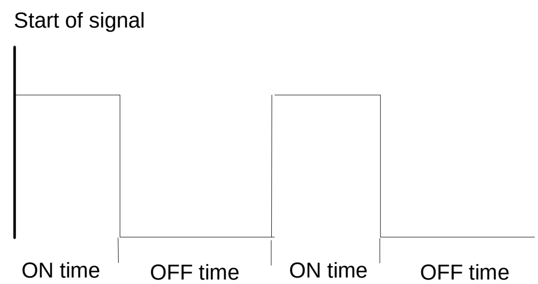
Pattern

A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when **pattern** is selected.

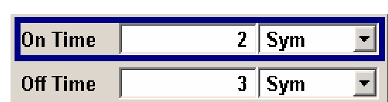
Remote-control commands:
`SOUR:BB:DM:TRIG:OUTP1:MODE PATT`
`SOUR:BB:DM:TRIG:OUTP1:PATT #B1111,4`

ON/OFF ratio

A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.



The ON time and OFF time are each expressed as a number of symbols and are set in an input field which opens when **ON/OFF ratio** is selected.



Remote-control commands:
`SOUR:BB:DM:TRIG:OUTP1:MODE RAT`
`SOUR:BB:DM:TRIG:OUTP1:OFFT 20`
`SOUR:BB:DM:TRIG:OUTP1:ONT  20`

The **Marker Delay** section can be used to set a delay for the markers.

Marker x Delay - Digital Modulation

Enters the delay between the marker signal at the marker outputs and the start of the signal.

The input is expressed as a number of symbols.

If the setting "**Fix marker delay to dynamic range**" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals can be set without restarting the marker and signal.

The allocation of marker signals to the outputs is described in the section "Marker Output Signals", page 4.152.

Remote-control command:
`SOUR:BB:DM:TRIG:OUTP2:DEL 20`

Current Range without Recalculation - Digital Modulation

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

Remote-control command:
`SOUR:BB:DM:TRIG:OUTP:DEL:MAX?`
`SOUR:BB:DM:TRIG:OUTP:DEL:MIN?`

Fix marker delay to current range - Digital Modulation

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

Remote-control command:
`SOUR:BB:DM:TRIG:OUTP:DEL:FIX ON`

The clock source is selected in the **Clock Settings** section.

Sync. Mode - Digital Modulation

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

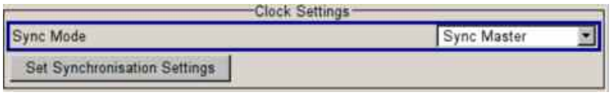
Note:
If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.
Avoid unnecessary cable length and branching points.

None The instrument is working in stand-alone mode.

Remote-control command:
`SOUR:BB:DM:SYNC:MODE NONE`

Sync. Master

The instrument provides all connected instrument with its synchronization clock (including the trigger signal) and reference clock signal.



Remote-control command:
`SOUR:BB:DM:SYNC:MODE MAST`

Sync. Slave

The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

Remote-control command:
`SOUR:BB:DM:SYNC:MODE SLAV`

Set Synchronization Settings - Digital Modulation

Performs automatically adjustment of the instrument's settings required for the synchronization mode, selected with the parameter **Synchronization Mode** (see *"Synchronous Signal Generation"*, on page *4.149*).

The status of the external clock source is displayed (see **Synchronisation State**).

Remote-control command:
`SOUR:BB:DM:SYNC:EXEC`

Clock Source - Digital Modulation

Selects the clock source (also see section "Clock Signals", page 4.148).

Internal

The internal clock reference is used.

Remote-control command:
`SOUR:BB:DM:CLOC:SOUR INT`

External

The external clock reference is fed in as the symbol clock via the REF IN connector.

The chip rate must be correctly set to an accuracy of ± 2 % (see data sheet).

The polarity of the clock input can be changed with the aid of **Global Trigger/Clock/External Input** Settings.

Remote-control command:
`SOUR:BB:DM:CLOC:SOUR EXT`

Clock Mode - Digital Modulation

Enters the type of externally supplied clock.

Symbol

A symbol clock is supplied via the CLOCK connector.

Remote-control command:
`SOUR:BB:DM:CLOC:MODE SYMB`

Multiple Symbol A multiple of the symbol clock is supplied via the CLOCK connector, the symbol clock is derived internally from this.

Remote-control command:
`SOUR:BB:DM:CLOC:MODE MSYM`

Measured External Clock - Digital Modulation

Displays the measured frequency of the external clock signal. This enables the user to permanently monitor the frequency of the externally introduced clock.

This information is displayed only if the external clock source has been selected.

Remote-control command:
`CLOC:INP:FREQ?`

Synchronisation State - Digital Modulation

For instruments working in slave synchronization mode, this parameter displays the status of the external clock source, i.e. whether the external clock source of the slave instrument is synchronized or not synchronized yet.

Remote-control command: n.a.

Global Trigger/Clock/Input Settings - Digital Modulation

Calls the **Global Trigger/Clock/Input Settings** menu. This menu is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

The parameters in this menu affect all digital modulations and standards, and are described in the section "*Global Trigger/Clock/Input Settings - Setup - Environment*".

Arbitrary Waveform Generator ARB

Introduction - ARB

The Arbitrary Waveform Generator (ARB) is an I/Q modulation source forming an integral part of the R&S Signal Generator. It can be used to output any externally calculated modulation signals or internally generated multi carrier signals.

The Arbitrary Waveform Generator is available for instruments equipped with option Baseband Generator (B10) or with ony of the ARB only options (B50/B51).

The three Baseband Generator options feature different ARB memory sizes (see data sheet). Apart from the memory size, however, the three options offer the same functionality, either one can be installed.

Waveform files can be loaded into the instrument via one of the computer interfaces (USB - memory stick, or Ethernet interface - network drive) or via the IEC bus.

A Windows software package **WinIQSIM2** is available for generating external waveform files on a PC.

It is included among the items and services supplied with the Baseband Generator (B10) option. With effect from version 4.10 and higher, this software defines waveforms in a format which fully exploits the extended functionality of the R&S Signal Generator (e.g. 16-bit resolution, extended memory capacity).

It is also possible to transfer signals that have been calculated using a mathematical program such as Matlab (see also Application Note 1MA28, IQWizard - I/Q Signal Measurement and Conversion, which can be obtained by visiting the Rohde&Schwarz web site at http://www.rohde-schwarz.com).

The R&S Signal Generator can actually generate ARB waveforms internally. These files are created and saved in the **ARB** menu.

It is possible to use either predefined or subsequently defined markers that are sent to the marker outputs in synchronicity with the I/Q output signals. The markers have to be selected in the menu and a delay can be selected by the user (see "Trigger/Marker/Clock - ARB MOD Menu", page 4.204).

Multi segment waveforms consisting of a combination of multiple waveforms can be defined in order to enable rapid alternation between different waveforms with differing test signals. Such waveforms can be used in test systems, for example. Each segment represents a completely independent waveform that is output with its own marker and clock settings. The entire multi segment waveform is loaded into memory. The segment intended to be output at any given moment can be selected by the user. It is therefore possible to alternate between the individual waveform segments without experiencing any delay due to the loading operation.

If very high switchover speeds are required, the test signals can be continuously scrolled through with the aid of an external trigger. For this purpose the segments must have a common sample rate. If the combined waveforms have different sample rates, they can be adapted to a common sample rate by resampling. By the same procedure the instantaneous amplitude of the various waveforms can be scaled to a common rms level.

Typical applications for the multi segment mode are described in the section "Typical Applications for Multi Segment Waveforms - ARB Menu", page 4.217.

Multi carrier waveforms consisting of up to 32 carriers modulated by user-selectable baseband signals can be created in order to simulate complex multi carrier scenarios with different baseband signals (e.g. CDMA2000 or 3GPP FDD).

The ARB has been produced in the form of an interpolating ARB generator. The resampler operates in such a way that a modulation signal with a sample rate of less than 150 or 90 MHz depending on the installed option R&S SMBV-B10/B50 or -B51 is interpolated on the 150 or 90 MHz respectively sample rate and then used as output.

The sample rate must satisfy the following condition:

$$\text{Sample rate x } 0.31 \geq \text{modulation bandwidth}$$

In the case of digital modulation: Sample rate = symbol rate (or chip rate) x oversampling

The value for the necessary oversampling is then calculated as follows:

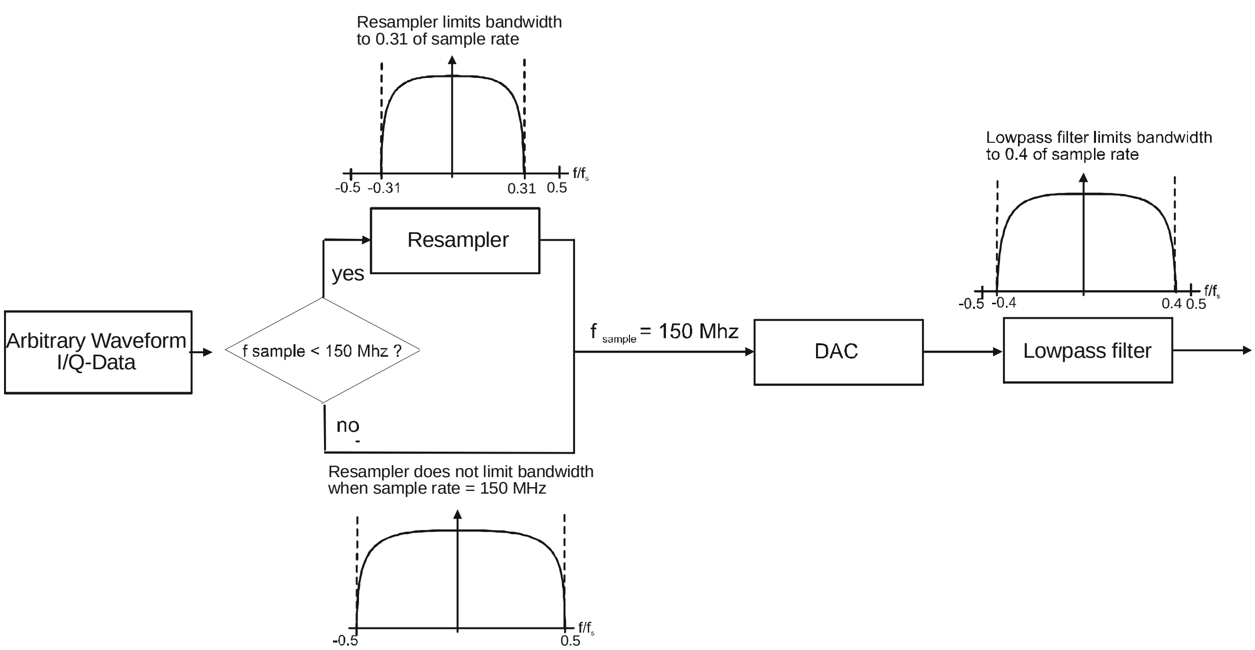
$$\text{Oversampling} \geq \frac{\text{modulation bandwidth}}{\text{symbol (chip) rate x } 0.31}$$

Example:

For the WCDMA digital standard with baseband filter √cos, $\alpha = 0.22$ the following value is therefore calculated for the necessary oversampling:

$$\text{Modulation bandwidth} = \frac{(1+\alpha)}{2} = 0.61, \text{ Oversampling} \geq \frac{0.61}{0.31} = 1.97.$$

A modulation signal with a sample rate of exactly 150 or 90 MHz respectively is passed directly to the Analog/Digital converter. The bandwidth is limited to 40 MHz by the lowpass filter only.



The reduced oversampling means that the signal duration is increased when the number of sample values is constant. Accordingly it is the case that when the duration is constant there is a reduction in the required number of sample values. In conventional ARB generators the minimum oversampling is normally held at 4. It therefore follows that with the above WCDMA system parameters and oversampling of 4 for the generation of a waveform with 10 frames (38 400 chips each) 1.5 Msamples are needed. The same waveform needs 740 ksamples in the R&S Signal Generator due to the lower oversampling of 1.97.

Modulation signals generated with the aid of the **WinIQSIM2** software can be optimized by selecting whole number oversampling or by defining a target sample rate, with the aim of achieving optimum exploitation of the maximum possible useful bandwidth, reducing the length of the waveform or obtaining the most extensive possible useful signal in the memory, according to need. Thus at the default target sample rate of 150 MHz respectively 90 MHz, the maximum bandwidth of 40 MHz is available (see above, Signals with a sample rate of exactly 150 respectively 90 MHz).

Modulation signals can be generated without marker signals, whenever the marker functionality can be directly provided by the R&S Signal Generator, thus increasing the maximum waveform length.

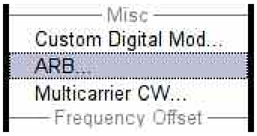
The resolution for the I/Q data is 16 bits (16 bits I, 16 bits Q) and there are 4 bits available for the markers. I/Q data and marker data are located in separate memory areas of the SDRAM and can be independently configured (for example the same output clock but different periods).

A memory size of 128 MB (B10) yields a maximum waveform length of 32 Msamples.

The minimum length of a waveform is 512 samples. If a waveform is shorter than this, it is automatically repeated until it reaches the minimum length.

ARB Menu

The menu for setting the ARB can be opened either in the **Baseband** block or by using the MENU key under **Baseband**.

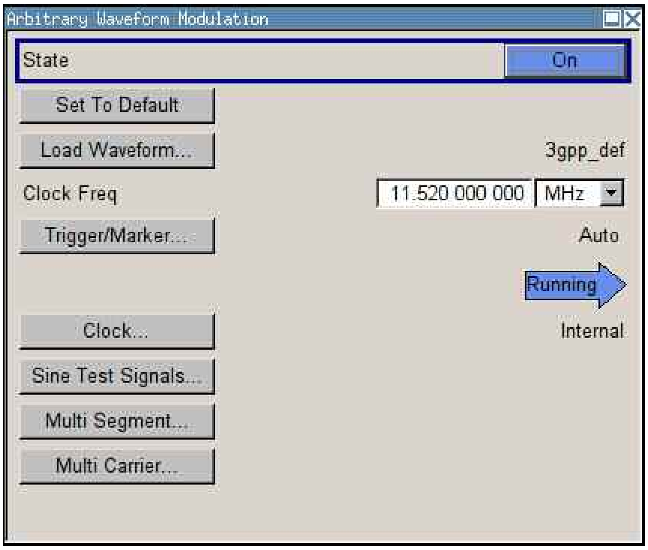


The **ARB** menu is divided into an upper and a lower general part together with a **Marker** section.

The upper part of the menu is used for powering up, selecting and configuring ARB modulation.

The section **Multi Segment Waveform Options** is only indicated if a multi segment waveform is loaded. In this part, the segment to be output is selected.

The buttons in the lower part of the menu open submenus for setting triggers and clocks, for configuring a sinusoidal test signal and for calculating a multi segment waveform or a multi carrier waveform.



ARB MOD Main Menu

The upper part of the menu is used for powering up, selecting and configuring ARB modulation.

State - ARB

Enables/disables ARB modulation.

Switching on this standard turns off all the other digital standards and digital modulation types.

The output is based on the waveform file that is loaded. The name of the waveform file is displayed next to **Load Waveform**.

If a multi segment waveform is loaded the section **Multi Segment Waveform Options** is indicated. In this section, the segment to be output is selected.

If no waveform file is loaded, ARB modulation cannot be powered up. **None** will be displayed next to **Load Waveform**. An error message asks the user to load a waveform file:

No waveform file loaded. ARB MOD state remains off. Please select a waveform file to load, before switching ARB MOD state on.

Remote-control command:
`SOUR:BB:ARB:STAT ON`

Set To Default - ARB

Calls default settings. The values are shown in the following table.

Remote-control commands:
`SOUR:BB:ARB:PRES`

Parameter	Value
State	Off
Trigger	
Mode	Auto
Source	Internal
Ext. Delay	0
Ext. Inhibit	0
Trigger Signal	
Mode	Auto
Source	Internal
External Delay	0
Inhibit	0
Marker Signal	
State	Off
CH. 1 Mode	Restart
CH. 2 Mode	Restart
CH. 3 Mode	Restart
CH. 4 Mode	Restart
Shift in Samples	0
Pulse Frequency	1 kHz
Pattern	'0'
ON/OFF ratio	1.1

Parameter	Value
Clock	
Sync. Mode	None
Frequency	1 MHz
Source	Intern
Delay	0
Sine Signal	
Frequency	1 kHz
Samples per Period	100
Phase Offset	90 DEG

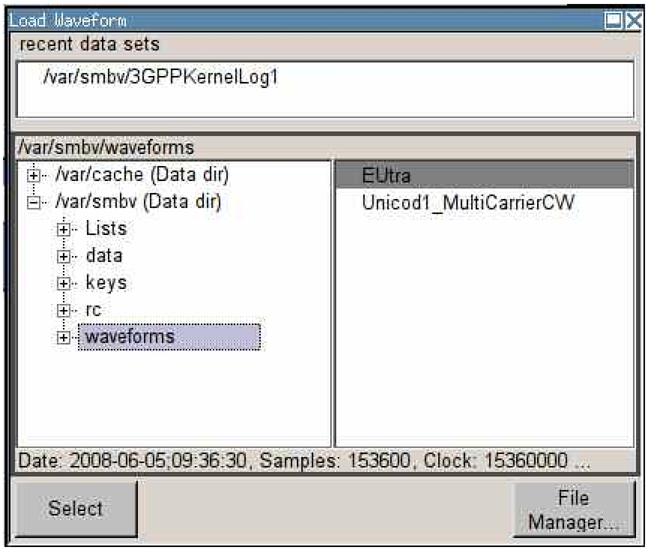
Load Waveform - ARB

Calls the **File Select** menu for loading the waveform file.

The files last used are listed in the **Recent Data Sets** section. The directory can be selected from the center left section. All waveform files (file extension ***.wv**) available from the selected directory are listed on the right side. The file info (tag contents and multi segment state) for the selected file is displayed below the file section.

The **Select...** button selects the marked file. This file is loaded when the ARB modulation is enabled (**State On**).

The **File Manager...** button leads to the file manager (see chapter 3).



Remote-control command:
Example for a file in the default directory:
`SOUR:BB:ARB:WAV:SEL 'Wave1'`
Example for a file in a different directory:
`SOUR:BB:ARB:WAV:SEL 'var/smbv/user/wave/Wave1.wv'`

Clock Frequency - ARB

Displays or enters the ARB output clock rate.

When the waveform file is loaded, this value is automatically set to the clock rate defined in the file (Clock tag). The user can subsequently alter the value if necessary.

When intending to work with an external clock source, the frequency to be applied must be entered here.

Remote-control command:
`SOUR:BB:ARB:CLOC 10 MHz`

The section **Multi Segment Waveform Options** of the menu is only displayed if a multi segment waveform is loaded.

Current Segment - ARB

Indication of the waveform segment that is currently output.

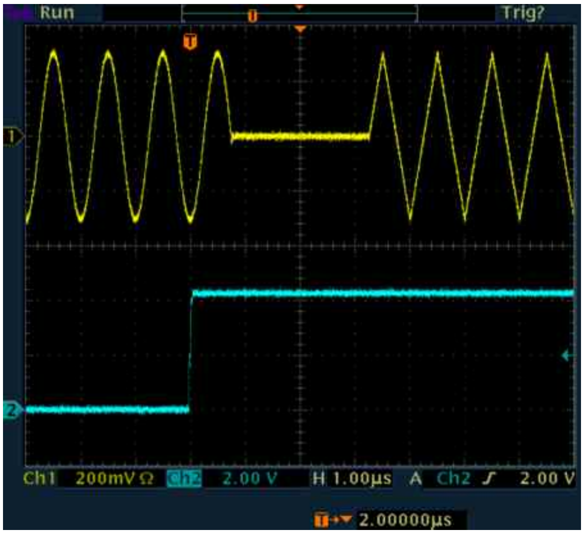
Remote-control command:
`SOUR:BB:ARB:WSEG?`

Extended Trigger Mode - Multi Waveform ARB

Sets the extended trigger mode in the case of a multi segment waveform.. Extended trigger mode defines how the switch between segments will take place:

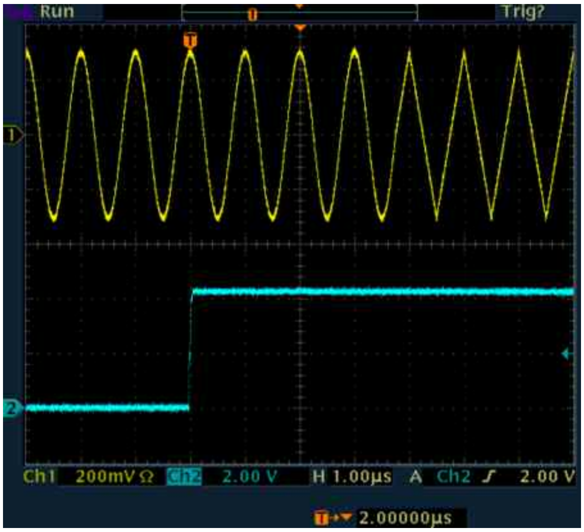
When **Same Segment** and **Next Segment** are selected, the current segment ceases to be output as soon as a new segment is entered in **Next Segment**, and the new segment starts to be output after a system-imposed signal gap.

The following figure shows an example of the transition from a sinewave signal segment to a sawtooth segment (I channel, above) in the case of external triggering (below).



When **Next Segment Seamless** is selected and a new segment is entered in **Next Segment**, the new segment is not output until the whole of the current segment has been output (wrap around). In this case the signal transition is seamless (see **Next Segment Seamless**). A seamless switchover is only possible in the case of segments that have the same sample rate.

The following figure shows an example of the seamless transition from a sinewave signal segment to a sawtooth segment (I channel, above) in the case of external triggering (below).



Extended trigger mode also defines the sequence in which segments will be output:

When **Internal Trigger Source** is selected it is possible to switch to any other segment by changing the entry in **Next Segment**. By selecting **Extended Trigger Mode** it is possible to define whether the new segment is generated immediately or only after the previous segment has been fully generated (wrap around).

Likewise when **External Trigger Source** is selected it is possible to switch to any other segment by changing the entry in **Next Segment**. It is also possible to scroll sequentially to the next available segment in the waveform by activating a trigger. The segment currently being output is displayed at **Current Segment**. The next trigger event after the last segment causes the first segment to be output again. By selecting **Extended Trigger Mode** it is possible to define whether the new segment is generated immediately or only after the previous segment has been fully output (wrap around).

When a multi segment waveform is loaded, generation of the signal starts at the segment defined in **Next Segment**.

The trigger settings in the **Trigger, Marker, Clock** submenu are similarly active. The possible combinations for the two trigger modes are specified in detail in the parameter description below.

Same Segment

Depending on the trigger setting, the currently selected segment is continuously output either immediately or after a trigger event.

Signal generation takes place differently according to the trigger selected in the Trigger menu:

In the case of **Trigger = Auto**, output starts at once and the segment is generated continuously. Trigger events are ignored.

If the segment is changed in **Next Segment**, output of the current segment is stopped and the new segment is output immediately, following a system-imposed signal gap (see above).

In the case of **Trigger = Armed_Auto**, output starts after the first trigger event. The segment is then generated continuously. Further trigger events are ignored.
If the segment is changed in **Next Segment**, signal output is stopped and the new segment is not output until a trigger occurs.

In the case of **Trigger = Retrigger**, output starts at once and the segment is generated continuously, a trigger event causes a restart.

If the segment is changed in **Next Segment**, output of the current segment is stopped and the new segment is output immediately, following a system-imposed signal gap (see above).

In the case of **Trigger = Armed_Retrigger**, output starts after the first trigger event. The segment is then generated continuously. Further trigger events cause a restart.

If the segment is changed in **Next Segment**, signal output is stopped and the new segment is not output until a trigger occurs.

In the case of **Trigger = Single**, output starts after the first trigger event. The segment is then generated once. Further trigger events cause a restart.

If the segment is changed in **Next Segment**, signal output is not stopped. The new segment is not output until a trigger occurs.

Remote-control command:
`SOUR:BB:ARB:TRIG:SMOD SAME`

Next Segment

Depending on the trigger setting, the segment selected under **Next Segment** is output either immediately or after a trigger event.

In the case of **internal Trigger = Auto**, output starts at once and the segment is generated continuously. Trigger events are ignored.

If the segment is changed in **Next Segment**, output of the current segment is stopped and the new segment is output immediately, following a system-imposed signal gap (see above).

In the case of **internal Trigger = Armed_Auto**, output starts after the first trigger event. The segment is then generated continuously. Further trigger events are ignored.

If the segment is changed in **Next Segment**, signal output is stopped and the new segment is not output until a trigger occurs.

In the case of **internal Trigger = Single**, output starts after the first trigger event. The segment is then generated once. Further trigger events cause a restart.

If the segment is changed in **Next Segment**, signal output is not stopped. The new segment is not output until a trigger occurs.

In the case of **External Trigger = Auto**, output starts at once and the segment is generated continuously. Each trigger event switches over to outputting the next segment. In this case there is a system-imposed signal gap (see above). The segment currently being output is displayed at **Current Segment**. The next trigger event after the last segment causes the first segment to be output again.

If the segment is changed in **Next Segment**, output of the current segment is stopped and the new segment is output immediately, following a system-imposed signal gap (see above).

In the case of **External Trigger = Armed_Auto**, output starts after the first trigger event. The segment is then generated continuously. Each trigger event switches over to outputting the next segment. In this case there is a system-imposed signal gap (see above). The segment currently being output is displayed at **Current Segment**. The next trigger event after the last segment causes the first segment to be output again.

If the segment is changed in **Next Segment**, signal output is stopped and the new segment is not output until a trigger occurs.

In the case of **External Trigger = Single**, output starts after the first trigger event. The segment is then generated once. Each trigger event switches over to outputting the next segment once. The segment currently being output is displayed at **Current Segment**. The next trigger event after the last segment causes the first segment to be output again.

If the segment is changed in **Next Segment**, signal output is not stopped. The new segment is not output until a trigger occurs.

The remaining trigger modes (**Retrigger** and **Armed_Retrigger**) are not available.

Remote-control command:
`SOUR:BB:ARB:TRIG:SMOD NEXT`

Next Segment Seamless

The segment selected under **Next Segment** is output.

This mode is only available if all segments have the same sample rate.

In the case of **Internal** Trigger **= Auto**, output starts at once and the segment is generated continuously. Trigger events are ignored.

If the segment is changed in **Next Segment**, the new segment is output seamlessly after the output of the current segment is complete.

In the case of **internal Trigger = Armed_Auto**, output starts after the first trigger event. The segment is then generated continuously. Further trigger events are ignored.

If the segment is changed in **Next Segment**, signal output is stopped and the new segment is not output until a trigger occurs.

In the case of **External** Trigger **= Auto**, output starts at once and the segment is generated continuously.

Each trigger event switches over to outputting the next segment once the output of the current segment has been completed. In each case segment currently being output is displayed at **Current Segment**. The next trigger event after the last segment causes the first segment to be output again.

If the segment is changed in **Next Segment**, the new segment is output seamlessly after the output of the current segment is complete.

In the case of **External Trigger = Armed_Auto**, output starts after the first trigger event. The segment is then generated continuously. Each trigger event switches over to outputting the next segment once the output of the current segment has been completed. The segment currently being output is displayed at **Current Segment**. The next trigger event after the last segment causes the first segment to be output again.

If the segment is changed in **Next Segment**, signal output is stopped and the new segment is not output until a trigger occurs.

The remaining trigger modes (**Retrigger**, **Armed_Retrigger** and **Single**) are not available.

Remote-control command:
`SOUR:BB:ARB:TRIG:SMOD NSE`

Next Segment - ARB

Selects the waveform segment to be output next. It determines the start segment when switching on the ARB.

For an **internal trigger source**, switchover to any segment is performed by changing the entry at **Next Segment**. Depending on the selected **Extended Trigger Mode** the new segment is output either at once or only after the complete output (wrap around) of the previous segment.

For an **external trigger source**, switchover to any segment is also performed by changing the entry at **Next Segment**. In addition, consecutive switchover to the next segment is performed on the occurrence of each trigger event. The currently output segment is indicated at **Current Segment**. When the last segment of the multi segment waveform has been output, the sequence starts again with the output of the first segment after the next trigger event.. Depending on the selected **Extended Trigger Mode** the new segment is output either at once or only after the complete output (wrap around) of the previous segment.

Remote-control command:
`SOUR:BB:ARB:WSEG:NEXT 1`

The lower part of the menu is used for setting triggers and clocks, as well as for file management. A simple sinewave signal can also be output for test purposes.

Trigger/Marker - ARB

Calls the Trigger and Marker menu.

This menu is used to select the trigger source, set the time delay on an external trigger signal and configure the marker output signals (see section "Trigger/Marker/Clock - ARB MOD Menu", page 4.204).

Remote-control command: n.a.

Execute Trigger - ARB

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than Auto are selected.

Remote-control commands:
`SOUR:BB:ARB:TRIG:SOUR INT`
`SOUR:BB:ARB:SEQ RETR`
`SOUR:BB:ARB:TRIG:EXEC`

Clock - ARB

Calls the Clock menu. The Clock menu is used to select the clock source (see section "Trigger/Marker/Clock - ARB MOD Menu", page 4.204).

Remote-control command: n.a.

Sine Testsignals - ARB

Calls the menu for generating sinusoidal test signals (see section "Sine Test Signals - ARB MOD Menu" page 4.211).

Remote-control command: n.a.

Multi Segment - ARB

Calls the menu for calculating multi segment waveforms (see section "Create Multi Segment Waveforms - ARB Menu", page 4.212).

Remote-control command: n.a.

Multi Carrier - ARB

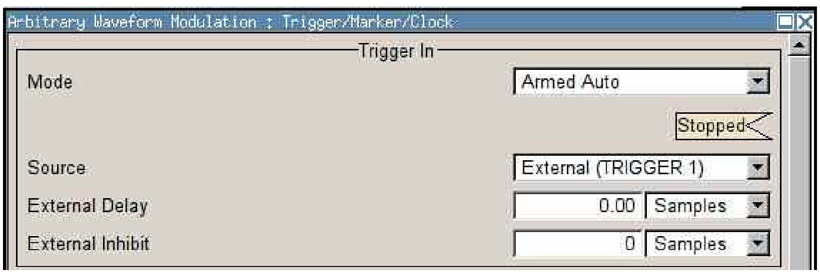
Calls the menu for calculating multi carrier waveforms (see section "Create Multi Segment Waveforms - ARB Menu").

Remote-control command: n.a.

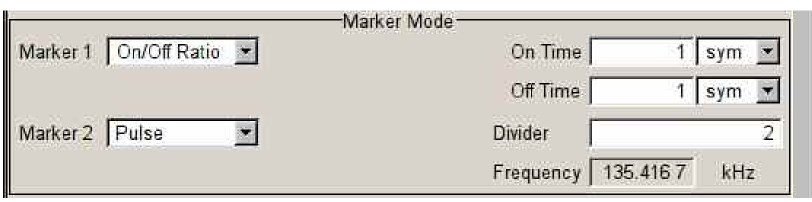
Trigger/Marker/Clock - ARB MOD Menu

The **Trigger/Marker/Clock** menu is used to enter settings for triggers and markers, to select the clock source and the synchronisation mode. The menu offers internal triggering as well as an external trigger inputs TRIGGER 1.

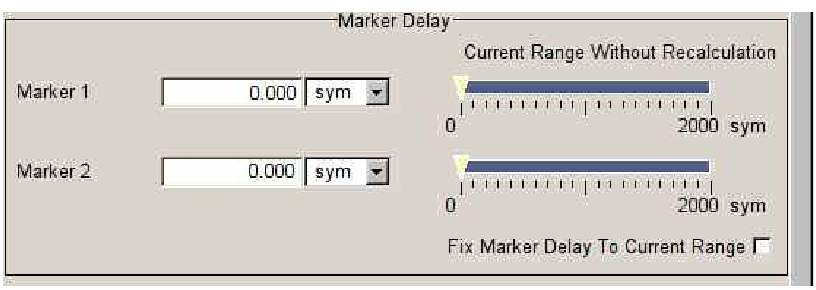
The Trigger menu is accessed via the **ARB MOD** main menu.



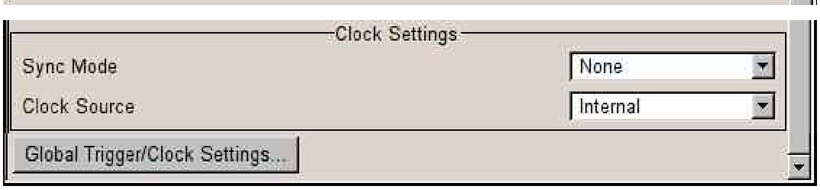
The **Trigger In** section is where the trigger for the waveform is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal output (**Running** or **Stopped**) is indicated for all trigger modes.



In the **Marker Mode** section markers can be defined in addition to the marker settings already defined in the waveform file.



The **Marker Delay** section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker output.



The **Clock Settings** section is where the clock source is selected and - in the case of an external source - the clock type.

The **Global Trigger/Clock Settings** button leads to a submenu for general trigger, clock and external input settings.

The **Trigger In** section is used to configure the trigger signal for the ARB modulation. The current status of waveform output is indicated for all trigger modes.

Trigger Mode - ARB

Selects trigger mode.

For multi segment waveforms, signal output is determined by the Extended Trigger Mode also (see main menu)

Auto

The waveform or segment is output continuously. Signal output starts immediately when ARB modulation is enabled, trigger events are ignored.

Remote-control command:
`SOUR:BB:ARB:SEQ AUTO`

Retrigger

The waveform output continuously. Signal output starts immediately when ARB modulation is enabled, a trigger event (internal or external) causes a restart.

This trigger mode is set automatically for each slave instrument configured to work in a synchronous mode (see *"Synchronous Signal Generation"*, on page *4.149*).

Remote-control command:
`SOUR:BB:ARB:SEQ RETR`

Armed_Auto

The waveform is output only when a trigger event occurs. Then the waveform is output continuously. Subsequent trigger events are ignored

Button **Arm** stops waveform output. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:ARB:SEQ AAUT`

Armed_Retrigger

The waveform is output only when a trigger event occurs. Then the waveform is output continuously. Every subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Button **Arm** stops waveform output. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:ARB:SEQ ARET`

Single

The waveform is output only when a trigger event occurs. Then the waveform is output once in the length specified in **Signal Duration**.

Every subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
`SOUR:BB:ARB:SEQ SING`

Signal Duration Unit - ARB

Defines the unit for the entry of the length of the signal sequence to be output in the **Single** trigger mode. Available units are samples or sequence length (SL).

Remote-control commands:
`SOUR:BB:ARB:TRIG:SLUN SAMP`

Signal Duration - ARB

Enters the length of the signal sequence to be output in the **Single** trigger mode. The unit of the entry is defined unter **Signal Duration Unit**. It is possible to output deliberately just part of the waveform, an exact sequence of the waveform, or a defined number of repetitions of the waveform.

Remote-control commands:
`SOUR:BB:ARB:TRIG:SLEN 2`

Running - Stopped - ARB

Displays the status of waveform output for all trigger modes.

Remote-control command:
`SOUR:BB:ARB:TRIG:RMOD?`
Response: RUN or STOP

Running

The waveform is output; a trigger was (internally or externally) initiated in triggered mode.

For selection **Armed_Auto** and **Armed_Retrigger** waveform output can be stopped with the **Arm** button. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Stopped

The Waveform output is stopped. The instrument waits for an internal or external trigger event to restart. ARB modulation is disabled (**State Off**).

Arm - ARB

Stops waveform output. This button appears only with **Running** signal output in the **Armed_Auto** and **Armed_Retrigger** trigger modes.

Signal output can be restarted by a new trigger (internally with **Execute Trigger** or externally).

Remote-control command:
`SOUR:BB:ARB:TRIG:ARM:EXEC`

Execute Trigger - ARB

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than Auto have been selected.

Remote-control commands:
`SOUR:BB:ARB:TRIG:SOUR INT`
`SOUR:BB:ARB:SEQ RETR`
`SOUR:BB:ARB:TRIG:EXEC`

Trigger Source - ARB

Selects trigger source.

Internal

The trigger event is executed by **Execute Trigger**. As a precondition a trigger mode other than **Auto** must be selected.

Remote-control command:
`SOUR:BB:ARB:TRIG:SOUR INT`

External (TRIGGER 1)

The trigger event is executed with the aid of the active edge of an external trigger signal. The trigger signal is supplied via the TRIG connector.

This trigger source is set automatically for each slave instrument configured to work in a synchronous mode (see *"Synchronous Signal Generation"*, on page *4.149*).

The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the **Global Trigger Settings** menu.

> ***Note:***
> *For multi segment waveforms, an external trigger source can be used for cyclical output of the segments. Each trigger event starts the output of the next segment. After the last segment, the first segment is output again.*

Remote-control command:
`SOUR:BB:ARB:TRIG:SOUR EXT`

Trigger Delay - ARB

Sets trigger signal delay in samples on external triggering.

This enables the R&S Signal Generator to be synchronized with the device under test or other external devices.

Remote-control command:
`SOUR:BB:ARB:TRIG:EXT:DEL 0`

Trigger Inhibit - ARB

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in samples.

In the **Retrigger** mode, every trigger signal causes signal output to restart. This restart is inhibited for the specified number of samples:

This parameter is only available on external triggering.

Remote-control command:
`SOUR:BB:ARB:TRIG:EXT:INH 0`

In the **Marker Mode** section markers can be defined in addition to the marker settings already defined in the waveform file.

Marker x - ARB

Selects a marker signal on the MARKER outputs.

> ***Note:***
> *The marker trace in the waveform file remains unchanged in any case. It is not overwritten, even if something else than **Unchanged** has been selected.*

Unchanged

The marker signal remains unchanged as defined in the waveform file.

Remote-control command:
`SOUR:BB:ARB:TRIG:OUTP1:MODE UNCH`

Restart

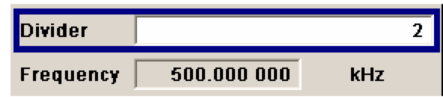
A brief marker signal is generated at the start of the waveform or segment.

Remote-control command:
`SOUR:BB:ARB:TRIG:OUTP1:MODE REST`

Pulse

A regular marker signal is generated. The pulse frequency is defined by entering a divider. The frequency is derived by dividing the sample rate by the divider. The input box for the divider opens when **Pulse** is selected, and the resulting pulse frequency is displayed below it.

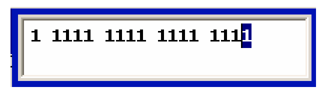
The precision of the frequency setting depends on the sampling rate. The maximum pulse frequency is equal to half of the sampling rate.



Remote-control command:
```
SOUR:BB:ARB:TRIG:OUTP1:MODE PULS
SOUR:BB:ARB:TRIG:OUTP1:PULS:DIV 4
SOUR:BB:ARB:TRIG:OUTP1:PFR?
```

Pattern

A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when **pattern** is selected.

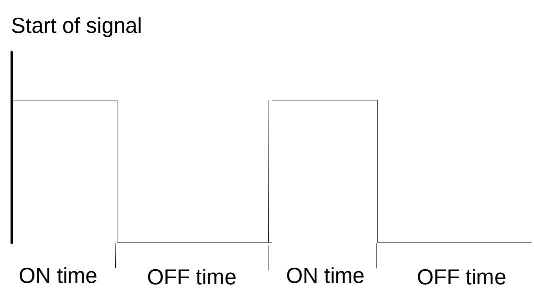


The pattern bits switch the marker signal to high and low state.

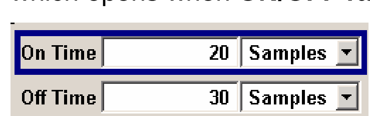
Remote-control command:
```
SOUR:BB:ARB:TRIG:OUTP1:MODE PATT
SOUR:BB:ARB:TRIG:OUTP1:PATT #B11001,5
```

ON/OFF ratio

A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.



The ON time and OFF time are each expressed as a number of samples and are set in an input field which opens when **ON/OFF ratio** is selected.



Remote-control command:
```
SOUR:BB:ARB:TRIG:OUTP1:MODE RAT
SOUR:BB:ARB:TRIG:OUTP1:OFFT 30
SOUR:BB:ARB:TRIG:OUTP1:ONT  20
```

The delays for the marker output signals are entered in the **Marker Delay** section.

Marker x Delay - ARB

Enters the delay between the marker signal at the marker outputs and the start of the signal.

The input is expressed as a number of samples. If the setting "**Fix marker delay to dynamic range**" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals during signal output can be set without restarting the marker and signal.

Remote-control command:
`SOUR:BB:ARB:TRIG:OUTP2:DEL 2`

Current Range without Recalculation - ARB

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

Remote-control command:
`SOUR:BB:ARB:TRIG:OUTP2:DEL:MAX?`
`SOUR:BB:ARB:TRIG:OUTP2:DEL:MIN?`

Fix marker delay to current range - ARB

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

Remote-control command:
`SOUR:BB:ARB:TRIG:OUTP:DEL:FIX ON`

The **Clock Settings** section is used to select the clock source.

Sync. Mode - ARB

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note:
If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.
Avoid unnecessary cable length and branching points.

None

The instrument is working in stand-alone mode.

Remote-control command:
`SOUR:BB:ARB:SYNC:MODE NONE`

Sync. Master

The instrument provides all connected instrument with its synchronization clock (including the trigger signal) and reference clock signal.

Remote-control command:
`SOUR:BB:ARB:SYNC:MODE MAST`

Sync. Slave

The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

Remote-control command:
`SOUR:BB:ARB:SYNC:MODE SLAV`

Set Synchronization Settings - ARB

Performs automatically adjustment of the instrument's settings required for the synchronization mode, selected with the parameter **Synchronization Mode** (see *"Synchronous Signal Generation"*, on page *4.149*).

The status of the external clock source is displayed (see **Synchronisation State**).

Remote-control command:
`SOUR:BB:ARB:SYNC:EXEC`

Clock Source - ARB

Selects the clock source (also see section "Clock Signals", page 4.148).

Internal

The internal clock reference is used to generate the sample clock.

Remote-control command:
`SOUR:BB:ARB:CLOC:SOUR INT`

External

The external clock reference is fed in as the symbol clock via the REF IN connector.

While working in master-slave synchroniuos mode, an external clock source has to be selected for the slave-instrument(s) and the CLOCK IN connector has to be connecter to the CLOCK OUT connector of the master instrument.
This allows the slave instrument(s) to synchronise its clock to the system clock of the master instrument.

The polarity of the clock input can be changed with the aid of **Global Trigger/Clock** Settings.

Remote-control command:
`SOUR:BB:ARB:CLOC:SOUR EXT`

Clock Mode - ARB

Enters the type of externally supplied clock.

Sample

A sample clock is supplied via the CLOCK connector.

Remote-control command:
`SOUR:BB:ARB:CLOC:MODE SAMP`

Multiple

A multiple of the sample clock is supplied via the CLOCK connector; the sample clock is derived internally from this.

Remote-control command:
`SOUR:BB:ARB:CLOC:MODE MSAM`

Measured External Clock - ARB

(External Clock Source only)Indicates the measured frequency of the external clock signal. Thus, screening of the external clock is possible.

The frequency is only indicated when external clock source is selected.

Remote-control command:
`CLOC:INP:FREQ?`

Synchronisation State - Digital Modulation

For instruments working in slave synchronization mode, this parameter displays the status of the external clock source, i.e. whether the external clock source of the slave instrument is synchronized or not synchronized yet.

Remote-control command: n.a.

Global Trigger/Clock/Input Settings - ARB

Calls the **Global Trigger/Clock/Input Settings** menu. This menu is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

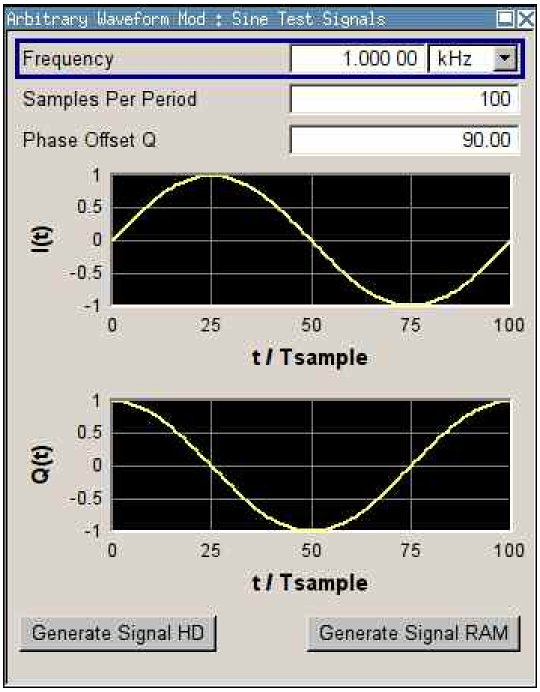
The parameters in this menu affect all digital modulations and standards, and are described in the section "*Global Trigger/Clock/Input Settings – Setup -Environment*".

Sine Test Signals - ARB MOD Menu

The **Sine Test Signals** menu is accessed via the **ARB MOD** main menu.

The menu can be used to configure a sinusoidal test signal. A sine wave is always generated on the I path, and optionally a sine wave of the same frequency but phase-shifted can be generated on the Q path.

The signal actually set is displayed in graphical form in the center of the menu.



Frequency - ARB

Enters the frequency of the test signal.

Remote-control command:
`SOUR:BB:ARB:TSIG:SINE:FREQ 2 MHz`

Samples per Period - ARB

Enters the number of sample values required from the sine wave per period.

The resulting clock rate must not exceed the maximum ARB clock rate (see data sheet). The number of sample values is automatically restricted by reference to the set frequency.

Remote-control command:
`SOUR:BB:ARB:TSIG:SINE:SAMP 35`

Phase Offset Q - ARB

Enters the phase offset of the sinewave signal on the Q channel relative to the sinewave signal on the I channel.

Remote-control command:
`SOUR:BB:ARB:TSIG:SINE:PHAS 75DEG`

Generate Signal HD - ARB

Generates a signal and saves it to a file.

The File Select window opens automatically and the signal can be stored as a waveform file.

Remote-control command:
`SOUR:BB:ARB:TSIG:SINE:CRE:NAM 'sine_test'`

Generate Signal RAM - ARB

Generates a signal and uses it as output straight away.

Remote-control command:
`SOUR:BB:ARB:TSIG:SINE:CRE`

Create Multi Segment Waveforms - ARB Menu

The **Multi Segment...** menu is accessed via the **ARB** main menu.

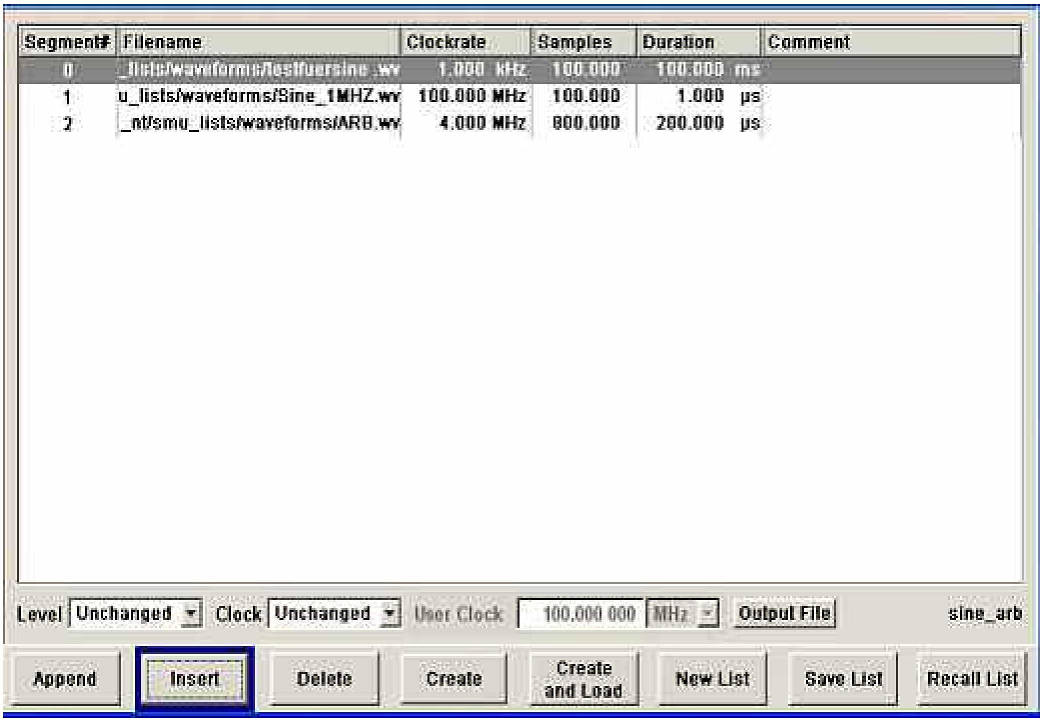
The menu can be used to create a multi segment waveform from existing waveforms and save it under its own name. As with normal waveforms, the file extension is ***.wv**. Information on whether a file is a multi segment waveform is displayed in the File menu with the tag information when a waveform is loaded.

If the combined waveforms have different sample rates, they can be adapted to a common sample rate by resampling. By the same procedure the instantaneous amplitude of the various waveforms can be scaled to a common rms level.

The configuration of a multi segment waveform, that is to say details of how it is made up from different waveforms, the level and clock rate settings, and the file name, can be saved separately in a list. The file extension is ***.inf_mswv**. This method can be used to create any number of configurations as a basis for defining further multi segment waveforms.

Example for the creation of a multi segment waveform file.

1. Create empty list (**New List**)
2. Append two or more waveform files (**Append** or **Insert**)
3. Set level and clock mode (**Level** and **Clock**)
4. Enter file name (**Output File**)
5. Save configuration (**Save List**)
6. Save multi segment waveform (**Create** or **Create and Load**)



Multi Segment Table - Multi Segment ARB

The table lists the individual waveforms (segments) of the selected multi segment waveform. The information about the segments is taken from the tags of the corresponding waveform files.

Segment#

Indication of segment index. The segment index is used to select the segment to be output.

The segment index also defines the sequence of the output during external triggering in the **Next Segment** or **Next Segment Seamless** trigger modes.

Remote-control command: n.a.

File Name

Indication of the path and waveform file name of the segment.

Remote-control command: n.a.

Clock Rate

Indication of the clock rate of the segment.

The polarity of the clock input can be changed with the aid of **Global Trigger/Clock Settings**.

Remote-control command: n.a.

Duration

Indication of the segment duration.

Remote-control command: n.a.

Samples

Indication of the number of samples in the segment.

Remote-control command: n.a.

Comment

Indication of the comment on the segment

Remote-control command: n.a.

Level - Multi Segment ARB Defines the level mode for the multi segment waveform.

Unchanged Segments are output exactly as defined in the files. The **Level** display applies only to the segment with the highest rms value. In some circumstances the remaining segments are output at a lower level than that displayed.

Remote-control command:
`SOUR:BB:ARB:CONF:LEV:MODE UNCH`

Equal RMS Segments are output so that all segments have the same rms value. The **Level** display applies to all segments.

Remote-control command:
`SOUR:BB:ARB:CONF:LEV:MODE ERMS`

Clock - Multi Segment ARB Selects the clock rate mode for the multi segment waveform.

Unchanged A segment is output with the clock rate defined in the file.

If segments have different clock rates, extended trigger mode **Next Segment** allows internal segment switchovers only (**Internal** trigger source).

Extended trigger mode **Next Segment Seamless** can only be selected if all segments have the same clock rate.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:CLOC:MODE UNCH`

Highest All segments are output at the highest available clock rate.

This mode provides very short switchover times between segments.

The time for calculating the multi segment waveform is increased since the individual segments have to be resampled.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:CLOC:MODE HIGH`

User All segments are output at the clock rate defined in **User Clock**.

This mode provides very short switchover times between segments.

The time for calculating the multi segment waveform is increased since the individual segments have to be resampled.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:CLOC:MODE USER`

User Clock - Multi Segment ARB

Defines the sample rate used for multi segment waveform output in case of Clock Mode **User**.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:CLOC 50MHz`

Output file - Multi Segment ARB

Opens the **File** menu, where the file name of the multi segment waveform which has to be calculated can be entered.

The multi segment waveform is saved under this name by clicking the **Create** or **Create and Load** button.

A name must also be entered here before the list can be saved as a configuration file (**Save List**). In this case the name is needed for internal storage procedures. It is entered as the default name for the multi segment waveform file when loading the list.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:OFIL "Multi1"`

Append - Multi Segment ARB

Opens the file menu to enter the file name of the waveform file to be appended.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:SEGM:APP 'arb2'`

Insert - Multi Segment ARB

Opens the file menu to enter the file name of the waveform file to be inserted. The new waveform is inserted above the marked line.

Remote-control command: n.a.

Delete- Multi Segment ARB

Deletes the selected segment.

Remote-control command: n.a.

Create- Multi Segment ARB

Creates a new multi segment waveform using the current table entries.

This multi segment waveform is saved with the file name specified in **Output File**. If no file name is specified, the File Manager opens so that the file name can be entered. As with normal waveforms, the file extension is ***.wv**.

Depending on the configuration of the multi segment waveform, calculation may take some time. A panel with a progress bar and an **Abort** button appears during creating of the multi segment waveform.

Remote-control command:
`SOUR:BB:ARB:WSEG:CRE "conf_16"`

(in remote control the configuration file to be used for the creation of the multi segment waveform is defined with the command:

`SOUR:BB:ARB:WSEG:CRE` or `SOUR:BB:ARB:WSEG:CLO`.

The file name of the waveform file is always determined with the command:

`SOUR:BB:ARB:WSEG:CONF:OFIL 'wv_name'`)

Create and Load- Multi Segment ARB

Creates a new multi segment waveform using the current table entries.

This multi segment waveform is saved with the file name specified in **Output File**. If no file name is specified, the File Manager opens so that the file name can be entered. As with normal waveforms, the file extension is ***.wv**.

Depending on the configuration of the multi segment waveform, calculation may take some time.

Following this the **Create Multi Segment Waveform File** submenu is closed and the new multi segment waveform is loaded. The digital standard **ARB** is activated and the first segment of the waveform is output in accordance with the trigger settings.

Remote-control command:
`SOUR:BB:ARB:WSEG:CLO "conf_16"`

(in remote control the configuration file to be used for the creation of the multi segment waveform is defined with command:

`SOUR:BB:ARB:WSEG:CRE` or `SOUR:BB:ARB:WSEG:CLO`.

The file name of the waveform file is always determined with the command:

`SOUR:BB:ARB:WSEG:CONF:OFIL 'wv_name')`

New List- Multi Segment ARB

Deletes all entries of the table. A new configuration table is created.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:SEL "new_mseg"`

Save List- Multi Segment ARB

Saves the current entries of the table in a configuration file, including the level mode, clock mode and output file name settings.

The file name is entered in the **File** menu. Configuration files have the file extension ***.inf_mswv**. They can be used later as the basis for further multi segment waveforms.

Before a multi segment configuration file can be saved, a file name must be entered in **Output File**, since this is saved with the configuration file for internal purposes. This file name is also used as the default name for the multi segment waveform when loading the configuration file.

Remote-control command: n.a.

(in remote control the configuration file to be used for the creation of the multi segment waveform is defined with the command:

`SOUR:BB:ARB:WSEG:CRE` or `SOUR:BB:ARB:WSEG:CLO`.

The file name of the waveform file is always determined with the command:

`SOUR:BB:ARB:WSEG:CONF:OFIL 'wv_name')`

Recall List- Multi Segment ARB

Opens the file menu to select the configuration file to be edited.

Remote-control command:
`SOUR:BB:ARB:WSEG:CONF:SEL "multi_seg2"`

Typical Applications for Multi Segment Waveforms - ARB Menu

High Speed Switchovers

To test DUTs/chips using different test signals at high throughput requires extremely fast switchovers (for instance when testing ATE devices during manufacture). The following settings enable switching times of approx. 5 µs and the test signals are scrolled through with the aid of an external trigger signal.

Trigger Mode = **Auto**

Trigger Source = **External Trigger 1**

If the waveforms have different sample rates:

Clock Mode = **Highest** or **User** (when creating the waveform in the Multi Segment Editor)

Flexible Dynamic Switchovers

When testing DUTs using different test signals, it may be necessary to switch dynamically and flexibly between any of the test signals, for instance depending on the outcome of the previous test. When using remote control via an external computer, the following settings enable switching times of approx. 20 ms for segments with the same sample rate and approx. 200 ms for segments with different sample rates.

Extended Trigger Mode = **Next Segment**

Trigger Mode = **Auto**

Trigger Source = **Internal**

Flexible Dynamic Switchovers without Signal Interruptions

Testing receivers requires a continuous output of different test signals without interrupting the signal. The test signals then produce a complex total signal with no signal gaps on switchover. Control procedures can use a simulated back channel of the receiver (trigger line or remote control).

Switching times depend on the length of the segment currently being output, since switchover to the next segment does not take place until the current segment comes to an end.

Extended Trigger Mode = **Next Segment Seamless**

Trigger Mode = **Auto**

Trigger Source = **Internal or External**

If the waveforms have different sample rates:

Clock Mode = **Highest** or **User** (when creating the waveform in the Multi Segment Editor)

Create Multi Carrier Waveforms - ARB Menu

Multi carrier waveforms consisting of up to 32 carriers modulated by user-selectable baseband signals can be created in order to simulate complex multi carrier scenarios with different baseband signals (e.g. CDMA2000 or 3GPP FDD).

The carriers are equally spaced and centered toward the RF frequency or baseband DC line, respectively. The carrier spacing is adjustable within the total available baseband bandwidth of 80 MHz. Each carrier can be separately defined in terms of power, phase and modulated input signal. Optionally, crest factor optimization can be applied.

Thus, multi carrier waveforms can be very easily configured as broadband test signals and used for such purposes as transmitter or receiver tests. In addition. Even complex multi carrier scenarios composed of signals from different digital standards can be created and used for these tests.

Example for the creation of a multi carrier waveform file.

1. Configure general settings
2. Configure carrier table
3. Enter file name of multi carrier waveform (**Output File**)
4. Save and load multi carrier waveform (**Create** or **Create and Load**)

The **Multi Carrier...** menu is accessed via the **ARB** main menu.

The menu can be used to create a multi carrier waveform and save it under its own name. As with normal waveforms, the file extension is ***.wv**. Information on clock rate, number of samples and creation day is displayed in the File menu when a waveform is loaded.

The **Multi Carrier** submenu is divided into the following sections.

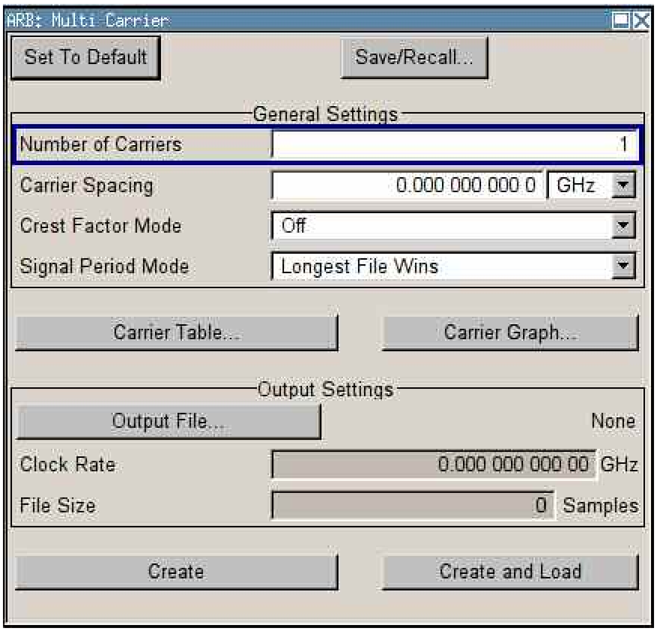
The upper part of the menu is used for calling the default settings and saving and recalling the submenu settings.

The **General Settings** section is used to configure the main multi carrier waveform.

The buttons in the middle part of the menu open submenus for defining the carrier table. The carrier settings can be checked in the graphical **Carrier Graph** submenu.

The **Output Settings** section indicates the name, the size and the clock rate of the multi carrier waveform (after calculation).

The buttons in the lower part of the menu activate creation and optionally loading of multi carrier waveform files into the main ARB menu.



The upper part of the menu is used for calling the default settings and saving and recalling existing ARB multi carrier submenu settings.

Set to Default - ARB Multi Carrier

Calls default settings. The values are shown in the following table.

Remote-control command:
`SOUR:BB:ARB:MCAR:PRES`

Parameter	Value
General Settings	
Number of Carriers	1
Carrier Spacing	0 MHz
Crest Factor Mode	Off
Signal Period Mode	Longest file wins

Save/Recall Frame - ARB Multi Carrier

Calls the **Save/Recall** menu.

From the **Save/Recall** menu the **File Select** windows for saving and recalling the configurations of the ARB **Multi Carrier** submenu and the **File Manager** can be called.

Remote-control command:
```
MMEM:MDIR 'var/smbv/gen_lists/dm'
SOUR:BB:ARB:MCAR:SETT:CAT?
SOUR:BB:ARB:MCAR:SETT:LOAD 'M_carr1'
SOUR:BB:ARB:MCAR:SETT:STOR 'M_carr2'
```

The **General Settings** section is used to configure the Multi Carrier signal.

Number of Carriers - ARB Multi Carrier

Sets the number of carriers for the multi carrier waveform.

By default the multi carrier table lists 1 carrier. A maximum of 32 carriers can be configured and activated.

When the number of carriers is increased, the multi carrier table is extended by adding further lines at the end of the table. If these carrier already have been defined before, the settings are preset according to the former settings. Otherwise the parameters are preset with the default values.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR:COUN 22`

Carrier Spacing - ARB Multi Carrier

Sets the frequency spacing between adjacent carriers of the multi carrier waveform.

The carriers are arranged symmetrically around the RF carrier.

The maximum carrier spacing is limited to

Carrier spacing = Total baseband bandwidth /(Number of carriers - 1);

The total baseband bandwidth is 120 MHz for R&S SMBV equipped with option B10/B50 or 60 MHz for R&S SMBV-B51.

Note:
*In order to avoid wrap-around problems, the effective **Carrier Spacing** might be slightly modified. The **Carrier Spacing** is rounded in that way that the carrier closest to the shows no phase jump assuming that the carrier is unmodulated.*
For odd number of carriers:
RoundedCarrierSpacing=1/OutputSignalDuration round(CarrierSpacing * OutputSignalDuration);*
For even number of carriers:
*RoundedCarrierSpacing=2/OutputSignalDuration*round(0.5 *CarrierSpacing * OutputSignalDuration).*

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR:SPAC 10 kHz`

Crest Factor Mode - ARB Multi Carrier

Selects the mode for optimizing the crest factor by calculating the carrier phases.

The crest factor represents the ratio of the peak voltage value to the rms voltage value. The higher the crest factor and resulting dynamics of a signal, the greater the requirement for a power amplifier fed by the signal to be linear.

The following modes are available:

Off

There is no automatic setting for minimizing or maximizing the crest factor. The **Phase** setting as defined in the carrier table is in use.

Remote-control command:
`SOUR:BB:ARB:MCAR:CFAC:MODE OFF`

Minimize	The crest factor is minimized by internally calculating optimized carrier phases. The Phase setting displayed in the carrier table is invalid. Remote-control command: `SOUR:BB:ARB:MCAR:CFAC:MODE MIN`
Maximize	The crest factor is maximized by internally calculating optimized carrier phases. The Phase setting displayed in the carrier table is invalid. Remote-control command: `SOUR:BB:ARB:MCAR:CFAC:MODE MAX`

Signal Period Mode - ARB Multi Carrier

Selects the mode for calculating the resulting signal period of the multi carrier waveform. The carrier table provides an information button to obtain sample rate and file length data of each carrier.

The resulting period is always calculated for all carriers in the carrier table irrespective of their state (ON/OFF).

Note:
Wrap-around and timing problems may occur when I/Q signals of different length are used. Thus, demodulation of a carrier may be difficult or even impossible. It is therefore recommended to consider the timing already when creating the input I/Q files or to adjust the signal duration to the carrier which is subsequently demodulated (in this case, the other carriers are for interfering the signal only). These problems do not arise with signals of the same standard (e.g. 3GPP).

The following modes are available:

Longest File Wins	The resulting signal period is defined by the longest I/Q file in the carrier table. Shorter I/Q files are periodically repeated. Remote-control command: `SOUR:BB:ARB:MCAR:TIME:MODE LONG`
Shortest File Wins	The resulting signal period is defined by the shortest I/Q file in the carrier table. Only the first part of longer I/Q files is used. Remote-control command: `SOUR:BB:ARB:MCAR:TIME:MODE SHOR`
User	The signal period can be set by the user in the **Signal Period** field. Shorter I/Q files are repeated periodically, and only the first part of longer I/Q files is used. Remote-control command: `SOUR:BB:ARB:MCAR:TIME:MODE USER`

Signal Period - ARB Multi Carrier

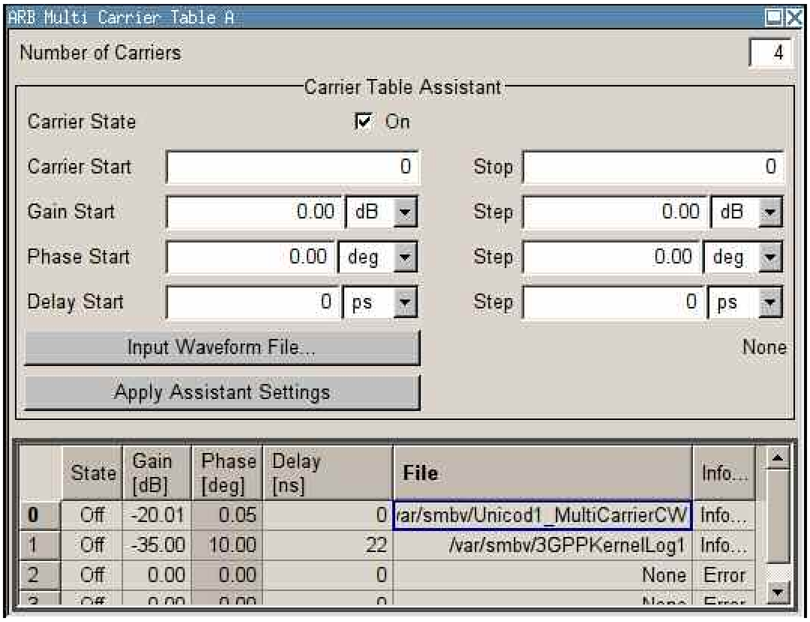
Sets the signal period in Signal Duration Mode **User**. Shorter I/Q files are repeated periodically, and only the first part of longer I/Q files is used.

Remote-control command:
`SOUR:BB:ARB:MCAR:TIME 1s`

The buttons in the middle part of the menu open submenus for defining the carrier table. The carrier settings can be checked in the graphical **Carrier Graph** submenu. The **Carrier Table Assistant** section can be used to set a selectable carrier range.

Carrier Table Submenu - ARB Multi Carrier

Calls the table for configuring individual carriers. A selectable carrier range can be set with the aid of the optional **Carrier Table Assistant** The multi carrier configuration can be checked with the aid of the **Carrier Graph**.



The **Carrier Table Assistant** serves as a optional mean to quickly set up a multi carrier scenario within a specified carrier range.

Number of Carriers - ARB Multi Carrier

Defines the number of carriers of the multi carrier waveform.

This parameter is identical to that in the **General Setting** section.

Remote-control command:
`SOUR:BB:ARB:MCAR:COUN 22`

Carrier State - ARB Multi Carrier

Switches the carriers in the range **Carrier Start** to **Carrier Stop** on/off.

Remote-control command
`SOUR:BB:ARB:MCAR:EDIT:CARR:STAT ON`

Carrier Start - ARB Multi Carrier

Defines the start index of the carrier range to which the assistant settings are intended to apply.

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:STAR 2`

Carrier Stop - ARB Multi Carrier

Defines the stop index of the carrier range to which the assistant settings are intended to apply.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR:CARR:STOP 20`

Gain Start - ARB Multi Carrier

Sets the gain of the carrier marked by **Carrier Start**.

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:POW 0 dB`

Gain Step - ARB Multi Carrier

Sets the step width that is used to increment the gain

The resulting carrier gain in the carrier table equals:

GainStart + n Gain Step*

where n ranges from 0 to (Carrier Stop - Carrier Start).

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:POW:STEP -0.2 dB`

Phase Start - ARB Multi Carrier

Sets the phase of the carrier marked by **Carrier Start**.

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:PHAS 0`

Phase Step - ARB Multi Carrier

Sets the step width that is used to increment the phase.

The resulting phase in the carrier table equals:

PhaseStart + n PhaseStep*

where n ranges from 0 to (Carrier Stop – Carrier Start)

`Remote-control command:`
`SOUR:BB:ARB:MCAR:EDIT:CARR:PHAS:STEP 1DEG`

Delay Start - ARB Multi Carrier

Sets the delay of the carrier marked by **Carrier Start**.

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:DEL 0`

Delay Step - ARB Multi Carrier

Sets the step width that is used to increment the delay

The resulting delay in the carrier table equals:

Delay*Start + n* DelayStep*

where n ranges from 0 to (Carrier Stop – Carrier Start).

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:DEL:STEP 10us`

Input Waveform File - ARB Multi Carrier

Calls the **File** menu for selecting the inputfile with the I/Q signal to be modulated onto all carriers of the selected carrier range.

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:FILE "iq_test"`

Apply Assistant Settings - ARB Multi Carrier

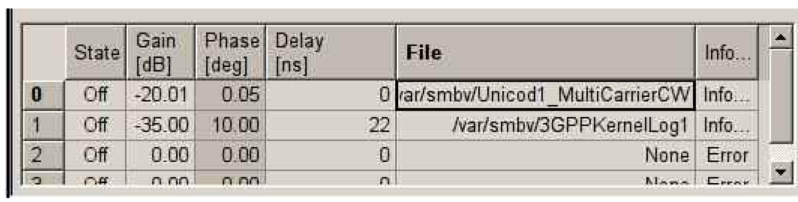
Transfer the assistant settings to the carrier table.

Remote-control command:
`SOUR:BB:ARB:MCAR:EDIT:CARR:EXEC`

Carrier Table - ARB Multi Carrier

The table displays the settings of all available carriers. Previously applied assistant settings can be further refined. The number of lines corresponds to the number of carriers.

Note:
The phase/deg settings are only valid if optimization of the crest factor is disabled (Crest Factor Mode = Off).



	State	Gain [dB]	Phase [deg]	Delay [ns]	File	Info...
0	Off	-20.01	0.05	0	/var/smbv/Unicod1_MultiCarrierCW	Info...
1	Off	-35.00	10.00	22	/var/smbv/3GPPKernelLog1	Info...
2	Off	0.00	0.00	0	None	Error

No.

Indicates the carrier index ranging from 0 to (number of carriers -1).

Remote-control command:
- individual carriers can be set using the commands:
`SOUR:BB:ARB:MCAR:CARR:..`
by specifying the index in the parameter.

State

Switches On/Off a carrier.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR2:STAT ON`

Gain

Sets the gain of a carrier.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR2:POW -30dB`

Phase

Sets the starting phase of a carrier.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR2:PHAS 0DEG`

Delay

Sets the starting delay of a carrier.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR2:DEL 2US`

File

Calls the **File** menu for selecting the input file with the I/Q signal to be modulated onto the carrier.

Remote-control command:
`SOUR:BB:ARB:MCAR:CARR2:FILE "iq_test"`

Info

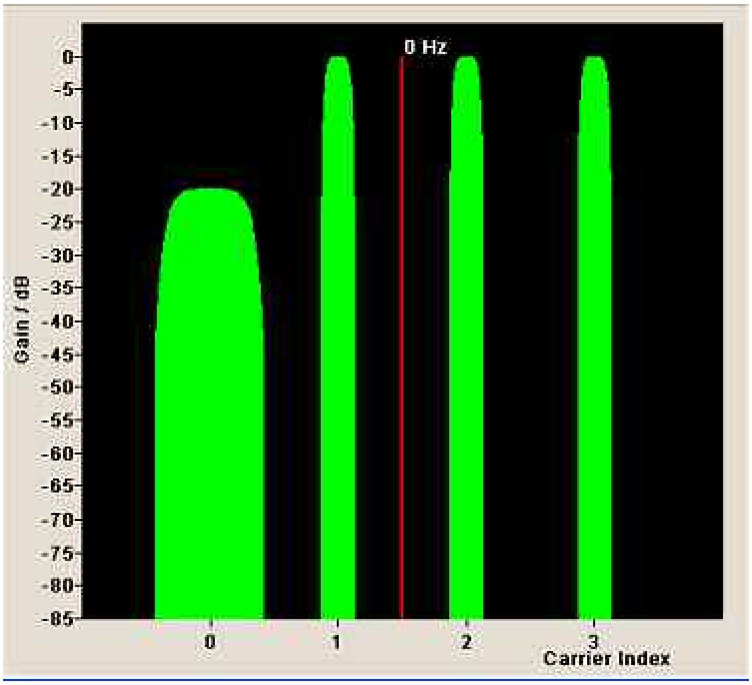
Indicates the sample rate, number of I/Q value pairs (number of samples), and the resulting signal period of the selected I/Q input file.

Remote-control command: n.a.

Carrier Graph - ARB Multi Carrier

Calls a graphical representation of the current multi carrier configuration in the frequency domain.

The height of the bars corresponds to the chosen gain of each individual carrier. The bandwidth of the carriers signals is indicated by the width of the bars.



The **Output Settings** section in the multi carrier main menu indicates the name, the size and the clock rate of the currently calculated multi carrier output file.

File - ARB Multi Carrier

Opens the **File** menu, where the output file name of the multi carrier waveform which has to be calculated can be entered.

The multi carrier waveform is calculated and saved under this name by clicking the **Create** or **Create and Load** button.

Remote-control command:
`SOUR:BB:ARB:WCAR:OFIL "Multi1"`

Clock Rate - ARB Multi Carrier

Displays the resulting sample rate at which the multi carrier waveform is output by the arbitrary waveform generator. The output clock rate depends on the number of carriers, carrier spacing and input sample rate of the leftmost or rightmost carriers.

Remote-control command
`SOUR:BB:ARB:MCAR:CLOC?`

File Size - ARB Multi Carrier

Displays the resulting number of samples of the multi carrier waveform.

Remote-control command:
`SOUR:BB:ARB:MCAR:SAMP?`

Create - ARB Multi Carrier

Creates a new multi carrier waveform defined by the multi carrier table and General Setting entries.

This multi carrier waveform is saved with the file name specified in **Output File**. If no file name is specified, the File Manager opens so that the file name can be entered. As with normal waveforms, the file extension is ***.wv**.

Depending on the configuration of the multi carrier waveform, calculation may take some time. A panel with a progress bar and an **Abort** button appears during the calculation process.

Remote-control command:
`SOUR:BB:ARB:MCAR:CRE`
(in remote control the file name of the multi carrier waveform file is determined with command:
`SOUR:BB:ARB:MCAR:OFIL 'wv_name'`)

Create and Load - ARB Multi Carrier

Creates a new multi carrier waveform defined by the multi carrier table and General Setting entries and loads it subsequently in the **ARB** main menu.

This multi carrier waveform is saved with the file name specified in **Output File**. If no file name is specified, the File Manager opens so that the file name can be entered. As with normal waveforms, the file extension is ***.wv**.

Depending on the configuration of the multi carrier waveform, calculation may take some time. A panel with a progress bar and an **Abort** button appears during the calculation process.

Remote-control command:
`SOUR:BB:ARB:MCAR:CLO`
(in remote control the file name of the waveform file is determined with command:
`SOUR:BB:ARB:MCAR:OFIL 'wv_name')`

Typical Applications for Multi Carrier Waveforms - ARB Menu

High Power Amplifiers of multi carrier base stations face increased requirements in terms of linearity and acceptable intermodulation performance. A standard transmitter test might be quickly setup by the following instructions.

- Load a standardized 3GPP downlink test model, e.g. **Test Model 1_16**; Set State to **ON**
- Create a 3GPP Testmodel ARB file by activating **Generate Waveform File**.
- Setup a multi carrier scenario with 4 carriers and a carrier spacing of 5 MHz.
- Apply the input file containing the previously generated 3GPP testmodel to all 4 carriers.

Contents Chapter 5 - Remote Control - Basics

5 Remote Control - Basics

Introduction - Remote Control Basics

This chapter provides:

- Instructions on how to set up the instrument for remote control operation.
- A general introduction to remote control of programmable instruments. This includes the description of the command structure and syntax according to the SCPI standard, the description of command execution and of the status registers.

The remote control commands of the instrument are described in detail after each related Instrument Function section. In addition, the description of each menu parameter is linked to the related remote control command.

In chapter 6, all remote control functions are described in detail. The subsystems are listed by alphabetical order according to SCPI. All commands and their parameters are listed by alphabetical order in the command list at the end of chapter 6.

The instrument is equipped with the following interfaces for remote control:

- IEC/IEEE bus interface according to standard IEC 625.1/IEEE 488.2
- LAN interface: the network card uses 10/100/1000Mbps Ethernet IEEE 802.3u; the protocol is based on the VXI-11 standard.
- USB interface: The type B interface (device USB) is used for remote control.

The connectors are located at the rear of the instrument and permit a connection to a controller for remote control either via GPIB, via a local area network (LAN) or USB interface. The remote control interfaces and their interface functions are described in chapter 8.

A VISA installation on the controller is a prerequisite for remote control over LAN or USB interface. VISA is a standardized software interface library providing input and output functions to communicate with instruments. For more information about VISA refer to the user documentation.SCPI (**S**tandard **C**ommands for **P**rogrammable **I**nstruments) commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of instrument control commands, error handling and the status registers. The tutorial "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

This section assumes basic knowledge of programming and operation of the controller. A description of the interface commands can be obtained from the relevant manuals.

The requirements that the SCPI standard places on command syntax, error handling and configuration of the status registers are explained in detail in the following sections. Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

The program examples for IEC/IEEE-bus programming are all written in VISUAL BASIC. A condition for programming in VISUAL BASIC is that the modules NIGLOBAL (Niglobal.bas) and VBIB32 (Vbib_32.bas) are added to the projects.

Note:
*Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the device status. Therefore, control programs should always define an initial device status (e.g. with the command *RST) and then implement the required settings.*
Drivers for the generator, e.g. IVI-COM and LabVIEW drivers, are available in the download area of the R&S product website (http://www.rohde-schwarz.com/product/SMBV100A).

Getting Started

The short and simple operating sequence given below permits fast putting into operation of the instrument and setting of its basic functions. As a prerequisite, the IEC/IEEE-bus address, which is factory-set to 28, must not have been changed.

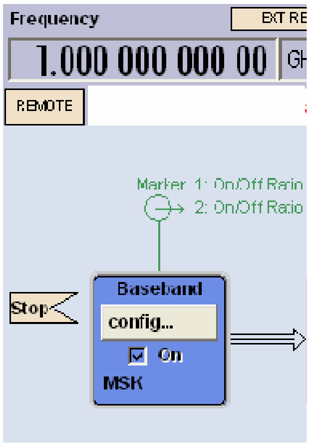
- Connect instrument and controller using IEC/IEEE-bus cable and switch them on.
- Write and start the following program on the controller:

```
CALL IBFIND("DEV1", generator%)                'Open port to the instrument
CALL IBPAD(generator%, 28)                     'Inform controller about instrument address
CALL IBWRT(generator%, "*RST;*CLS")            'Reset instrument
CALL IBWRT(generator%, "FREQ 50MHz")           'Set frequency to 50 MHz
CALL IBWRT(generator%, "POW -7.3dBm")          'Set output level to -7.3 dBm
CALL IBWRT(generator%, "OUTP:STAT ON")         'Switch on RF output
CALL IBWRT(generator%, "AM:SOUR INT")          'Set AM modulation source LFGEN
CALL IBWRT(generator%, "LFO:FREQ 15kHz")       'Set modulation frequency to 15 kHz
CALL IBWRT(generator%, "AM 30PCT")             'Set AM modulation depth to 30%
CALL IBWRT(generator%, "AM:STAT ON")           'Swicth on AM
```

- To return to manual operation, press the LOCAL key at the front panel.

Switchover to Remote Control

On power-on, the instrument is always in the manual operating state and can be operated via the front panel controls or via mouse and external keyboard.
In case of remote control via the IEC/IEEE bus, the instrument is set to remote control (REMOTE status) by means of an addressed command.
With remote control via Ethernet, remote control is not automatically set by means of a command. The instrument must be explicitly set to the REMOTE state, e.g. by sending the interface command **&GTR** (go to remote).
In the REMOTE state, instrument control from the front panel or via mouse and keyboard is disabled. Menus can be opened, however, e.g. to verify settings. Buttons and setting fields are displayed in gray and cannot be activated. REMOTE is displayed in the status line.



The instrument remains in the REMOTE mode until local control is selected with one of the following ways:
- manually with the [LOCAL] key on the front panel
- with the interface command **&GTL** via the remote-control interface
- manually with the Local button in the menu **Remote Control Channels**.

Switching from manual operation to remote control and vice versa does not affect the remaining instrument settings.
In the remote control mode, the front-panel keys and an external mouse or keyboard that may be connected can be disabled with command `:SYST:KLOC ON`. Menus cannot be opened in this case and switchover from remote control to manual operation is only possible by means of a remote-control command. Inadvertent switchover with the [LOCAL] key is not possible in this case.
Operation of the [LOCAL] key alone can be disabled with interface command **&LLO.**

Remote Control via IEC/IEEE Bus

To be able to control the instrument via the IEC/IEEE bus, instrument and controller must be linked by an IEC/IEEE-bus cable. An IEC/IEEE-bus card, the card drivers and the program libraries for the programming language used must be provided in the controller.
The controller must address the instrument with the set IEC/IEEE-bus address. The IEC/IEEE bus address of the instrument is factory-set to 28. It can be changed manually in the **Environment - GPIB** menu or via IEC/IEEE bus with command `SYSTem:COMMunicate:GPIB: ADDRess`. Addresses 0 to 30 are permissible.

Manually: **Setup - Remote - GPIB ...**

Via IEC/IEEE bus:

```
CALL IBFIND("DEV1", generator%)                  'Open port to the instrument
CALL IBPAD(generator%, 28)                       'Inform controller about old address
CALL IBWRT(generator%, "SYST:COMM:GPIB:ADDR 18") 'Set instrument to new address
CALL IBPAD(generator%, 18)                       'Inform controller about new address
```

Sending the first command starts remote control operation.
Return to manual operation is possible via the front panel or the IEC/IEEE bus.

Manually:

- Press *the* LOCAL *key.*

Notes:

Before the transition, command processing must be completed as otherwise transition to remote control is performed immediately.

The LOCAL *key can be disabled by the interface message &LLO (see chapter 8, section "IEC/IEEE-Bus Interface Functions") in order to prevent unintentional transition. In this case, transition to manual mode is only possible via the IEC/IEEE bus.*

The LOCAL *key can be enabled again by deactivating the REN line of the IEC/IEEE bus (see chapter 8, section "IEC/IEEE Bus Interface").*

Via IEC/IEEE bus:

```
...
CALL IBLOC(generator%)    'Set instrument to manual operation
...
```

Remote Control via LAN Interface

For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol.
Software for instrument control and the VISA program library must be installed on the controller.
Instrument control is via the VXI-11 standard protocol.
Only the IP address or the computer name (host name) is required for link setup. The IP address/computer name is part of the "visa resource string" used by the programs for identification and control of the instrument. The visa resource string has the form:

TCPIP::ipaddr::inst0::INSTR

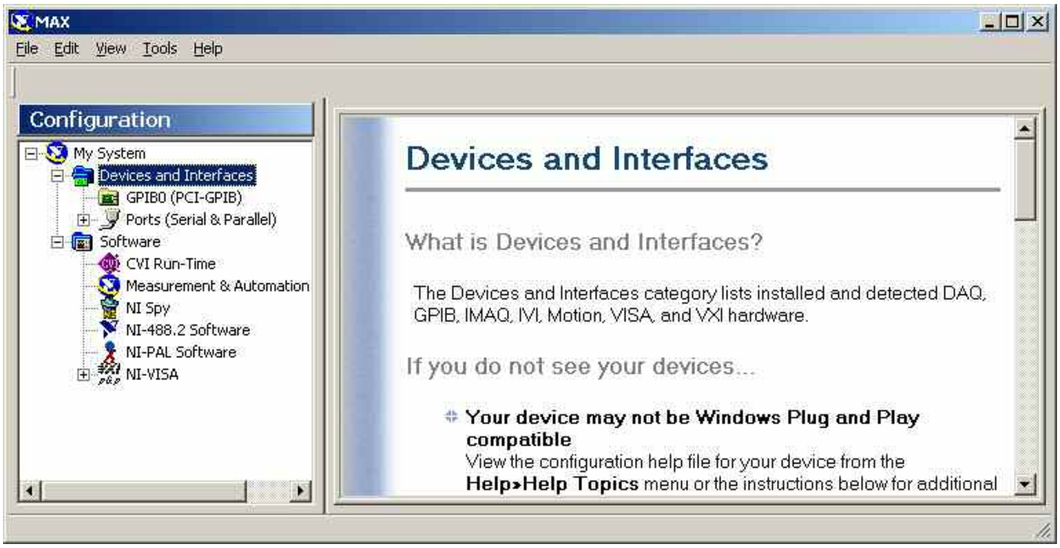
ipaddr has to be replaced by the IP address or the computer name of the instrument.
For instance, if the instrument has the IP address 192.1.2.3, TCPIP::192.1.2.3::inst0::INSTR is the valid resource string. Specification of **inst0** in the resource string is optional. In this example, also TCPIP::192.1.2.3::INSTR is therefore a valid resource string.
A visa resource string with computer name could be TCPIP::RSSM1::INSTR, for instance.
TCPIP designates the network protocol used and **INSTR** indicates that the VXI-11 protocol is used.

Note:
The visa resource string is indicated in the Setup-Remote -Ethernet menu.

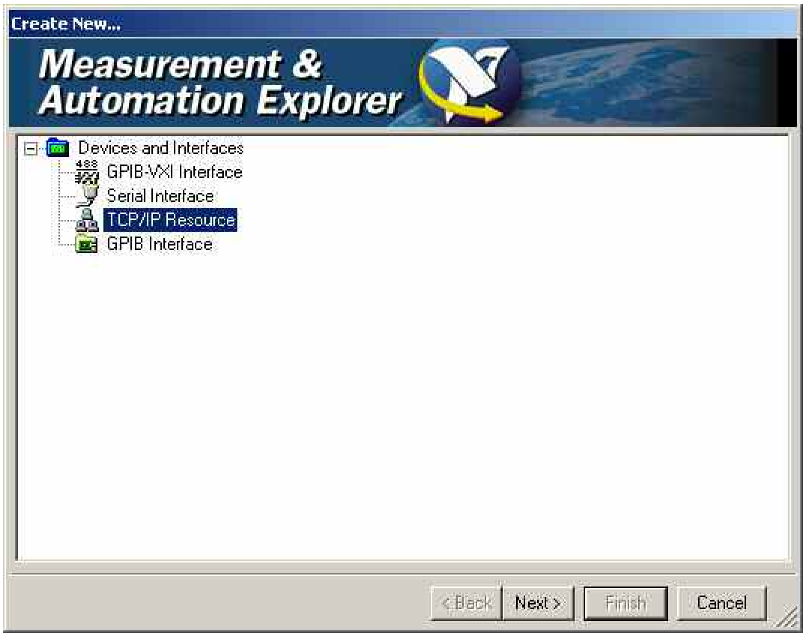
If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by means of the resource string.
In the example below, the program 'Measurement & Automation Explorer' from National Instruments is used for setting up an Ethernet remote-control link. Link setup with this program is easy and first tests can be performed. The R&S Signal Generator is preconfigured 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 a fixed IP address to the instrument (see chapter 1, section "*Connection to the Network*").

Setting up Control of the R&S Signal Generator in the 'Measurement & Automation Control' Program.

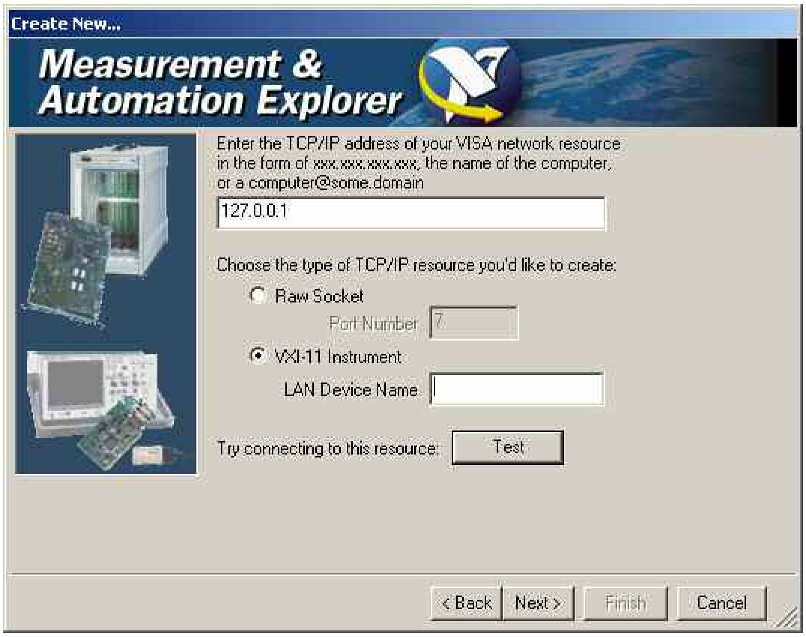
1. Start program on the controller
2. Open the **Create new** menu with the right mouse key.



3. Select **TCP/IP Resource** and open the next page of the **Create new** menu with the right mouse key.

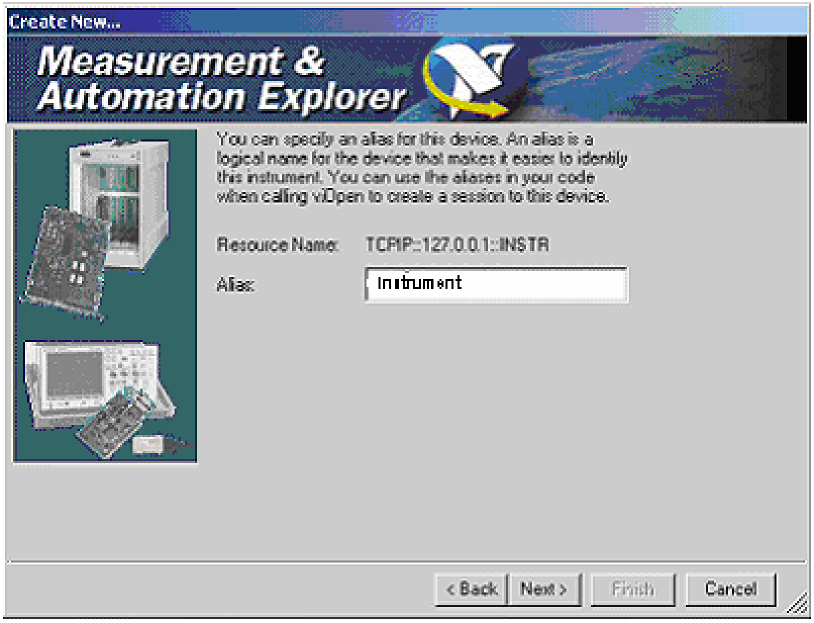


4. Enter the IP address of the R&S Signal Generator and select **VXI-11 Instrument** (the computer name may be entered instead).

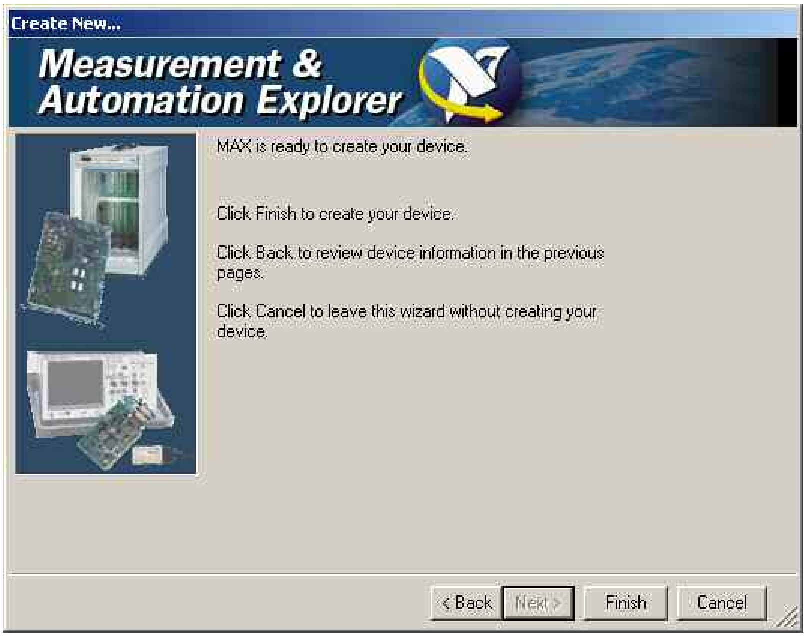


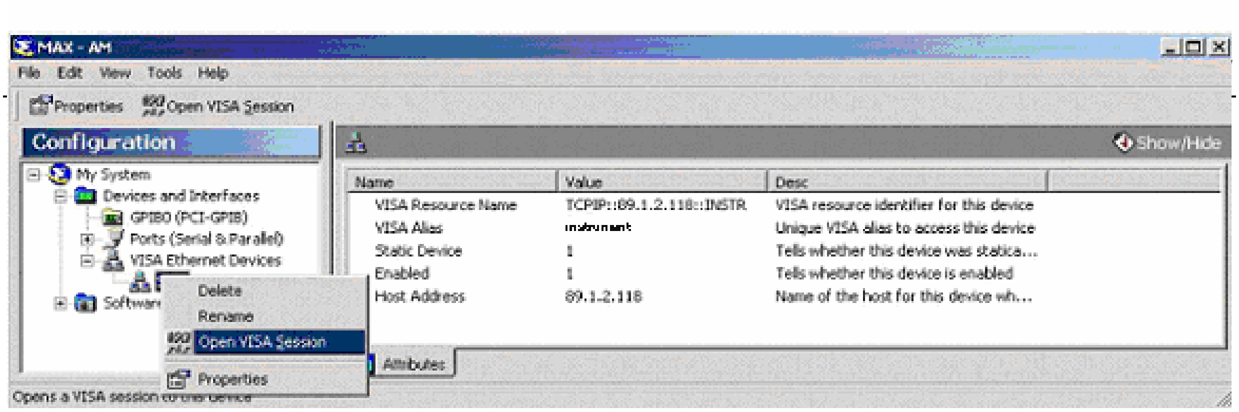
5. Press the **Test** button
   A message indicates whether the link to the R&S Signal Generator can be set up or not. If a connection cannot be set up, check whether the controller and the instrument are connected to the network (network cable) and switched on. Correct spelling of the IP address or the computer name can also be checked. For further error location, inform the network administrator. In large networks, specification of additional addresses may be required for link setup, e.g. gateway and subnet mask, which are known to the network administrator.

6. Press the **Next** button. An alias name for the instrument can be entered in the next window. 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.

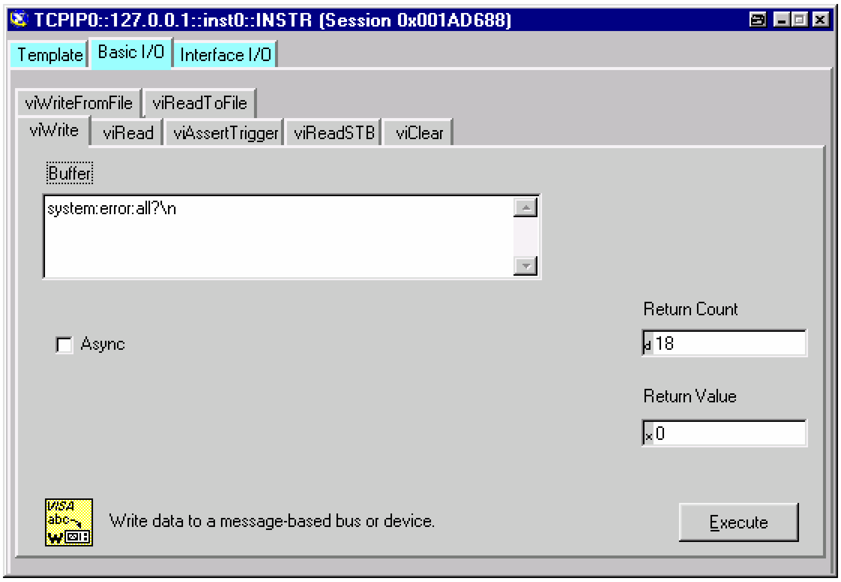


7. Press **Next** and then the **Finish** button.
   The instrument is now registered in the program and can be addressed via the resource string or alias name.





4. 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 of the program).



Return to manual operation is possible via the front panel or the LAN interface.

Manually:

- Press *the* [LOCAL] *key.*

Notes:

The [LOCAL] *key can be disabled by the universal command &LLO (see chapter 8, section VXI-11 Interface Messages) in order to prevent unintentional transition. In this case, transition to manual mode is only possible via remote control.*

The [LOCAL] *key can be enabled again by the interface message &NREN (see chapter 8, section VXI-11 Interface Messages).*

Via IEC/IEEE bus:

...

`CALL IBLOC(generator%)` 'Set instrument to manual operation

...

Remote Control via USB Interface

The PC and the instrument must be connected via the USB type B interface. An USB connection requires the VISA library to be installed. VISA will detect and configure the generator automatically when the USB connection is established. No entry of an address string and no separate driver installation is necessary.
The used USB address string is:
USB::<vendor Id>::<product Id>::<serial number>::INSTR

Example:
"USB::0x0AAD::0x005F::100001::INSTR", where:
the first block 0x0AAD is the vendor Id for Rohde&Schwarz,
the second block is the product Id for the R&S Signal Generator
and the third block is the individual serial number on the rear panel of the instrument.

Interface and Device Messages

The messages transferred via the data lines of the IEC/IEEE-bus (see chapter 8, section "IEC/IEEE Bus Interface") or via a TCP/IP network can be divided into two groups:

– – interface messages and

– – device messages.

Interface Messages

Interface messages are transferred on the data lines of the IEC/IEEE bus, the ATN control line being active. They are used for communication between controller and instrument and can only be sent by a computer which has the function of an IEC/IEEE bus controller.

Interface commands can be further subdivided into

- **universal commands**
- **addressed commands**

Universal commands act on all devices connected to the IEC/IEEE-bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in chapter 8, section "IEC/IEEE Bus Interface".

If an Ethernet connection is present, signalling via a hardware control line is not required. The IEC/IEEE-bus interface commands are emulated (see chapter 8, section "LAN Connector").

Device Messages (Commands and Device Responses)

Device messages are transferred on the data lines of the IEC/IEEE-bus, the "ATN" control line not being active. ASCII character set is used.

If an Ethernet connection is present, signalling via a hardware control line is not required.

The device messages are equal for the different interfaces (IEC/IEEE bus and Ethernet). A distinction is made according to the direction in which they are sent:

Commands (Program Messages) are messages the controller sends to the instrument. They operate the device functions and request information.

The commands are subdivided according to two criteria:

1. According to the effect they have on the instrument:

Setting commands cause instrument settings such as a reset of the instrument or setting the frequency.

Queries cause data to be provided for output on the IEC/IEEE bus, e.g. for identification of the device or polling a parameter value. Queries are formed by directly appending a question mark to the header.

2. According to their definition in standard IEEE 488.2 and SCPI:

Common commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standardized status registers, reset and selftest.

Instrument control commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee Device-specific extensions following the SCPI rules are permitted by the standard.

Device responses (Response Messages and Service Request) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. section "Responses to Queries", page 5.16).

Structure and syntax of the device messages are described in the following section.

SCPI Command Structure and Syntax

The commands consist of a so-called header and, in most cases, one or more parameters. The header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note:
The commands used in the following examples are not in every case implemented in the instrument.

or more parameters, if any.

Examples:

`*RST`	RESET, resets the device
`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable register
`*ESR?`	EVENT STATUS QUERY, queries the contents of the event status register.

Instrument control commands

Hierarchy**:** Instrument control commands are of hierarchical structure (see figure below). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system

Example: `:SOURce`

This key word denotes the command system `SOURce`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example: `SOURce:BB:DM:FORMat QPSK`
'selects the QPSK format for of digital modulation.

This command lies in the fourth level of the SOURce.

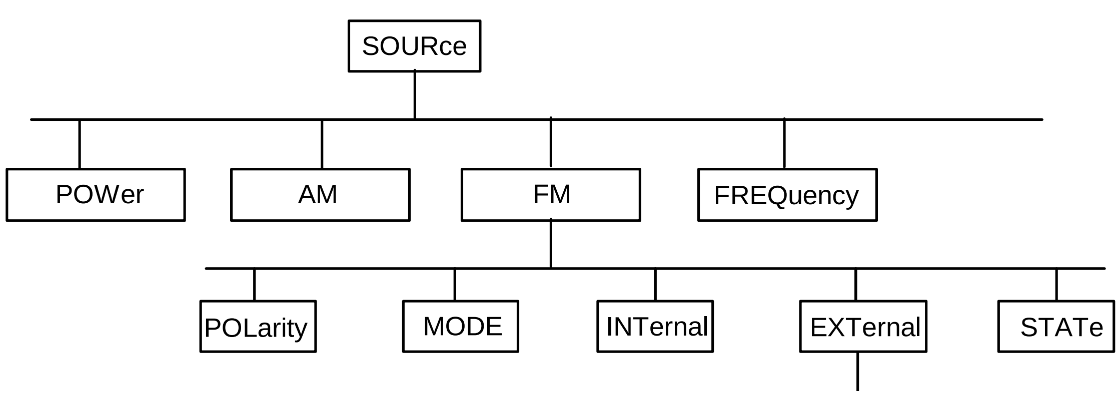


Figure 5-1 Example for the tree structure of the SCPI command systems; the `SOURce` system

Multiple key words

Some key words occur on several levels within one command system. Their effect depends on the structure of the command, i. e. on the position in the command header they are inserted in.

Example: `SOURce:BB:DM:STATe ON`

This command contains key word STATe in the fourth command level. It switches digital modulation on.

`SOURce:BB:DM:PRAMp:STATe ON`

This command contains key word STATe in the fifth command level. It switches power ramping on.

Optional key words:

Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in this manual. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by omitting optional key words.

Example: **[**`SOURce:]BB:DM:PRAMp[:STATe] ON`

This command switches power ramping on. The following command has the same effect:

`BB:DM:PRAMp ON`

Note:
An optional key word must not be omitted if its effect is specified in detail by a numeric suffix. In the R&S Signal Generator, this for instance applies to the keyword SOURce which can be omitted for path A = SOURce1 but must be specified for path B = SOURce2.

Long and short form:

The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permitted.

Example: `STATus:QUEStionable:ENABle 1` ≡ `STAT:QUES:ENAB 1`

Note:
Upper-case and lower-case notation only serves to distinguish the two forms in the manual, the instrument itself does not distinguish upper-case and lower-case letters.

Parameters:

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to section Parameters, page 5.16 .

Example: `SOURce:IQ:OUTPut:BIAS:Q? MAXimum`

Response: `2.7`

This query requests the maximal value (2.7 V) for the amplifier bias of the Q signal component.

Numeric suffix: If a device features several functions or features of the same kind, e.g. several inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1. Optional keywords must be specified if they select a function with the suffix.

Example: `SOURce2:BB:DM:STATe ON`

This command activates digital modulation for path B. The keyword `SOURce` must be specified in the command. For path A, the keyword is optional and can be omitted.

Note:
In case of remote control, suffix counting may differ from the numbers of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.
Some standards define a fixed numbering, starting with 0. With GSM, for instance, slots are counted from 0 to 7. In the case of remote control, the slots are selected with the suffixes 1 to 8.
If the numbering differs in manual operation and remote control, it is indicated with the respective command.

Structure of a Command Line

A command line may consist of one or several commands. It is terminated by an EOI together with the last data byte.
Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon. A colon ":" at the beginning of a command marks the root node of the command tree.

Example: `":SOURce:BB:IMPairment:IQRatio 4PCT; :SOURce:IQ:OUTPut:TYPE DIFF"`

This command line contains two commands. The first command is part of the IMPairment system and is used to set the imbalance for the digital I/Q channels. The second command is part of the OUTPut system and sets the analog output type to DIFFerential.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Figure 0-1). The colon following the semicolon must be omitted in this case.

Example: `"SOURce:BB:IMP:IQRatio 4PCT;:SOURce:BB:IMP:STATe ON"`

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SOURce command system, subsystem BB and subsystem IMPairment, i.e. they have three common levels.The first command sets the imbalance for the digital I/Q channels. The second command enables the impairment values.

When abbreviating the command line, the second command begins with the level below `SOURce:BB:IMPairment`. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

`"SOURce:BB:IMP:IQRatio 4PCT; STATe ON"`

Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1. The requested parameter value is transmitted without command header.

   Example: `"SOURce:BB:DM:FORMat?"` Answer: `BPSK`

2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values

   Example: `"SOURce:IQ:OUTPut:BIAS:Q? MAXimum"` Answer: `2.7`

3. Boolean values are returned as 0 (for OFF) and 1 (for ON).

   Example: `"SOURce:IQ:OUTPut:STATe?"` Answer (for ON): `ON` or `1`

4. Text (character data) is returned in a short form

   Example: `"SOURce:BB:DM:FILter:TYPE?"` Answer (for COSine): `COS`

Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description.

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the values must be in the value range –9.9E37 to 9.9E37. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed.

Units

In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example:
`SOUR:BB:MCCW:CARR:SPAC 1MHZ = SOUR:BB:MCCW:CARR:SPAC 1E6`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:
`:SOURce:BB:IMPairment:IQRatio 4PCT`

Special numeric values

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as special numerical values.

In the case of a query, the associated numerical value is provided.

Example:
Setting command:
`:SOURce:IQ:OUTPut:BIAS:Q MAXimum`

Query:
`:SOURce:IQ:OUTPut:BIAS:Q?` Answer: `2.7`

`MIN/MAX` — `MINimum` and `MAXimum` denote the minimum and maximum value

`DEF` — `DEFault` denotes a preset value. This value conforms to the default setting, as it is called by the *RST command.

`UP/DOWN` — `UP`, `DOWN` increases or reduces the numerical value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.

`INF/NINF` — `INFinity`, Negative INFinity (`NINF`) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device responses.

`NAN` — Not A Number (`NAN`) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are division by zero, subtraction or addition of infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. ON or OFF is returned by a query.

Example:
Setting command:
`:SOURce:IQ:OUTPut:STATe ON`

Query:
`:SOURce:IQ:OUTPut:STATe?` Answer: `1`

Text

Text parameters observe the syntax rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:
Setting command:
`:SOURce:BB:DM:CLOCK:MODE SYMBol`

Query:
`:SOURce:BB:DM:CLOCK:MODE?` Answer: `SYMB`

Strings

Strings must always be entered within quotation marks (' or ").

Example:

```
DIAGnostic:MEASure:POINt?      'DIAG_UNICOD_INT_ROUT' or
                               "DIAG_UNICOD_INT_ROUT"
```

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter with definite length has the following structure:

Example: `MMEMory:DATA test_file.wv, #45168xxxxxxxx`

Test_file.wv denotes the name of the file to which the data are written. The comma is followed by the binary data block. The hash symbol # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted.

The format of the binary files within the block depends on the IEC/IEEE-bus command

`SOURce:LIST:FREQuency|:POWer` (R&S SMx only)

`SOURce:CORRection:CSET:DATA:FREQuency|:POWer` (R&S SMx only)

`SOURce:BB:MCCW:CARRier:LIST:PHASe |:POWer`

use the IEEE-754 format for double precision floating point numbers. Each number is represented by 8 bytes.

Example:
a# = 125.345678E6

b# = 127.876543E6

```
CALL IBWRT(generator%, "SOURce:BB:MCCW:CARRier:LIST:PHASe
#216" + MKD$(a#) + MKD$(b#))
```

- #' in the command string introduces the binary block,
- 2' indicates that 2 digits specifying the length will follow next,
- 16' is the length of the binary block (in bytes), here: 2 double precision floating point number with 8 bytes each.
- The actual binary data follow now. As the function IBWRT requires a text string, MKD$ is used for the type conversion.

The following ASCII format has the same effect:

```
CALL IBWRT(generator%, "SOURce:BB:MCCW:CARRier:LIST:PHASe
125.345678E6, 127.876543E6")
```

Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

: The colon separates the key words of a command. In a command line the separating semicolon marks the uppermost command level.

; The semicolon separates two commands of a command line. It does not alter the path.

, The comma separates several parameters of a command.

? The question mark forms a query.

***** The asterisk marks a common command.

" Quotation marks introduce a string and terminate it.

The hash symbol # introduces binary, octal, hexadecimal and block data.

Binary: #B10110
Octal: #O7612
Hexa: #HF3A7
Block: #21312

A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates header and parameter.

Instrument Model and Command Processing

The block diagram in the figure below shows how SCPI commands are serviced in the instrument. The individual components work independently and simultaneously. They communicate with each other by means of so-called "messages".

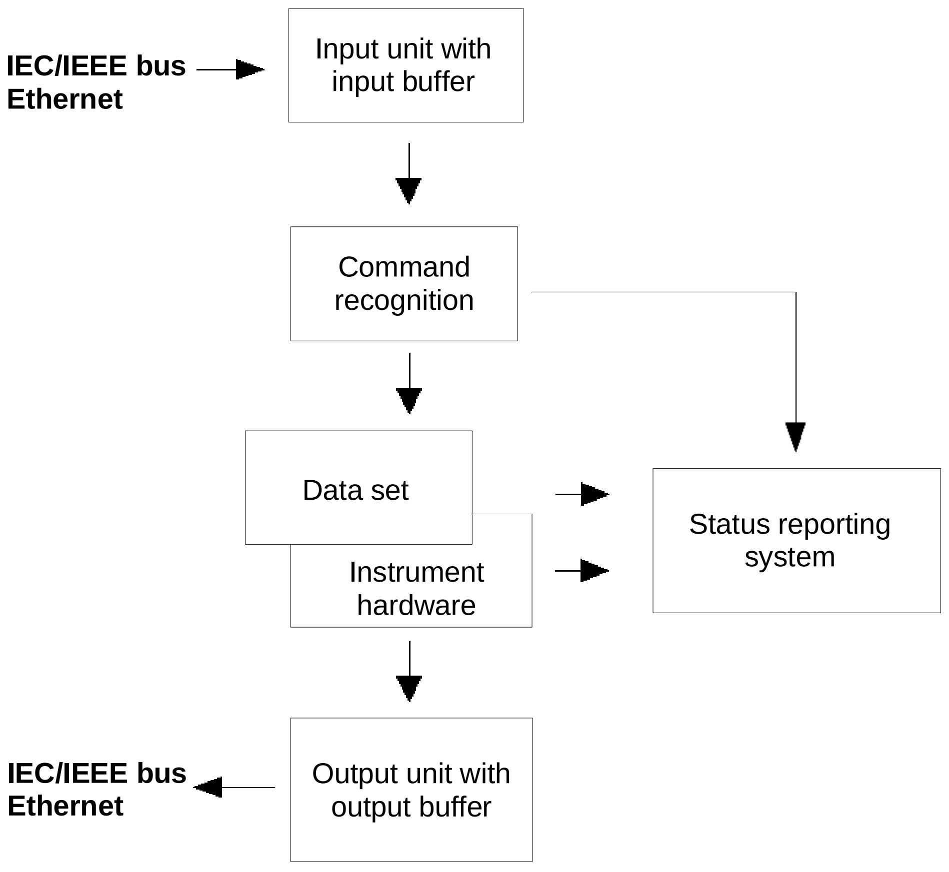


Figure 5-2 Instrument model in the case of remote control via IEC/IEEE bus or TCP/IP network

Input Unit

The input unit receives commands character by character from the IEC/IEEE bus or via the Ethernet and collects them in the input buffer. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.
If the input buffer is full, the traffic is stopped and the data received up to then is processed. Subsequently the traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before. Each recognized command is immediately transmitted to the data set but not executed immediately.
The command recognition detects syntax errors in the commands and transfers them to the status reporting system. The rest of a command line after a syntax error is analyzed further if possible and serviced. After the syntax test, the value range of the parameter is checked, if required.
If the command recognition detects a delimiter or a DCL, it also requests the data set to perform the necessary instrument hardware settings. Subsequently it is immediately prepared to process further commands. This means that new commands can already be serviced while the hardware is still being set ("overlapping execution").

Data Base and Instrument Hardware

The expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation etc. The controller is not included. The term "database" denotes a database that manages all the parameters and associated settings required for setting the instrument hardware.
Setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. power) into the data set, however, only passes them on to the hardware when requested by the command recognition. As this is only ever effected at the end of a command line, the order of the setting commands in the command line is not relevant.
The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that execution is not possible, an "execution error" is signaled to the status reporting system. All alterations of the data set are canceled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, impermissible instrument states can be set for a short period of time within one command line without this leading to an error message. At the end of the command line, however, a permissible instrument state must have been reached again.

Example:

With **Custom Digital Modulation**, the settable FSK deviation depends on the set symbol rate (in case of FSK modulation). The R&S Signal Generator responds as follows:

Assuming the set symbol rate is 100 ksymb/s, i.e. the permissible value range for FSK deviation is 1 kHz to 150 kHz. A deviation of 300 kHz should be set. To do so, the symbol rate has to be changed to 150 ksymb/s. The following commands are sent:

1. All commands in one program message:

```
:SOUR:BB:DM:FORM FSK2; :SOUR:BB:DM:FSK:DEV 300kHz; :SOUR:BB:DM:SRAT
150kHz
```

This command line yields the desired setting. Since a valid state is obtained at the end of the program message, no error message is issued.

2. Each command in a separate program message:

   `:SOUR:BB:DM:FORM FSK2`

   `:SOUR:BB:DM:FSK:DEV 300kHz`

   `:SOUR:BB:DM:SRAT 150kHz`

   The command for setting the FSK deviation is rejected and an execution error is generated. At the time when this command is processed, the previous setting of the symbol rate (100 ksymb) is still valid, i.e. the value for the FSK deviation is outside the permissible value range. The two other commands are set.

3. The two first commands in one program message, the third command in a separate program message.

   `:SOUR:BB:DM:FORM FSK2; :SOUR:BB:DM:FSK:DEV 300kHz`

   `:SOUR:BB:DM:SRAT 150kHz`

   The command for setting the FSK deviation is rejected and an execution error is generated. At the time when this command is processed, the previous setting of the symbol rate (100 ksymb) is still valid, i.e. the value for the FSK deviation is outside the permissible value range. The two other commands are executed.

This example shows that it is advisable to send interdependent commands in one program message as in this case the sequence in which they are sent is irrelevant.

For further examples on command sequence see section "Command Sequence and Command Synchronization", on page *5.22*.

Before passing on the data to the hardware, the settling bit in the `STATus:OPERation` register is set (see section Status Reporting System, page 5.25. The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

Queries induce the data set management to send the desired data to the output unit.

Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in section "Status Reporting System", page 5.25.

Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer.

If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends the error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC/IEEE bus or via the Ethernet , the controller waits until it has reached its time limit. This behavior is specified by SCPI.

Command Sequence and Command Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- An overlapped command is one which does not automatically finish executing before the next command starts executing. Overlapped commands allow the program to do other tasks while being executed.
- A sequential command is one which always finishes before the next command starts executing. Sequential commands are not implemented in the generator, however the execution time of most commands is so short that they act as sequential commands when sent in different command lines.

If a particular device action can be performed only after the execution of a previous overlapped command, the controller must know when the overlapped command has finished. The necessary interaction between the controller and the test instrument is called command synchronization.

Example 1: Overlapped command followed by non-conflicting commands

Suppose that the generator is switched on to provide a real time test signal that requires some calculation time. At the same time some settings for the configuration of a different signal are made which do not interact with the generated signal (e.g. the signal may be used later on).

The signal generation and the signal configuration are independent from each other, so none of the following overlapped commands needs to be synchronized:

```
SOURce:BB:3GPP:STAT ON
SOURce:BB:GSM:FORMat FSK2
```

Example 2: Overlapped command followed by conflicting commands

Suppose that the generator is switched on to provide a real time test signal that requires some calculation time. This signal is to be added to a waveform from the second baseband generator. In this case the application program must ensure that the real signal is actually available in the added signal before further action is started. This involves an appropriate synchronization technique for the first command (the following sseqzuence assumes an appropriate routing):

```
SOURce:BB:3GPP:STAT ON
<Wait until command has finished>
SOURce2:BB:GSM:STATe ON
```

Depending on the selected synchronization techniques, non-conflicting commands can be executed while waiting until the synchronized overlapped command has finished.

Command Sequence

According to section "*Data Base and Instrument Hardware*", overlapped execution is possible in principle for all commands of the signal generator. Equally, setting commands within one command line are not necessarily serviced in the order in which they have been received.In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line (see also example in section "Data Base and Instrument Hardware", on page *5.20*).

Example 1: Commands and queries in one command line

The response from a query combined in a program message with commands that affect the queried value is not predictable. Sending

`SOURce:BB:GSM:MODE DOUBle; FRAMe2:REPetitions 20`

`SOURce:BB:GSM:FRAMe2:REPetitions?`

always returns 20. When:`SOURce:BB:GSM:MODE DOUBle; FRAMe2:REPetitions 20; FRAMe2:REPetitions?`

is sent, however, the result is not specified by SCPI. The result could be the RF generator frequency before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1GHz if the instrument executes commands as they are received.

As a general rule, send commands and queries in different program messages.

Example 2: Overlapped command with *OPC in one command line

Assuming that `SOURce:BB:3GPP:STAT ON` takes longer to execute than *OPC, sending the command sequence

`SOURce:BB:W3GPp:STAT ON; *OPC?`

results in initiating the calculation of the 3GPP signal and, and after the calculation is finished, setting the OPC bit in the ESR.

Sending the commands:

`SOURce:BB:W3GPp:STAT ON; *OPC?; CLS`

still the calculation of the 3GPP signal. Since the calculation may not yet be finished when the signal generator executes *CLS, *OPC can be effectively skipped. In this case the OPC bit is not set until the signal generator executes another *OPC command.

As a general rule, avoid sending commands with reverse action in a single command line.

Command Synchronization

In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By suitable programming, the controller can be forced to wait for the respective action to occur (see table).

*Table 5-1 Synchronization with *OPC, *OPC? and *WAI*

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the ESR after all previous commands have been executed.	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed. Disabling bit 4 (MAV) of the SRE register. **Alternative:** Service request or timeout method with enabled MAV bit; see below.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Sending *WAI directly after the command whose processing should be terminated before other commands are executed.

Command synchronization by means of a *WAI or *OPC? appended to an overlapped command is a good choice if the overlapped command takes only little time to process. The two synchronization techniques simply block overlapped execution of the command.
For time consuming overlapped commands it is usually desirable to allow the controller or the R&S signal generator to do other useful work while waiting for command execution. Use one of the following methods:

***OPC with a service request**

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Set bit no. 5 in the SRE: *SRE 32 to enable ESB service request.
3. Send the overlapped command with *OPC
4. Wait for a service request

The service request indicates that the overlapped command has finished.

***OPC? with a service request**

1. Set bit no. 4 in the SRE: *SRE 16 to enable MAV service request.
2. Send the overlapped command with *OPC?
3. Wait for a service request

The service request indicates that the overlapped command has finished.

Event Status Register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Send the overlapped command without *OPC, *OPC? or *WAI
3. Poll the operation complete state periodically (by means of a timer) using the sequence: *OPC; *ESR?

A return value (LSB) of 1 indicates that the overlapped command has finished.

***OPC? with short timeout**

1. Send the overlapped command without *OPC, *OPC? or *WAI
2. Poll the operation complete state periodically (by means of a timer) using the sequence: <short timeout>; *OPC?

A return value (LSB) of 1 indicates that the overlapped command has finished. In case of a timeout, the operation is ongoing.

3. Reset timeout to former value
4. Clear the error queue with SYStem:ERRor? to remove the "-410, Query interrupted" entries.

Using several threads in the controller application

As an alternative, provided the programming environment of the controller application supports threads, separate threads can be used for the application GUI and for controlling the instrument(s) via SCPI.
A thread waiting for a *OPC? thus will not block the GUI or the communication with other instruments.

Status Reporting System

The status reporting system stores information on errors which have occurred. This information is stored in the error queue. The error queue can be queried via IEC/IEEE bus or via the Ethernet.
The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers.
The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.
The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB.

Overview of the Status Register

The following figure shows the status registers used in the R&S Signal Generator.

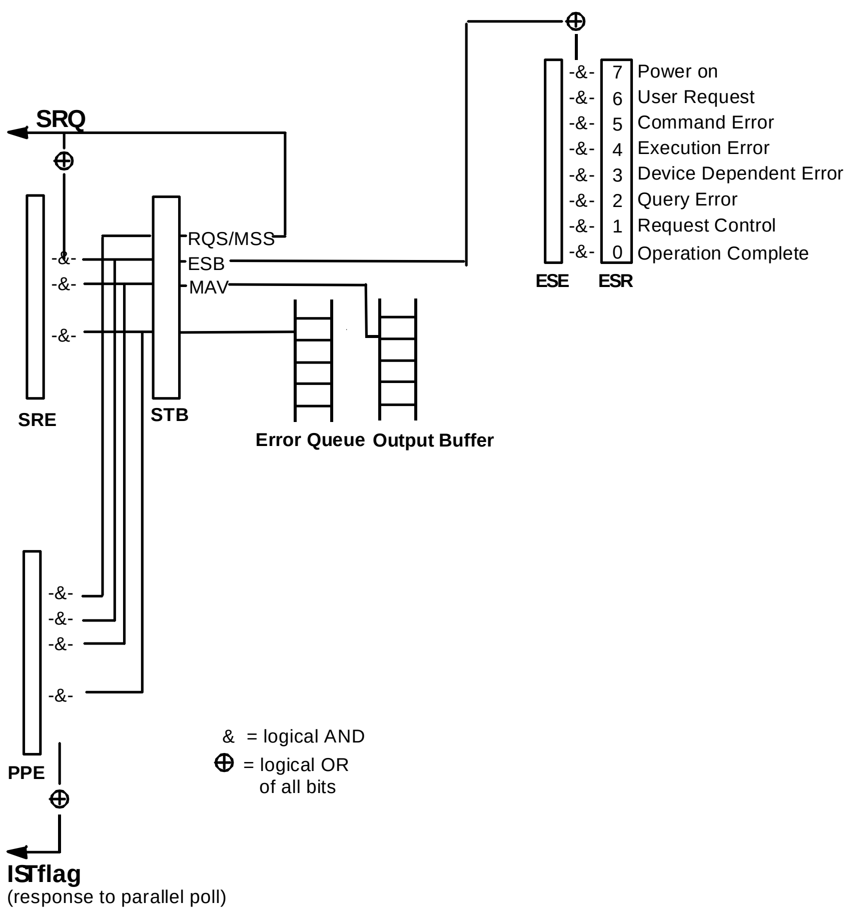


Figure 5-3 Overview of status registers

Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.
The STATUS BYTE is read out using the command "*STB?" or a serial poll.
The STB is linked to the SRE. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the IEC/IEEE bus or via the Ethernet, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command "*SRE" and read using "*SRE?".

Table 5-2 Meaning of the bits used in the status byte

Bit no.	Meaning
0...1	Not used
2	Error Queue not empty The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with Remote control.
3	Not used
4	**MAV bit** (Message available) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.
5	ESB bit Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	**MSS bit** (Master-Status-Summary-Bit) The bit is set if the instrument 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 SRE.
7	Not used

IST-Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. section "Parallel Poll, page 5.28") or using the command "`*IST?`".
The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "`*PRE?`".

Event Status Register (ESR) and Event Status Enable Register (ESE)

The ESR is defined in IEEE 488.2. The event status register can be read out using command "*ESR?". The ESE is the associated ENABle part. It can be set using the command "*ESE" and read using the command "*ESE?".

Table 5-3 Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.
5	Command Error This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set on pressing the LOCAL key, i.e., when the instrument is switched over to manual operation.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

Application of the Status Reporting System

In order to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed. There are several methods, which are outlined in the following.

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from section "Overview of the Status Register", page 5.25, an SRQ is always initiated if one or several of bits 2, 4 or 5 of the status byte are set and enabled in the SRE. Each of these bits combines the information of the error queue or the output buffer. In order to use the possibilities of the service request effectively, all bits should be set to "1" in the enable registers SRE and ESE.

Example:
Use command "`*OPC`" to generate an SRQ

- `CALL IBWRT(generator%, "*ESE 1")` set bit 0 of ESE (Operation Complete)
- `CALL IBWRT(generator%, "*SRE 32")` set bit 5 of SRE (ESB)

After its settings have been completed, the instrument generates an SRQ.
The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request.

Serial Poll

In a serial poll, just as upon the command "`*STB`", the status byte of an instrument is queried. However, the query is made via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.
The VISUAL BASIC command for executing a serial poll is "`IBRSP()`". The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the IEC/IEEE bus or via the Ethernet.

Parallel Poll

In a parallel poll, the controller uses a single command to request up to eight instruments to transmit one bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logical "0" or "1". In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a parallel poll enable register (PPE). This register is ANDed with the STB bit by bit, considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent as a response to the parallel poll of the controller. The result can also be queried without parallel poll by means of the command "`*IST?`".

The instrument first has to be set for the parallel poll using the VISUAL BASIC command "`IBPPC()`". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "`IBRPP()`".
The parallel poll method is mainly used to find out quickly which one of the instruments connected to the IEC/IEEE bus has sent a service request. To this effect, SRE and PPE must be set to the same value.

Query by Means of Commands

Each part of any status register can be read by means of queries. The individual commands are listed in the description of the STATus Subsystem. The returned value is always a number that represents the bit pattern of the register queried. This number is evaluated by the controller program.
Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Error Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages that can be looked at in the ERROR menu via manual operation or queried via the IEC/IEEE bus or via the Ethernet using command "`SYSTem:ERRor?`". Each call of "`SYSTem:ERRor?`" provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with `0, "No error"`.
The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

Reset Values of the Status Reporting Systems

Commands `*RST`, `*DCL` and `SYSTem:PRESet` and switching on the supply voltage also affect the status reporting system. None of the commands, except for `*RST` and `SYSTem:PRESet` influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 5-4 Resetting the Status Reporting System

Event / Effect	Switching on supply voltage Power-On-Status-Clear: 0	Switching on supply voltage Power-On-Status-Clear: 1	DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
Clear STB,ESR	–	yes	–	–	–	yes
Clear SRE,ESE	–	yes	–	–	–	–
Clear PPE	–	yes	–	–	–	–
Clear error-queue	yes	yes	–	–	–	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	–	–	–

1) Every command being the first in a command line, i.e. immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer

Contents - Chapter 6 "Remote Control Commands"

6 Remote-Control Commands - Description of Commands

In the following, all remote-control commands will be presented in detail with their parameters and the ranges of numerical values.

An introduction to remote control and the status registers is given in chapter 5.

Notation

All commands implemented in the instrument are first listed in tables and then described in detail, arranged alphabetically according to the command subsystems. The notation is adapted to the SCPI standard. The SCPI conformity information is included in the individual description of the commands.

Table of Commands

Command: In the command column, the table provides an overview of the commands.

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

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

Remark: In the remark column an indication is made on:

- whether the command does not have a query form,
- whether the command has only one query form

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

The options that are required to execute the command are listed. In case of dependencies between commands they are also indicated.

Upper/lower case notation Upper/lower case letters are used to mark the long or short form of the key words of a command in the description (see Chapter 5). The instrument itself does not distinguish between upper and lower case letters.

Special characters | A selection of key words with an identical effect exists for several commands. These keywords are indicated in the same line; they are separated by a vertical stroke. Only one of these keywords needs to be included in the header of the command. The effect of the command is independent of which of the keywords is used.

Example: `SOURce:FREQuency:CW|:FIXed`

The two following commands with identical meaning can be created. They set the frequency of the fixed frequency signal to 1 kHz

`SOURce:FREQuency:CW 1E3` = `SENSe:FREQuency:FIXed 1E3`

A vertical stroke in parameter indications marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is used.

Example: Selection of the parameters for the command

`SOURce:COUPling  AC | DC`

If parameter AC is selected, only the AC content is fed through, in the case of DC, the DC as well as the AC content.

[ ] Key words in square brackets can be omitted when composing the header (cf. Chapter 5, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.

Parameters in square brackets can be incorporated optionally in the command or omitted as well.

{ } Parameters in braces can be incorporated optionally in the command, either not at all, once or several times..

Description of parameters Due to the standardization, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has therefore specified a series of definitions, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also Chapter 5, Section "Parameters").

<Boolean> This keyword refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword **OFF** or by the numeric value 0, the "on" state is indicated by **ON** or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value>

<num> These keywords mark parameters which may be entered as numeric values or be set using specific keywords (character data).

The following keywords given below are permitted:

MINimum	This keyword sets the parameter to the smallest possible value.
MAXimum	This keyword sets the parameter to the largest possible value.
DEFault	This keyword is used to reset the parameter to its default value.
UP	This keyword increments the parameter value.
DOWN	This keyword decrements the parameter value.

The numeric values associated to MAXimum/MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example: `SOURce:FREQuency? MAXimum`

eturns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>

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

Command Description

Common Commands

The common commands are taken from the standard IEEE 488.2 (IEC 625.2). Identical commands have an identical effect in different instruments. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands affect the status reporting system, which is described in detail in Chapter 5.

Command	Parameters	Default unit	Remark
*CLS			Clear status; no query
*ESE	0...255		Event status enable
*ESR?	0...255		Standard event status query; query only
*IDN?			Identification query; query only
*IST?	0...255		Individual status query; query only
*OPC			Operation complete
*OPT?			Option identification query; query only
*PRE	0...255		Parallel poll register enable
*PSC	0	1		Power on status clear
*RCL	1...10		Recall
*RST			Reset; no query
*SAV	1...10		Save
*SRE	0...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 standard event register (ESR), and the EVENt part of the QUEStionable and OPERation register to zero. The command does not change the enable and transition parts of the registers. It deletes the output buffer.

*ESE 0...255

EVENT STATUS ENABLE sets the event status enable register to the specified value. The *ESE? query command 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...255) and then sets the register to zero.

*IDN?

IDENTIFICATION QUERY queries the instrument identification. The instrument type, serial number and firmware version are returned.

*IST?

INDIVIDUAL STATUS QUERY returns the content of the IST flag in decimal form (0 **|** 1). The IST flag is the status bit which is sent during a parallel poll.

*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 to ensure that the timeout set at the IEC/IEEE bus is long enough.

*OPT?

OPTION IDENTIFICATION QUERY queries the options configured in the instrument and returns a list of the installed options. The options are separated by commas.

*PRE 0 ... 255

PARALLEL POLL REGISTER ENABLE sets the parallel poll enable register to the specified value. The *PRE? query command returns the content of the parallel poll enable register in decimal form.

*PSC 0 | 1

POWER ON STATUS CLEAR determines whether the content of the ENABle registers are retained or reset at power on.

Parameters: **0**

The content of the status registers is retained at power on. If the status registers ESE and SRE are configured accordingly, this may cause a service request to be triggered at power on.

1

The content of the status registers is reset at power on.

The **query** *PSC? retrieves the contents of the Power-on-Status-Clear flag. The answer is either 0 or 1.

*RCL <number>

RECALL calls up the instrument status which was stored under the specified number using the `*SAV` command, e.g. `*SAV 4`. It also activates the instrument settings which are stored in a file and loaded using the `MMEMory:LOAD <number>, <file_name.extension> command`.

***RST**

RESET resets the instrument to a defined default state. (see section "Preset Commands", on page 6.7)

***SAV <number>**

SAVE stores the current device state under the specified number (see also *RCL). The command is used to store the current instrument state in an intermediate memory. The instrument state can be recalled by using the command *RCL with the associated number.
To transfer the stored instrument settings in a file, command `MMEMory:STORe <number>, <file_name.extension>` is used. Parameter file extension is *.savrcl. Parameter <number> is the specific number defined with the *SAV command, e.g. *SAV 4.

***SRE 0 ... 255**

SERVICE REQUEST ENABLE sets the service request enable register to the specified value. Bit 6 (MSS enable bit) remains 0. This command determines the conditions under which a service request is triggered. The *SRE? query command reads out the content of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads out the content of the status byte in decimal form.

***TRG**

TRIGGER triggers all actions which are waiting for a trigger event. Specific trigger events can be triggered by means of the "TRIGger" command system (sweep and lists) or the SOURce subsystems (baseband).

***TST?**

SELF TEST QUERY triggers all self tests of the instrument and outputs an error code in decimal form (see Service Manual supplied with the instrument).

***WAI**

WAIT-to-CONTINUE does not allow subsequent commands to be processed until all previous commands have been executed and all signals are in their transient condition.

Preset Commands

The preset commands are not bundled in one subsystem. Therefore, they are listed separately in this section. In addition, a specific preset command is provided for each digital standard and for the fader. These specific commands are described in the associated subsystems.

Four presetting actions are available:

1. Activating the default state of all internal instrument functions (`*RST`). Functions that concern the integration of the instrument into a measurement setup are not changed, e.g. IEC/IEEE bus address or reference oscillator source settings.
2. Activating the preset state of the parameters related to the selected signal path (`SOURce<[1]:2>:PRESet`)
3. Activating the preset state of all parameters that are not related to the signal path (`DEVice:PRESet`)
4. Activating the original state of delivery (factory reset, SYSTem:FPReset). Only functions that are protected by a password remain unchanged as well as the passwords themselves.

Command	Parameters	Default unit	Remark
DEVice:PRESet			No query
*RST			No query
SOURce<[1]|2>:Preset			No query
SYSTem:FPReset			No query

DEVice:PRESet

The command presets all parameters which are not related to the signal path. This includes presetting the LF generator and bit/block error measurement.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"DEV:PRES"`
'presets all instruments settings that are not related to the signal path.

*RST value	Resolution	SCPI
-	-	Device-specific

*RST

RESET resets the instrument to a defined default state. The command has the same effect as pressing the PRESET key. The default setting is given in the description of the commands.

Fading (if available) and transient recorder are only preset by this command.

Functions that concern mainly the integration of the instrument into a measurement setup or are password related are not changed:

- Reference frequency settings
- Power on settings
- Network settings
- IEC/IEEE-bus address
- Password and settings protected by passwords
- Start/Stop Gui Update
- Display and keyboard settings

SOURce<[1]:2>:PRESet

The command presets all parameters which are related to the selected signal path.

Fading (if available) and transient recorder are only preset by command `*RST`.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"SOUR:PRES"`
'presets all settings that are related to signal path.

*RST value	Resolution	SCPI
-	-	Device-specific

SYSTem:FPReset

The command triggers an instrument reset to the original state of delivery.

Note:
*Since **Factory Preset** resets the Remote Channel and network settings to the default values, executing Factory Preset via remote control terminates the connection to the instrument, if these settings had been configured to values different to the default ones!*

The **Factory Preset** function resets nearly all instrument settings. In addition to the regular preset by means of the PRESET key, a **Factory Preset** resets also the following values:

- Reference frequency settings (Ref Oscillator menu)
- Power on settings (Level/EMF menu)
- Network settings including hostname (Setup menu)
- Remote Channel settings including IEC/IEEE-bus address and emulation (Setup menu)
- Start/Stop Gui Update (Setup menu)
- Display and keyboard settings (Setup menu).

To maintain security, password settings and all settings protected by these passwords like disabled USB and LAN connections are not changed.
Not affected by the **Factory Preset** are also user data, lists or instrument settings files, created for example by means of the Save/Recall function.

The command triggers an event and therefore has no *RST value and no query form.

Example: `SYST:FPR`
'all instrument settings (also those that are not currently active) are reset to the factory values.

*RST value	Resolution	SCPI
-	-	Device-specific

CALibration Subsystem

The CALibration system contains the commands for adjustment. Adjustment is triggered by the query commands. The response "0" indicates error-free adjustment, and the response "1" means that an error occurred during adjustment.

Command	Parameters	Default unit	Remark
CALibration:ALL[:MEASure]?			Query only
CALibration:FMOFfset[:MEASure]?			Query only
CALibration:FREQuency[:MEASure]?			Query only
CALibration:IQModulator:FULL?			Query only
CALibration:IQModulator:LOCal?			Query only
CALibration:LEVel:ALCTable[:MEASure]?			Query only
CALibration:LEVel:EXT:DATA?	FACTory | CUSTom		Query only
CALibration:LEVel[:MEASure]?			Query only

CALibration:ALL[:MEASure]?

The command starts all internal adjustments for which no external measuring equipment is needed.

Example: "CAL:ALL:MEAS?"
'starts the adjustment of all functions for the entire instrument.

Response: "0"
'adjustment has been performed successfully.

*RST value	Resolution	SCPI
-	-	Compliant

CALibration:FMOFfset[:MEASure]?

The command starts all adjustment for the FM/PhiM modulator.

Example: "CAL:FMOF?"
'starts the adjustments for the FM/Phim modulator.

Response: "0"
'the adjustments have been performed successfully.

*RST value	Resolution	SCPI
-	-	Device-specific

CALibration:FREQuency[:MEASure]?

The command starts all adjustments which affect the frequency.

Example: "CAL:FREQ:MEAS?"
'starts the adjustments for maximum frequency accuracy.

Response: "0"
'the adjustments have been performed successfully.

*RST value	Resolution	SCPI
-	-	Device-specific

CALibration:IQModulator:FULL?

The command starts adjustment of the I/Q modulator for the entire frequency range. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature.

The command is a query command and therefore has no *RST value.

Example: `"CAL:IQM:FULL?"`
'starts adjustments for the I/Q modulator across the entire frequency range.

Response: "0"
'adjustment has been performed successfully.

*RST value	Resolution	SCPI
-	-	Device-specific

CALibration:IQModulation:LOCal?

The command starts adjustment of the I/Q modulator for the currently set frequency, I/Q swap and baseband gain. The I/Q modulator is adjusted with respect to carrier leakage, I/Q imbalance and quadrature.

The command is a query command and therefore has no *RST value.

Example: `"CAL:IQM:LOC?"`
'starts adjustment for the I/Q modulator for the currently set frequency.

Response: "0"
'adjustment has been performed successfully.

*RST value	Resolution	SCPI
-	-	Device-specific

CALibration:LEVel:ALCTable[:MEASure]?

Performs ALC adjustments according to the predefined values in the ALC table.

Example: `CAL:LEV:ALCT:MEAS?`
'starts adjustments according to the ALC table.

`Respone: "0"`
'adjustment has been performed successfully.

*RST value	Resolution	SCPI
-	-	Device-specific

CALibration:LEVel:EXT:DATA FACTory | CUSTom

Selects the data used for of external level correction.

By default the instrument uses correction data obtained in the factory before delivery. In addition, customer data can be used for external level correction. The customer data is obtained using a R&S NRP power sensor. External level correction is a protected function (see service manual, chapter 2, "Adjustment").

Example: `CAL:LEV:EXT:DATA FACT`
'selects the use of the data aquired at the factory for external level correction.

*RST value	Resolution	SCPI
FACTory	-	Device-specific

CALibration:LEVel[:MEASure]?

The command starts all adjustments which affect the level.

Example: `"CAL:LEV:MEAS?"`
'starts adjustments for maximum level accuracy.

Response: "0"
'adjustment has been performed successfully.

*RST value	Resolution	SCPI
-	-	Device-specific

CLOCk Subsystem

The CLOCk system contains the commands for configuration of the signals at the clock output and input connectors.

Command	Parameters	Default unit	Remark
CLOCk:INPut:FREQuency			Query only
CLOCk:INPut:SLOPe	POSitive | NEGative		
CLOCk:OUTPut:SOURce			Query only

CLOCk:INPut:FREQuency

The command sets the measured frequency of the external clock signal. An external clock reference must be supplied at the CLOCK input.

The command is a query command and therefore does not have an *RST value.

Example: `"CLOC:INP:FREQ?"`
'queries the measured frequency of the external clock reference.

*RST value	Resolution	SCPI
	-	Device-specific

CLOCk:INPut:SLOPe POSitive | NEGative

The command sets the active slope of an externally applied clock signal at the CLOCK connector.

Example: `"CLOC:INP:SLOP NEG"`
'the active slope of the external clock signal at the CLOCK connector is the falling slope.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

CLOCk:OUTPut:SOURce?

The command queries the path for which the clock signal at the CLOCK OUT connector is to be output.

The command is a query command and therefore does not have an *RST value.

Example: `"CLOC:OUTP:SOUR?"`
'queries the path for which the clock signal at the CLOCK OUT connector is to be output.

Response: A
'the clock signal of path is output at the CLOCK OUT connector.

*RST value	Resolution	SCPI
-	-	Device-specific

DIAGnostic Subsystem

The DIAGnostic system contains the commands used for instrument diagnosis and servicing. SCPI does not define any DIAGnostic commands; the commands listed here are all Device-specific. All DIAGnostic commands are query commands which are not influenced by *RST.

Command	Parameters	Default unit	Remark
DIAGnostic:BGINfo?	<module name>		Query only
DIAGnostic:BGINfo:CATalog?			Query only
DIAGnostic:INFO:OTIMe?			Query only
DIAGnostic:INFO:POCount?			Query only
DIAGnostic:POINt:CATalog?			Query only
DIAGnostic[:MEASure]:POINt?	<point name>		Query only

DIAGnostic:BGINfo? <module name>

The command checks the modules available in the instrument using the variant and revision state.

If the command is sent without parameters being specified, a complete list of all modules is returned (the various entries are separated by commas). The length of the list is variable and depends on the instrument equipment configuration.

If the command is sent with parameters, a list of the specified modules is returned (the various entries are separated by commas). A list of modules names can be called up using the `DIAG:BGIN:CATalog?` command.

Each entry for one module consists of four parts which are separated by space characters:

Module name Module stock number incl. variant   Module revision   Module serial number.

Example: `"DIAG:BGIN?"`
'queries the instrument configuration.

Response: `MBRD,SSYN,IQOP3,IQOP3_LCM,....`
'returns the data of all available modules.

`"DIAG:BGIN? 'MBRD'"`
'queries the configuration of the motherboard.

Response: `MBRD 1141.3501.02 1.5.3 100023`
'module motherboard with stock number 1141.3501.01 has revision 1.5.3 and serial number 100023.

*RST value	Resolution	SCPI
-	-	Device-specific

DIAGnostic:BGINfo:CATalog?

The command queries the names of the assemblies available in the instrument.

A complete list of all assemblies is returned (the various entries are separated by commas). The length of the list is variable and depends on the instrument equipment configuration.

Example: `"DIAG:BGIN:CAT?"`
'queries the names of the assemblies.

Response: `MBRD,SSYN,IQOP3,IQOP3_LCM,....`

*RST value	Resolution	SCPI
-	-	Device-specific

DIAGnostic:INFO:OTIMe?

The command queries the number of operation hours

Example: `"DIAG:INFO:OTIM?"`
'queries the operation hours.

Response: `"100023"`
'the instrument was operated for 100023 hours up to now.

*RST value	Resolution	SCPI
-	-	Device-specific

DIAGnostic:INFO:POCount?

The command queries the number of power-on events.

Example: `"DIAG:INFO:POC?"`
'queries the number of power on events.

Response: `"123"`
'the instrument was switched on for 123 times up to now.

*RST value	Resolution	SCPI
-	-	Device-specific

DIAGnostic:POINt:CATalog?

The command queries the test points available in the instrument. A detailed description of the test points can be found in chapter 3, section "Trouble Shooting" of the Service Manual (on CD-ROM, supplied with the instrument).

Example: `"DIAG:POIN:CAT?"`
'queries the test points available in the instrument.

Response: `'DIAG_IQOP3_LCM_CAL_I,DIAG_IQOP3_LCM_I,...`

*RST value	Resolution	SCPI
-	-	Device-specific

DIAGnostic[:MEASure]:POINt?

The command triggers voltage measurement at the specified test point and returns the measured voltage. A detailed description of the test points can be found in chapter 3, section "Trouble Shooting" of the Service Manual (on CD-ROM, supplied with the instrument).

A list of the available test points for the respective path can be queried using the `DIAG:POIN:CAT?` command.

Example: `"DIAG:POIN? 'DIAG_IQOP3_LCM_CAL_I'"`
'triggers measurement at the test point DIAG_IQOP3_LCM_CAL_I.

Response: `0.5`
'the voltage at the test point is 0.5 volt.

*RST value	Resolution	SCPI
-	-	Device-specific

DISPlay Subsystem

The DISPlay system contains the commands to set the power-save mode of the instrument.

Command	Parameters	Default unit	Remark
DISPlay:PSAVe:HOLDoff	1…60		
DISPlay:PSAVe[:STATe]	ON | OFF		

DISPlay:PSAVe:HOLDoff 1 … 60

This command sets the wait time for the screen-save mode of the display. The available value range is 1 to 60 minutes, the resolution 1 minute. The entry is dimensionless.

Example: `DISP:PSAV:HOLD 10`
"sets the wait for the screen saver mode to 10 minutes.

*RST value	Resolution	Options	SCPI
1	-		Device-specific

DISPlay:PSAVe[:STATe] ON | OFF

This command activates/deactivates the screen-save mode of the display. With the screen-save mode activated the display including backlight is completely switched off after the elapse of the wait time (see command `DISPlay:PSAVe:HOLDoff`) when no entries via front panel, external mouse or external keyboard are made.

This mode is recommended for preserving the display especially if the instrument is exclusively operated via remote control.

Example: `DISP:PSAV ON`
"activates screen saver mode.

*RST value	Resolution	Options	SCPI
OFF	-		Device-specific

FORMat Subsystem

The FORMat subsystem contains the commands which determine the format of the data that the R&S Vector Signal Generator returns to the controller. This affects all query commands which return a list of numerical data or block data. Reference is made to this in the descriptions of the commands.

Command	Parameters	Default unit	Remark
FORMat:BORDer	NORMal | SWAPped		
FORMat[:DATA]	ASCii | PACKed		
FORMat:SREGister	ASCii | BINary | HEXadecimal | OCTal		

FORMat:BORDer NORMal | SWAPped

The command determines the sequence of bytes within a binary block. This only affects blocks which use the IEEE754 format internally.

Parameters: **NORMal**

The R&S Vector Signal Generator expects (with setting commands) and sends (with queries) the least significant byte of each IEEE754 floating-point number first, and the most significant byte last.

SWAPped

The R&S Vector Signal Generator expects (with setting commands) and sends (with queries) the most significant byte of each IEEE754 floating-point number first, and the least significant byte last.

Example: `"FORM:BORD SWAP"`

'the data is transferred with the most significant bit first.

*RST value	Resolution	SCPI
NORMal	-	Compliant

FORMat[:DATA] ASCii | PACKed

The command determines the data format which the R&S Vector Signal Generator uses to return data. When data is transferred from the control computer to the instrument, the instrument detects the data format automatically. In this case, the value set here is irrelevant.

Parameters: **ASCii**

Numerical data is transferred as plain text separated by commas.

PACKed

Numerical data is transferred as binary block data. The format within the binary data depends on the command. The various binary data formats are explained in the description of the parameter types.

Example: `"FORM ASC"`

'the data is transferred as ASCII data.

*RST value	Resolution	SCPI
ASCii	-	Compliant

FORMat:SREGister ASCii | BINary | HEXadecimal | OCTal

The command determines the numerical format which is returned when the status registers are queried.

Parameters: **ASCii**
The register content is returned as a decimal number.

BINary
The register content is returned as a binary number. #B is placed in front of the number.

HEXadecimal
The register content is returned as a hexadecimal number. #H is placed in front of the number.

OCTal
The register content is returned as an octal number. #Q is placed in front of the number.

Example: `"FORM:SREG HEX"`
'the register content is returned as a hexadecimal number.

*RST value	Resolution	SCPI
ASCii	-	Compliant

HCOPy Subsystem

Command	Parameters	Default unit	Remark
HCOPy:DATA?			Query only
HCOPy:DEVice	FILE | PRINter		
HCOPy:DEVice:LANGuage	BMP | JPG | XPM | PNG		
HCOPy:FILE[:NAME]			
:HCOPy:FILE[:NAME]:AUTO:DIRectory			
:HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar			
HCOPy:FILE[:NAME]:AUTO:FILE?			Query only
HCOPy:FILE[:NAME]:AUTO:STATe			
HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe	OFF | ON		
HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?			
HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe	OFF | ON		
HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh?			
HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer:RESet			
HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer?			
HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix			
HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe			
HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe			
HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?			
HCOPy:FILE[NAME]:AUTO?			Query only
HCOPy:IMAGe:FORMat	BMP | JPG | XPM | PNG		
HCOPy:IMAGe:SIZE	320,640 | 640,480 | 800,600 | 1024,768		
HCOPy:PRINter:LIST?			Query only
HCOPy:PRINter:PAGE:MARGins	<top,bottom,left,right>		
HCOPy:PRINter:PAGE:ORIentation	PORTrait | LANDscape		
HCOPy:PRINter:PAGE:SIZE			
HCOPy:PRINter:PAGE:UNIT	CM | IN		
HCOPy:PRINter[:NAME]			
HCOPy[:EXECute]			

HCOPy:DATA?

The commands transfers the hard copy (snapshot) as a NByte stream to the remote client.

The command is a query command and therefore has no *RST value.

Example: `"HCOP:DEV:LANG JPG`

`"HCOP:DATA?"`
'transfers the hard copy to the remote client.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:DEVice FILE | PRINter

The command selects the destination to which the hard copy (snapshot) should be transferred to.

The hard copy either can be printed out by selecting **Printer** or can be saved in a file by selecting **File**, respectively.

Example: `"HCOP:DEV FILE"`
'the hard copy will be stored in a file.

*RST value	Resolution	SCPI
FILE	-	Device-specific

HCOPy:DEVice:LANGuage BMP | JPG | XPM | PNG

The command sets the image format in which the hard copy should be stored.

Example: `"HCOP:DEV:LANG BMP"`
'selects bmp as imge format.

`"HCOP:FILE 'C:/TEMP/snapshot001'"`
'defines directory, path and file for storing the hard copy.

`"HCOP"`
'executees the hard copy procedure.

*RST value	Resolution	SCPI
BMP	-	Device-specific

HCOPy:FILE[:NAME] <name>

Manually naming only

Including drive and path the command stores the hard copy under the entered file name or returns drive, path and file name.

Example: `"HCOP:FILE:NAME 'usb\HCopy'"`
'stores the hard copy .

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:FILE[:NAME]:AUTO:DIRectory

Automatic naming only

The command automatically defines the destination directory where the hard copy will be saved in. The "HCopy" directory will be created if not yet existing.

Example: `"HCOP:FILE:NAME:AUTO:DIR 'usb:\HCopy'"`
'defines the destination directory usb:\HCopy.

*RST value	Resolution	SCPI
.\HCopy	-	Device-specific

HCOPy:FILE[:NAME]:AUTO:DIRectory:CLEar§CLEar":CLEar

This command deletes all image files in the path directory of the hard copy files.

Before deleting the image files a warning message is displayed requiring the confimation of deletion. If confirmed, all files with the extensions "bmp", "img", "png" and "xpm" are deleted.

Example: `"HCOP:FILE:AUTO:DIR:CLE"`
'delets all image files with extensions "bmp", "img", "png" and "xpm".

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:FILE[:NAME]:AUTO:FILE?

Automatic naming only

This command returns the automatically generated file name in which the hard copy will be saved in.

The command is a query command and therefore has no *RST value.

Example: `"HCOP:FILE:AUTO:FILE?"`
'displays the file name of the hard copy file.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:FILE[:NAME]:AUTO:STATe OFF | ON OFF | ON"

The command specifies whether the destination file name of the hard copy command should be automatically generated.

Note:
As default the automatically generated file name is composed of:
*"***`<Path>/<Prefix><YYYY><MM><DD><Number>.<Format>`***".*
Each component can be deactivated/activated separately to individually design the file name.

Example: `"HCOP:FILE:AUTO:STAT OFF"`
'deactivates autmatic naming.

*RST value	Resolution	SCPI
ON	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY:STATe OFF | ON OFF | ON"

Automatic naming only

This command defines wether the currrent day should be appended to the file name.

Example: `"HCOP:FILE:AUTO:DAY:STAT OFF"`
'deactivates appending the day to the automatically generated file name.

*RST value	Resolution	SCPI
ON	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:DAY?"

The command returns the day of the current system date which will be appended to the file name if automatic naming is activated.

The command is a query command and therefore has no *RST value.

Example: `"HCOP:FILE:NAME:AUTO:DAY?"`
'returns a two digit number for the day of the current system date.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh:STATe OFF | ON OFF | ON"

Automatic naming only

This command defines wether the currrent month should be appended to the file name.

Example: `"HCOP:FILE:AUTO:MONT:STAT OFF"`
'deactivates appending the month to the automatically generated file name.

*RST value	Resolution	SCPI
ON	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:MONTh??"

The command returns the month of the current system date which will be appended to the file name if automatic naming is activated.

The command is a query command and therefore has no *RST value.

Example: `"HCOP:FILE:AUTO:MONT?"`
'returns a two digit number for the month of the current system date.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:NUMBer??"

Automatic naming only

The command appends a file number of three digits to the automatically generated file name of the hard copy.

Note:
On initially switching on the device the number will be reset to the lowest possible value. Starting with number 0 the output directory will be scanned for already exisiting files. As long as files with the same name are existing the number will be increased by 1. The number will be automatically set to a number so that the resulting file name will be unique within the selected path. The current number will not be saved in the save recall file but will be temporarily stored within the database. On subsequent saves the number will be increased.

The command is a query command and therefore has no *RST value.

Example: `"HCOP:FILE:AUTO:NUMB?"`
'returns the current unicque number that will be appended to the file name.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix <prefix>

Automatic naming only

This command defines the parameter **<Prefix>** that is appended automatically to the file name of the hard copy. The Prefix is appended only, if the state of the prefix is activated.

Example: `"HCOP:FILE:NAME:AUTO:PREF 'Snapshot'"`
'appends "Snapshot" as prefix to the generated file name.

*RST value	Resolution	SCPI
HCopy	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:PREFix:STATe OFF | ONSTATe OFF | ON"

Automatic naming only

This command defines wether a prefix should be appended to the file name. The prefix is entered via the command `HCOP:FILE:NAME:AUTO:PREF`.

Example: `"HCOP:FILE:AUTO:PREF:STAT OFF"`
'deactivates appending a prefix to the automatically generated file name.

*RST value	Resolution	SCPI
ON	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR:STATe OFF | ON"

Automatic naming only

This command defines wether the currrent year should be appended to the file name.

Example: `"HCOP:FILE:AUTO:YEAR:STAT OFF"`
'deactivates appending the year to the automatically generated file name.

*RST value	Resolution	SCPI
ON	-	Device-specific

HCOPy:FILE[:NAME]:AUTO[:FILE]:YEAR?"

The command returns the year of the current system date which will be appended to the file name if automatic naming is activated.

Example: `"HCOPy:FILE:AUTO:YEAR?"`
'returns a four digit number for the year of the current system date.

*RST value	Resolution	SCPI
Year of current system date	-	Device-specific

HCOPy:IMAGe:FORMat BMP | JPG | PNG | XPM

This command sets the image format in which the hard copy (snapshot) should be stored.

Example: `"HCOP:IMAG:FORM XPM"`
'sets the image format to XPM.

*RST value	Resolution	SCPI
BMP	-	Device-specific

HCOPy:IMAGe:SIZE 320,640 | 640,480 | 800,600 | 1024,768

The command sets the image size in which the hard copy should be stored. The default value depends on the device and is for example:

SMBV: 640*480

Example: `"HCOP:IMAG:SIZE 640,480"`
'sets width and height of the image.

*RST value	Resolution	SCPI
depends on device	-	Device-specific

HCOPy:PRINter:LIST?

The command queries printers which are available.

The command is a query command and therefore has no *RST value.

Example: `"HCOP:PRIN:LIST?"`
'returns a list of the available printers.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy:PRINter:PAGE:MARGins <top,bottom,left,right>

The command defines the margins of the paper size for printing the hard copy. **Top, bottom, left** and **right** margin values have to be entered in this sequence, separated by commas. Decimal places are separated by a decimal point. Depending on the set physical unit by the parameter **Unit**, width and height are expressed in cm or inches.

Example: `"HCOP:PRIN:PAGE:UNIT IN"`
'sets the physical unit for the page layout values to inches.

`"HCOP:PRIN:PAGE:MARG 2.5,2.0,1.5,1.5"`
'sets the margin values of the page layout to top=2.5, bottom=2.0, left=1.5 and right=.1.5.

*RST value	Resolution	SCPI
2.5,2.5,2.5,2.5	-	Device-specific

HCOPy:PRINter:PAGE:ORIentation PORTrait | LANDscape

The command defines the orientation of the printer page for the hard copy.The selectable orientations are **Portrait** and **Landscape**.

Example: `"HCOP:PRIN:PAGE:ORI LAND"`
'selects landscape orientation for the printer page.

*RST value	Resolution	SCPI
PORTrait	-	Device-specific

HCOPy:PRINter:PAGE:SIZE LETTer | LEGal | EXECutive | A4 | A5

The command selects the size of the printer paper for the hard copy. The currently selectable paper formats are **Letter, Legal, Executive, A4** and **A5**. For information on the paper format width and height values are indicated additionally. Depending on the set physical unit by the parameter **Unit**, width and height are expressed in cm or inches.

Example: `"HCOP:PRIN:PAGE:SIZE LETT"`
'sets the page size to letter format.
`"HCOP:PRIN:PAGE:SIZE?"`
'returns the selected page size, e.g. LETT

*RST value	Resolution	SCPI
LETTer (21.6, 35.6)	-	Device-specific

HCOPy:PRINter:PAGE:UNIT CM | IN

This command defines the physical unit of the page size and margins used for the hard copy. The selectable units are **inches** or **centimeter**.

Example: `"HCOP:PRIN:PAGE:UNIT IN"`
'presets all instruments settings that are not related to the signal path.

*RST value	Resolution	SCPI
CM	-	Device-specific

HCOPy:PRINter[:NAME] <name>

The command returns the name of the selected printer.

Example: `"HCOP:PRIN:NAME "printer1""`
'displays the name of the currently selected printer, e.g. printer1.

*RST value	Resolution	SCPI
-	-	Device-specific

HCOPy[:EXECute]ß

The command executes the hard copy command to the selected destination.

Example: `"HCOP:DEV FILE"`
'the hard copy will be stored in a file.
`"HCOPy"`
'executes storing the hard copy in a file.

*RST value	Resolution	SCPI
-	-	Device-specific

KBOard Subsystem

The KBOard system contains the commands to set the external keyboard.

Command	Parameters	Default unit	Remark
KBOard:LANGuage	US | DE		
KBOard:LAYout	US | DE		

KBOard:LANGuage US | DE

This command selects the keyboard language. The assignment of some keys depends on the selected language.

Example: `KBO:LANG US`
"selects keyboard language American English.

*RST value	Resolution	Options	SCPI
US	-		Device-specific

KBOard:LAYout US | DE

This command selects the keyboard layout for the selected keyboard language. The assignment of some keys depends on the selected layout and language.

Example: `KBO:LAY US`
"activates American keyboard layout

*RST value	Resolution	Options	SCPI
US	-		Device-specific

MMEMory Subsystem

The MMEMory subsystem (Mass Memory) contains the commands for managing files and directories as well as for loading and storing complete instrument settings in files.

The files are stored on the internal Mass Memory of the instrument or on a USB memory device . The /var directory can be used to save user-defined data; any subdirectory structure can be created on /var. Some default subdirectories are predefined and must not be changed.

The default directory is determined using the command `MMEMory:CDIR.`

***Note**:*
The /opt directory is a protected and therefore unaccessable system director. The files on this directory contain data that must not be changed. Therefore, this directory should not be accessed, since reconstruction of the system partition will lead to data loss.

To enable files in different file systems to be used, the following file naming conventions should be observed:

The file name can be of any length and no distinction is made between uppercase and lowercase letters. The file and the optional file extension are separated by a dot. All letters and numbers are permitted (numbers are, however, not permitted at the beginning of the file name). Where possible, special characters should not be used. Use of the slashes "\" and "/" should be avoided since they are used in file paths. A number of names are reserved by the operating system, e.g. CLOCK$, CON, AUX, COM1...COM4, LPT1...LPT3, NUL and PRN.

In the R&S Vector Signal Generator all files in which lists and settings are stored are given a characteristic extension. The extension is separated from the actual file name by a dot (see the following table containing a list of the file types).

The two characters "*" and "?" function as "wildcards", i.e. they are used for selecting several files. The "?" character represents exactly one character, while the "*" character represents all characters up to the end of the file name. "*.*" therefore stands for all the files in a directory.

When used in conjunction with the commands, the parameter <file_name> is specified as a string parameter with quotation marks. It can contain either the complete path including the drive, only the path and file name, or only the file name. The file name must include the file extension. The same applies for the parameters <directory_name> and <path>. Depending on how much information is provided, either the values specified in the parameter or the values specified with the commands `MMEM:MSIS` (default drive) and `MMEM:CDIR` (default directory) are used for the path and drive setting in the commands.

Before the instrument settings can be stored in a file, they have to be stored in an intermediate memory using common command `*SAV <number>`. The specified number is subsequently used in the `MMEM.STOR:STATe<number>, <file>` command.
Also, subsequently to loading a file with instrument settings with command `MMEM:LOAD:STAT <number>, <file>`, these settings have to be activated with the common command `*RCL <number>`.

In the example below, the current instrument setting is always stored in the file `'test1.savrcl'` in the directory 'user' on the internal flash card.

```
*SAV 4
```

```
MMEM:STOR:STAT 4,"var/smbv/rs_gen/test1.savrcl"
```

If the complete path is specified, the file is stored in the specified path.

```
MMEM:CDIR  'var/smbv/rs_gen'
*SAV 4
```

```
MMEM:STOR:STAT 0,"test1.savrcl"
```

If the parameter only contains the file name, the file is stored in the default directory which was selected with the `MMEM:CDIR` command.

Table 6-1 List of file extensions assigned automatically in R&S Vector Signal Generator

List type	Contents	File suffix
Instrument State		
Instrument State	Instrument settings	*.savrcl
User Correction		
User Correction	User-defined level correction values	*.uco
List Mode		
List	User-defined frequency/level value pairs	*.lsw
Frequency Response Correction		
Frequency Response Correction	User-defined frequency response correction file	*.frc
Arbitrary Waveform Generator		
Waveform Multi segment waveform	ARB waveforms ARB multi segment waveforms	*.wv
Multi carrier waveform	ARB multi carrier settings	*.arb_multcarr
Configuration data	Configuration file for creation of multisegment ARB waveforms	*.inf_mswv
DM		
Data List	Digital modulation data	*.dm_iqd *.tdm
Control List	Data to control digital modulation	*.dm_iqc
Settings	Digital modulation settings	*.dm
User Standard	Digital modulation user standard	*.dm_stu
User Mapping	Digital modulation user mapping	*.vam
User Filter	Digital modulation user filter	*.vaf
Fading		
Fading	Fading data	*.fad
GSM/EDGE		
Settings	GSM/EDGE settings	*.gsm
Slot	User-defined slot data	*.gsm_slu
Frame	User-defined frame data	*.gsm_fu
Higher symbol rate slot	Higher symbol rate slot	*.gsm_hslu
Higher symbol rate frame	Higher symbol rate frame	*.gsm_hfu
3GPP FDD		
3GPP Settings	Complete setting of the 2GPP (FDD) menu	*.3g
Channel Coding DPCH	Channel coding enhanced DPCH channels (downlink)	*.3g_ccod_dl_s
Channel Coding DPDCH	Channel coding enhanced DPDCH channels (uplink)	*.3g_ccod_ul
IEEE 802.11 WLAN		
WLAN Settings	Complete setting of the IEEE 802.11 WLAN menu	*.wlan

MMEMory - Command Table

Command	Parameters	Default unit	Remark
MMEMory:CATalog?	<path>		Query only
MMEMory:CATalog:LENGth?			Query only
MMEMory:CDIRectory	<directory_name>		No query
MMEMory:COPY	<file_name>,<file_name>		No query
MMEMory:DATA	<file_name>[,<block>]		
MMEMory:DCATalog?			Query only
MMEMory:DCATalog:LENGth?			Query only
MMEMory:LOAD:STATe	<number>,<file_name>		No query
MMEMory:DELete	<file_name>		No query
MMEMory:MDIRectory	<directory_name>		No query
MMEMory:MOVE	<file_name>,<file_name>		No query
MMEMory:MSIS	<msus>		
MMEMory:RDIRectory	<directory_name>		
MMEMory:STORe:STATe	<number>,<file_name>		

MMEMory:CATalog? <path>

This command reads out the subdirectories and files in the specified directory. If no directory is specified, the default directory selected with the `MMEM:CDIR` command is read out on the default drive selected with the `MMEM:MSIS` command.

The response has the following format:

```
<used_bytes_in_this_directory>,<free_bytes_on_this_disk>,
"<file_name>,<file_type>,<filesize_in_bytes>",
"<file_name>,<file_type>,<filesize_in_bytes>", …
```

The command is a query command and therefore has no *RST value.

Parameters:

<file_name>
File or directory name.

<file_type>
File type. There are the following file types: DIR (directory), ASCii (ASCII file), BINary (Binary file), and STATe (file with instrument settings).

<filesize_in_bytes>
File size. The size "0" is returned for a directory.

Example:

"`MMEM:CAT? '\\Server\DATA\*.LOG'`
Reads back all files in \\Server\DATA with the extension ".LOG".

"`MMEM:CAT? 'usb\user'`"
'reads out all files at the highest directory level of the USB stick.

Response:

"'127145265,175325184,"test,DIR,0","temp,DIR,0","readme.txt,ASC,1324","state.savracl,STAT,5327","waveform.wv,BIN,2342"
'the directory `usb\user` contains the subdirectories `'test'` and `'temp'` as well as the files `'readme.txt'`, `'state.savrcl'` and `'waveform.wv'` which have different file types.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:CATalog:LENGth? <path>

This command reads out the number of files in the specified directory. If no directory is specified, the default directory selected with the `MMEM:CDIR` command is read out on the default drive selected with the `MMEM:MSIS` command.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CAT:LENG? 'usb\"`
'reads out the number of files at the highest directory level of the memory stick.

Response: "'1"
'there is 1 file at the highest directory level of the memory stick.

*RST value	Resolution	SCPI
-	-	Device-specific

MMEMory:CDIRectory <directory_name>

This command changes the default directory. This directory is used for all subsequent MMEM commands if no path is specified with them. It is also possible to change to a higher directory using two dots '..' .

Example: `"MMEM:CDIR 'test'"`
'changes from the current directory level to the subdirectory `'test'`.

*RST value	Resolution	SCPI
/var	-	Compliant

MMEMory:COPY <source>[,<destination>]

This command copies the first specified file to the second specified file. Instead of just a file, this command can also be used to copy a complete directory together with all its files.

If <destination> is not specified, <source> is copied to the `MMEM:MSIS` drive and the `MMEM:CDIR` directory. Files which already exist with the same name in the destination directory are overwritten without an error message.

It is also possible to specify the path using another parameter. The command is:
MMEMory:COPY <file_source><msus_source>[,<file_destination>,<msus_destination>]

The command triggers an event and therefore has no query form and no *RST value.

Example: `"MMEM:COPY 'var/smbv/USER/TEST1.SVARCL','usb\'"`
'copies the file `'test1.savrcl'` in the USER directory on the internal flash card to the USB stick without changing the file name.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:DATA <file_name>[,<binary block data>]
MMEMory:DATA? <file_name>

This command writes the block data <binary block data> to the file identified by <file_name>. The IEC/IEEE-bus terminator should be set to EOI in order to ensure correct data transfer.

The associated query command transfers the specified file from the R&S Vector Signal Generator to the IEC/IEEE bus and then on to the control computer. It is important to ensure that the intermediate memory on the control computer is large enough to take the file. In this case, the setting for the IEC/IEEE-bus terminator is irrelevant. This command can be used to read/transfer stored instrument settings or waveforms directly from/to the instrument.

The binary data block has the following structure: #234<block_data>
always comes first in the binary block
<number> indicates how many digits the subsequent length entry has (2 in example)
<number> indicates the number of subsequent bytes (34 in example)
<binary block data> binary block data for the specified length

Example: `"MMEM:DATA 'TEST1.WV',#3767<binary data>"`
'writes the block data to the file 'test1.wv'.

`"MMEM:DATA? 'TEST1.WV'`
'sends the data of the file 'Test1.wv' from the R&S Vector Signal Generator to the control computer in the form of a binary block.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:DCATalog? <path>

This command reads out the subdirectories of the specified directory. If no directory is specified, the default directory selected with the `MMEM:CDIR` command is read out. The directories are output in a list (the list entries are separated by commas).

The command is a query command and therefore has no *RST value.

Example: `"MMEM:DCAT?`
'reads out the subdirectories of the current directory.

Response: "'test', 'wave', 'digital'"
'the subdirectories 'test', 'wave' and 'digital' exist in the current directory.

*RST value	Resolution	SCPI
-	-	Device-specific

MMEMory:DCATalog:LENGth? <path>

This command reads out the number of subdirectories in the specified directory. If no directory is specified, the directory selected with the `MMEM:CDIR` command is read out.

Example: `"MMEM:DCAT:LENG?`
'reads out the number of subdirectories in the current directory.

Response: "3"
'there are 3 subdirectories in the current directory.

*RST value	Resolution	SCPI
-	-	Device-specific

MMEMory:DELete <file_name>

This command deletes the specified file.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"MMEM:DEL 'var/smbv/USER/TEST1.SAVRCL'"`
'deletes the file `'Test1.savrcl'` in the USER directory on the internal flash card.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:LOAD:STATe 4,<file_name>

This command loads the specified file stored under the specified name in an internal memory.

The instrument setting must be activated using an *RCL command with the number used after the file has been loaded (see the section "Common Commands", page 6.4).

Example: `"*SAV 4"`
'stores the current instrument setting in an intermediate memory with number 4.

`"MMEM:STOR:STAT 4,'var/smbv/user/test4.savrcl'"`
'stores the instrument setting stored with the *SAV command under memory number 4 in the file `'test4.savrcl'` in the USER directory on the internal flash card.

`"MMEM:LOAD:STAT 4,'var/smbv/user/test4.savrcl'"`
'loads the file `'Test4.savrcl'` in the USER directory of the internal flash card.

`"*RCL 4"`
'activates the instrument setting of the file `'Test4.savrcl'`.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:MDIRectory <directory_name>

The command creates a new subdirectory in the specified directory. If no directory is specified, a subdirectory is created in the default directory. This command can also be used to create a directory tree.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"MMEM:MDIR 'carrier'"`
'creates the subdirectory `'carrier'` in the current directory.

*RST value	Resolution	SCPI
-	-	Device-specific

MMEMory:MOVE <file_source>,<file_destination>

This command renames an existing file if no path is specified for <file_destination>. Otherwise the file is moved to the specified path and stored under the original file name or, if specified, a new file name.It is also possible to specify the path using another parameter. The command is:
MMEMory:MOVE <file_source><msus_source>[,<file_destination>,<msus_destination>]

The command triggers an event and therefore has no query form and no *RST value.

Example: `"MMEM:MOVE 'test1.savrcl','keep1.savrcl"`
'renames the file 'test1.savrcls' as 'keep1.savrcl'.

`"MMEM:MOVE 'test1.savrcl','\instrument_one\keep1.savrcl"`
'moves the file 'test1.savrcl' to the subdirectory 'instrument_one' and stores it there under the name 'keep1.savrcl'.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:MSIS <msus>

The command is without effect for the Linux operating system.

*RST value	Resolution	SCPI
-	-	Compliant

MMEMory:RDIRectory <directory_name>

The command deletes the specified subdirectory in the specified directory. If no directory is specified, the subdirectory with the specified name is deleted in the default directory.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"MMEM:RDIR 'carrier'"`
'deletes the subdirectory 'carrier' in the current directory.

*RST value	Resolution	SCPI
-	-	Device-specific

MMEMory:STORe:STATe 4,<file_name>

This command stores the current instrument setting in the specified file.

The instrument setting must first be stored in an internal memory with the same number using the common command *SAV (see the section "Common Commands", page 6.4).

The command triggers an event and therefore has no query form and no *RST value.

Example: `"*SAV 4"`
'stores the current instrument setting in an intermediate memory with number 4. This setting can be called using command *RCL and the associated number of the memory, e.g. *RCL 4.

`"MMEM:STOR:STAT 4,'var/smbv/user/test4.savrcl'"`
'stores the instrument setting stored with the *SAV command under memory number 4 in the file `'test4.savrcl'` in the USER directory on the internal flash card.

*RST value	Resolution	SCPI
-	-	Compliant

OUTPut Subsystem

The OUTPut system contains the commands which set the properties of the RF output connectors and USER connectors. The properties of the LF output connector are set in the SOURce:LFOutput system.

Command	Parameters	Default unit	Remark
OUTPut:ALL[:STATe]	ON | OFF		
OUTPut:AFIXed:RANGe:LOWer?		dBm	Query only
OUTPut:AFIXed:RANGe:UPPer?		dBm	Query only
OUTPut:AMODe	AUTO | FIXed| NORMal		
OUTPut:BLANk:POLarity	NORMal | INVerted		
OUTPut:IMPedance		Ohm	Query only
OUTPut:PROTection:CLEar			No query
OUTPut:PROTection:TRIPped?			Query only
OUTPut::STATe]	ON | OFF		
OUTPut:[STATe]:PON	OFF | UNCHanged		
OUTPut:USER<1...4>:SOURce	AMARk4 | BMARk4 | ABLank | BBLank | AHOP | BHOP | ACW | BCW | BBITclock | BBURst | ATRig | BTRig| BSYMbolclock | BATTenuator		

OUTPut:AFIXed:RANGe:LOWer?

The command queries the minimum level which can be set without the attenuator being adjusted (Attenuator FIXed).

The command is a query and therefore has no *RST value.

Example: `"OUTP:AFIX:RANG:LOW?"`
'queries the minimum level for the FIXed setting.

Response:`"-50"`
'the minimum level is -50 dBm.

*RST value	Resolution	SCPI
-	-	Device-specific

OUTPut:AFIXed:RANGe:UPPer?

The command queries the maximum level which can be set without the attenuator being adjusted (Attenuator FIXed).

The command is a query and therefore has no *RST value.

Example: `":OUTP:AFIX:RANG:UPP?"`
'queries the maximum level for the FIXed setting for the RF output.

Response:`"-27"`
'the maximum level is -27 dBm.

*RST value	Resolution	SCPI
-	-	Device-specific

OUTPut:AMODe AUTO | FIXed | NORMal | HPOWer

The command switches the mode of the attenuator at the RF output (Attenuator MODe).

Parameters: **AUTO**
The electronically switching attenuator switches with a 5 dB step width at fixed switching points.

FIXed
The attenuator is fixed at the current position. The uninterrupted level settings are made if automatic level control is activated (`SOURce:POWer:ALC ON`).

Example: `":POW:ALC ON"`
'activates automatic level control for RF output.

`":POW:ALC ON"`
'activates automatic level control for RF output.

`"OUTP:AMOD FIX"`
'sets the fixed mode with uninterrupted level for RF output.

*RST value	Resolution	SCPI
AUTO	-	Device-specific

OUTPut:BLANk:POLarity NORMal | INVerted

The command sets the polarity of the No Signal (Blank) Marker.

Example: `"OUTP:BLAN:POL NORM"`
'causes the No Signal state (settling process in List mode) to be displayed as a result of the high output voltage (HIGH).

*RST value	Resolution	SCPI
NORMal	-	Device-specific

OUTPut:IMPedance

The command queries the impedance of the RF outputs. This permits converting the output level between units V and W. The impedances cannot be changed.

The command is a query and therefore has no *RST value.

Example: `":OUTP:IMP?"`
'queries the impedance of RF output.

Response: `"50"`
'the impedance is 50 ohms

*RST value	Resolution	SCPI
-	-	Compliant

OUTPut:PROTection:CLEar

The command resets the protective circuit after it has been tripped. The state of the output is again determined by `OUTPut:STATe`.

This does not change the value of `OUTPut:STATe`.

The command triggers an event and therefore has no reset value.

Example: `"OUTP:PROT:CLE"`
'resets the protective circuit for RF output A.

*RST value	Resolution	SCPI
-	-	Compliant

OUTPut:PROTection:TRIPped?

The command queries the state of the protective circuit.

The command triggers an event and therefore has no reset value.

Example: `"OUTP:PROT:TRIP?"`
'queries the state of the protective circuit for RF output A.

Response:`"0"`
'the protective circuit has not tripped.

Response:`"1"`
'the protective circuit has tripped.

*RST value	Resolution	SCPI
-	-	Compliant

OUTPut:[STATe] ON | OFF

This command activates and deactivates the RF output.

Example: `":OUTP OFF"`
'deactivates the RF output.

*RST value	Resolution	SCPI
-	-	Compliant

OUTPut:[STATe:]PON OFF | UNCHanged

This command selects the state which the RF output assumes when the instrument is switched on.

The command is an event and therefore has no *RST value and no query form.

Parameters: **OFF**
The output is deactivated when the instrument is switched on.

UNCHanged
When the instrument is switched on, the output remains in the same state as it was when the instrument was switched off.

Example: `"OUTP:PON OFF"`
'RF output A is deactivated when the instrument is switched on.

*RST value	Resolution	SCPI
-	-	Device-specific

OUTPut:USER<1...4>:SOURce AMARk4 | BMARk4 | ABLank | BBLank | AHOP | BHOP | ACW | BCW | BBITclock| BSYMbolclock | BATTenuator | BBURst | ATRig | BTRig | GPINput

The command selects the signal for the specified USER interface.

Some signals which can be applied at the USER interface are permanently assigned, and some are assigned using a dedicated command (e.g. `OUTP:CW:SOURce` for the CW control signal).

The general purpose input (GPINput) is available for USER interfaces 1 and 2 only.

Example: `"OUTP:CLOC:MODE SYMB"`
'specifies that the internally generated clock pulse is a symbol clock pulse.

`"OUTP:CLOC:STAT ON"`
'activates output of the symbol clock pulse at the USER2 pin.

*RST value	Resolution	SCPI
USER1 = AMARker4 USER2 = ACW USER3 = ABLank USER4 = ATRig	-	Device-specific

Power Sensor Measurements - SENSe, READ and INITiate Subsystems

The SENSe subsystem contains the commands for configuring the power measurements with power sensor(s) connected to the generator. The measurement is started and the measurement result retrieved with the READ command. The description of this commands is included in the following.

Up to three sensors can be connected to the signal generator. They are distinguished by means of the suffix under SENSe:

Power sensor connected to the SENSOR port = SENSe[1]

First Power sensor connected to one of the USB interfaces = SENSe 2

Second Power sensor connected to one of the USB interfaces = SENSe 3

Command	Parameters	Default unit	Remark
INITiate<[1]...3>[:POWer]:CONTinuous	ON | OFF		
READ<[1]...3>[:POWer]?			Query only
SENSe<[1]...3>[:POWer]:CORRection:SPDevice:STATe	ON | OFF		
SENSe<[1]...3>[:POWer]:DISPlay:PERManent:STATe	ON | OFF		
SENSe<[1]...3>[:POWer]:FILTer:LENGth:AUTO?			Query only
SENSe<[1]...3>[:POWer]:FILTer:LENGth[:USER]	1 …65536		
SENSe<[1]...3>[:POWer]:FILTer:NSRatio	0.0001 … 1.0		
SENSe<[1]...3>[:POWer]:FILTer:NSRatio.MTIMe	1.0 … 999.99	s	
SENSe<[1]...3>[:POWer]:FILTer:SONCe			No query
SENSe<[1]...3>[:POWer]:FILTer:TYPE	AUTO | USER | NSRatio		
SENSe<[1]...3>[:POWer]:FREQuency	<frequency>	Hz	Range depends on used sensor
SENSe<[1]...3>[:POWer]:OFFSet	-100 … 100 dB	dB	
SENSe<[1]...3>[:POWer]:OFFSet:STATe	OFF | ON		
SENSe<[1]...3>[:POWer]:SNUMber?			Query only
SENSe<[1]...3>[:POWer]:SOURce	A | B | USER		
SENSe<[1]...3>[:POWer]:STATus[:DEVice]?			Query only
SENSe<[1]...3>[:POWer]:SVERsion?			Query only
SENSe<[1]...3>[:POWer]:TYPE?			Query only
SENSe<[1]...3>[:POWer]:ZERO?			No Query
SENSe<[1]...3>:UNIT[:POWer]	DBM | DBUV | WATT	DBM	

INITiate<[1]...3>[POWer]:CONTinuous

The command switches the local state of the continuous power measurement by the R&S NRP-Zxx power sensors on and off. Switching the local state off enhances the measurement performance during remote control

Example: `INIT:CONT`
'switches local state of continuous power measurement on.

*RST value	Resolution	SCPI
OFF	-	Device specific

READ<[1]...3>[POWer]?

The command triggers the measurement with power sensors and provides the power measurement result of the selected power sensor. The value is provided with the unit set with command `SENSe:UNIT[:POWer]`.

For certain power sensors, e.g. R&S NRP-Z81, two values are returned, first the value for the average level and - separated by a comma - the peak level.

Note:
The local state is not influenced by this commands, measurements results can be retrieved with local state on or off. For long measurement times it is recommended to use a SRQ (MAV bit) for command synchronization.

The command is a query command and therefore has no *RST value.

Example: `SENS:UNIT DBM`
'selects unit dBm for presentation of measurement result.

`READ1?`
'queries the measurement result of the sensor connected to the SENSOR interface.

Response: `-45.6246576745440230`
'-45.6 dBm were measured at the given frequency.

or (e.g. for R&S NRP-Z81)

Response: `-55.62403263352178,-22.419472478812476`
'-55,6 dbm is the measured average level, -22. 4 dBm is the measured peak level at the given frequency.

*RST value	Resolution	SCPI
-	-	Device specific

SENSe<[1]...3>[:POWer]:CORRection:SPDevice:STATe ON | OFF

The command activates the use of the s-parameters correction data of the selected power sensor.

Example: `SENS:POW:CORR:SPD:STAT ON`
'activates the use of the s-parameters correction data of power sensor 1.

*RST value	Resolution	Dependencies	SCPI
OFF	-	For power sensor with attenuator this command is automatically set to ON.	Device specific

SENSe<[1]...3>[:POWer]:DISPlay:PERManent:STATe ON | OFF

The command switches on and off the permanent indication of the power measurement result in the upper right corner of the block diagram. For each sensor, the type of sensor, the connector, the measurement source and - if set - the offset is indicated.

Example: `SENS1:POW:DISP:PERM:STAT ON`
'the permanent viewer is switched on.

*RST value	Resolution	SCPI
OFF	-	-

SENSe<[1]...3>[:POWer]:FILTer:LENGth:AUTO?

The command queries the current filter length for auto filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE AUTO`)

The command is a query command and therefore has no *RST value.

Example: `SENS1:FILT:TYPE AUTO`
'selects auto filter mode for the power sensor connected to the SENSOR connector.

`SENS1:FILT:LENG:AUTO?`
'queries the automatically set filter length.

Response: `1024`

*RST value	Resolution	SCPI
	-	Device specific

SENSe<[1]...3>[:POWer]:FILTer:LENGth[:USER] 1 … 65536

The command selects the filter length for user filter mode (`:SENSe:POWer:FILTer:TYPE USER`). As the filter length works as a multiplier for the time window, a constant filter length results in a constant measurement time. Values 1 and 2^n are setable.

The time window is fixed to 20 ms.

Example: `SENS:FILT:TYPE USER`
'selects user filter mode.

`SENS:FILT:LENG 16`
'sets a filter length of 16. The resulting measurement time is 640 ms (2x16x20 ms).

*RST value	Resolution	SCPI
1	-	Device specific

SENSe<[1]...3>[:POWer]:FILTer:NSRatio 0.0001 … 1.0

The command defines the noise content for fixed noise filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE SNRation`). This value determines the proportion of intrinsic noise in the measured result.

Example: `SENS1:FILT:TYPE SNR`
'selects fixed noise filter mode for the power sensor connected to the SENSOR connector.

`SENS1:FILT:NSR 0.2`
'sets a noise content of 0.2.

*RST value	Resolution	SCPI
0.001	-	Device specific

SENSe<[1]...3>[:POWer]:FILTer:NSRatio:MTIMe 1.0 … 999.99 s

The command defines the timeout for fixed noise filter mode (`:SENSe<[1]...3>:POWer:FILTer:TYPE SNRation`). This value ensures limited settling times.

Example: `SENS1:FILT:TYPE SNR`
'selects fixed noise filter mode for the power sensor connected to the SENSOR connector.

`SENS1:FILT:NSR .2`
'sets a noise content of 0.2.

`SENS1:FILT:NSR:MTIM 5`
'limits the settling time to 5 seconds

*RST value	Resolution	SCPI
4 s	-	Device specific

SENSe<[1]...3>[:POWer]:FILTer:SONCe

The command activates the search for the optimum filter length for the current measurement conditions. The found filter length can be retrieved with command `:SENSe:POWer:FILTer:LENGth:USER?`. This command is only available for user filter mode (`:SENSe:POWer:FILTer:TYPE USER`).

The command triggers an event and therefore has no *RST value and no query form.

Example: `SENS:FILT:TYPE USER`
'selects user filter mode.

`SENS:FILT:SONC`
'activates the search for the optimum filter length.

`SENS:FILT:LENG?`
'returns the found optimum filter length.

Response: `128`

*RST value	Resolution	SCPI
-	-	Device specific

SENSe<[1]...3>[:POWer]:FILTer:TYPE AUTO | USER | NSRatio

The command selects the filter mode. The filter length is the multiplier for the time window and thus directly influences the measurement time.

Parameters: **AUTO**
The filter length is automatically selected depending on the measured value. For high values, a short filter length is selected and for low values a long filter length is selected.

USER
The filter length is set manually. As the filter length works as a multiplier for the measurement time, this results in a constant measurement time.

SNRatio

The filter lenghth (averaging factor) is selected so that the sensor's intrinsic noise (2 standard deviations) does not exceed the specified noise content. The desired noise content is entered with command `SENSe:FILTer:NSRatio.`
To avoid very long settling times when the power is low, the averaging factor can be limited with the **Timeout** parameter (command `SENSe:FILTer:NSRatio:MTIMe`).

Example: `SENS:FILT:TYPE AUTO`
'selects automatic filter selection.

*RST value	Resolution	SCPI
AUTO	-	Device specific

SENSe<[1]...3>[:POWer]:FREQuency <frequency>

The command sets the RF frequency of the source if the user source is selected (`SENSe[:POWer]:SOURce USER`).

Example: `SENS:SOUR USER`
'selects user-defined source.

`SENS:FREQ 2.44 GHz"`
'enters the RF frequency of the source which is 2.44 GHz.

*RST value	Resolution	SCPI
1 GHz	-	Device specific

SENSe<[1]...3>[:POWer]:OFFSet -100 … 100

The command enters a level offset which is added to the measured level value after activation with command `SENSe[:POWer]:OFFSet:STATe ON`. This allows e.g. an attenuator in the signal path to be taken into account.

Example: `SENS:POW:OFFS 10.0`
'sets a level offset of 10 dB

*RST value	Resolution	SCPI
0.0 dB	-	-

SENSe<[1]...3>[:POWer]:OFFSet:STATe ON | OFF

The command activates the addition of the level offset to the measured value. The level offset value is set with command `SENSe[:POWer]:OFFSet.`

Example: `SENS1:POW:OFFS 0.4dB`
'sets a level offset of 0.4 dB

`SENS1:POW:OFFS:STAT ON`
'a level offset of 0.4 dB is added to the measured value.

*RST value	Resolution	SCPI
OFF	-	-

SENSe<[1]...3>[:POWer]:SNUMber?

The command queries the serial number of the sensor.

The command is a query command and therefore has no *RST value.

Example: `"SENS:SNUM?"`
'queries the serial number.

*RST value	Resolution	SCPI
-	-	Device specific

SENSe<[1]...3>[:POWer]:SOURce A | B | USER

The command selects the signal source for the measurement.

Example: `SENS:SOUR A`
'selects the RF signal as measurement source. The RF frequency is used as the measurement frequency of the sensor and the corresponding correction factor is used. The level setting of the instrument serves as reference level of the measurement.

*RST value	Resolution	SCPI
A	-	Device specific

SENSe<[1]...3>[:POWer]:STATus[:DEVice]?

The command queries if a sensor is connected to the signal generator.

The sensor is selected by suffix **1**, **2** or **3** in key word SENSe or READ of the command header. Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor connected first to one of the USB interfaces and suffix 3 the sensor connected second to one of the USB interfaces.

The command is a query command and therefore has no *RST value.

Example: `SENS:STAT?`
'queries if a sensor is connected to the instrument.

Response: 1
'a sensor is connected to the POWER SENSOR interface.

*RST value	Resolution	SCPI
-	-	Device specific

SENSe<[1]...3>[:POWer]:SVERsion?

The command queries the software version of the connected R&S NRP power sensor.

Example: `SENS:POW:SVER?`
'queries the software version of the R&S NRP power sensor.

*RST value	Resolution	SCPI
-	-	-

SENSe<[1]...3>[:POWer]:TYPE?

The command queries the type of sensor. The type is automatically detected.

The command is a query command and therefore has no *RST value.

Example: "SENS:TYPE?"
'queries the type of sensor connected to the POWER SENSOR connector.

Response: NRP-Z21
'the R&S NRP-Z21 sensor is used.

*RST value	Resolution	SCPI
-	-	Device specific

SENSe<[1]...3>[:POWer]:ZERO

The command activates the autozero function. Zeroing is required in regular interval (at least once a day) and if the temperature has varied more than about 5 °C, if the sensor has been replaced or if measurements of signals with very low power are to be performed. The RF power source must be switched off or disconnected from the sensor before starting the autozero function.

The command is an event and therefore has no *RST value.

Example: SENS:ZERO
'activates autozero function.

*RST value	Resolution	SCPI
-	-	Device specific

SENSe<[1]...3>:UNIT[:POWer] DBM | DBUV | WATT

The command selects the unit used for result query with command READ. The power sensor provides the measured value in Watt. In which unit the measured value is returned is selected here and might be either Watt, dBm or dBuV.

Example: "SENS2:UNIT DBM"
'selects unit dBm for the measured value returned by command READ.

READ2?

Response: 7.34
'7.34 dBm are measured by sensor 2.

*RST value	Resolution	SCPI
DBM	-	Device specific

SOURce Subsystem

The SOURce subsystem contains the commands for configuring the digital and analog signals.

The keyword SOURce is optional and can be omitted.

SOURce:AM Subsystem

The AM subsystem contains the commands for checking the amplitude modulation . The settings for the internal modulation source (LF generator) are made in the SOURce:LFOutput subsystem.

The keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]AM[:DEPTh]	0...100 PCT	PCT	
[SOURce:]AM:EXTernal:COUPling	AC | DC		
[SOURce:]AM:SENSitivity?			Query only
[SOURce:]AM:SOURce	EXT | INT | INT, EXT		
[SOURce:]AM:STATe	ON | OFF		

[SOURce:]AM[:DEPTh] 0 ... 100 PCT

The command sets the modulation depth of the amplitude modulation in percent. The modulation depth is limited by the maximum peak envelope power (PEP).

Example: `"AM 15PCT"`
'sets the AM modulation depth to 15 percent.

*RST value	Resolution	SCPI
30 PCT	See data sheet	Compliant

[SOURce:]AM:EXTernal:COUPling AC | DC

The command selects the coupling mode for the external modulation input (EXT MOD) in the case of amplitude modulation.

Parameters: **AC**
The DC voltage component is disconnected from the modulation signal.

DC
The modulation signal is not changed.

Example: `"AM:EXT:COUP AC"`
'selects the coupling mode AC for external amplitude modulation.

*RST value	Resolution	SCPI
AC	-	Compliant

[SOURce:]AM:SENSitivity?

The command queries the input sensitivity of the EXT MOD input in %/V. The command is only effective if the external modulation source is selected (`SOUR:AM:SOUR EXT`). The returned value depends on the modulation depth setting (`SOUR:AM:DEPTh`). This value is assigned to the voltage value for full modulation of the input.

The command is a query command and therefore has no *RST value.

Example: `"AM:DEPT 50"`
'sets a modulation depth of 50 %.

`"AM:SENS?"`
'queries the input sensitivity at the EXT MOD input.

Response: `"50"`
'since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 50%/V.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]AM:SOURce EXT | INT | INT,EXT

The command selects the modulation source for amplitude modulation. INT is the LF generator. The frequency of the internal modulation signal can be set in the SOURce:LFOutput subsystem. The external signal is input at the EXT MOD connector. Internal and external modulation source can be selected at the same time.

Example: `"AM:SOUR INT"`
'selects the internal modulation source.

*RST value	Resolution	SCPI
INTernal	-	Compliant

[SOURce:]AM:STATe ON | OFF

The command activates/deactivates amplitude modulation.

Activation of amplitude modulation deactivates BB-AM, ARB, I/Q modulation, digital modulation and all digital standards.

Example: `"AM:STAT ON"`
'activates AM modulation.

*RST value	Resolution	Correlation	SCPI
OFF	-	AM ON deactivates BB-AM, ARB, I/Q modulation, DM and all digital standards.	Compliant

SOURce:BB Subsystem - Remote-Control Commands

Introduction - Baseband Remote-Control Commands

This subsystem contains all commands for digital signal generation. It is divided into several subsystems which are described separately.
The following section describes the commands for setting the frequency shift and the phase offset for the signal at the **Baseband** block output.

For one-path instruments, the keyword SOURce is optional and can be omitted.
In this section, all commands for setting or querying the characteristics of the instruments are described.

Table of Commands - SOURce:BB

Command	Parameter	Default unit	Note
[SOURce]:BB:FOFFset	<numeric_value>	Hz	
[SOURce]:BB:POFFset	<numeric_value>	RAD	

[SOURce]:BB:FOFFset <numeric_value>

The command sets the frequency offset for the baseband signal. The offset affects the signal on the **baseband block** output**.** It shifts the useful baseband signal in the center frequency.

Note:
It is not possible to enter a frequency offset if a waveform with a sample rate of exactly 150 or 90 MHz depending on the installed option is introduced. A signal of this nature is not routed via the resampler in which the frequency shift takes place. This type of entry is also prohibited if the noise generator (AWGN block) is on.

The complex I/Q bandwidth of the useful signal must not exceed MHz120 or 60 MHz depending on the installed option in total. The following applies:

$$f_{offset} - f_{use}/2 \geq -60\text{MHz} \quad \text{and} \quad f_{offset} + f_{use}/2 \leq +60\text{MHz}$$

f_{use} = the complex useful bandwidth of the I/Q signal before the offset.
f_{offset} = frequency offset.

Example: `":BB:FOFF 2MHZ"`
'sets a frequency offset of 2 MHz.

*RST value	Resolution	SCPI
0 Hz	0.01 Hz	Device-specific

[SOURce]:BB:POFFset <numeric_value>

The command sets the relative phase offset of the baseband signal. The phase offset affects the signal on the **baseband block** output.

Example: `":BB:POFF 0.5DEG"`
'sets a relative phase offset of 0.5 DEG for the baseband signal

*RST value	Resolution	SCPI
0 DEG	0.1 DEG	Device-specific

SOURce:BB:ARB Subsystem - Remote Control Commands

Introduction - ARB Remote-Control Commands

The ARB subsystem contains the commands for setting the ARB Generator.

Settings for clock and trigger interfaces and for external outputs are entered in the SOURce:INPut and SOURce:OUTput subsystems.

For one-path instruments, the keyword SOURce is optional and can be omitted.Section "R&S Signal Generator Waveform and List Format", page 6.80 describes the ARB waveform format and how it is used to transmit waveforms via the IEC bus.

Table of Commands - ARB (Primary Commands)

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<tr><td>[SOURce]:BB:ARB:CLOCk:MODE</td><td>SAMPle | MSAMple</td><td></td><td></td></tr>
<tr><td>[SOURce]:BB:ARB:CLOCk:SOURce</td><td>INTernal | EXTernal</td><td></td><td></td></tr>
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<tr><td>[SOURce]:BB:ARB:TRIGger:SOURce</td><td>INTernal | EXTernal</td><td></td><td></td></tr>
<tr><td>[SOURce]:BB:ARB:TSIGnal:SINE:CREate</td><td></td><td></td><td>No query</td></tr>
</table>

Command	Parameter	Default unit	Note
[SOURce]:BB:ARB:TSIGnal:SINE:CREate:NAMed	<file_name>		No query
[SOURce]:BB:ARB:TSIGnal:SINE:FREQuency	100 Hz ... 40 MHz	HZ	
[SOURce]:BB:ARB:TSIGnal:SINE:PHASe	-180.00 Deg ... + 180.00 Deg	RAD	
[SOURce]:BB:ARB:TSIGnal:SINE:SAMPle	3 ... 1000 samples per period		
[SOURce]:BB:ARB:SYNChronization:EXECute			
[SOURce]:BB:ARB:SYNChronization:MODE	NONE | MASTer | SLAVe		

[SOURce]:BB:ARB:CLOCk <numeric_value>

The command sets the clock rate in samples. Loading a waveform sets the clock rate that is defined in the waveform tag 'clock'. The command subsequently changes the clock rate; see data sheet for value range.

In the case of an external clock source (selection `ARB:CLOCk:SOURce EXTernal`) the clock for the external source must be entered with this command.

Example: `":BB:ARB:CLOC:SOUR INT"`
'selects the internal clock source for generating waveforms.

`":BB:ARB:CLOC 0.5 MHz"`
'sets the clock rate to 0.5 MHz.

*RST value	Resolution	Dependency	SCPI
1 MHz	0.001 Hz	Loading a waveform (`ARB:WAV:SEL <name>`) automatically sets the clock rate to the allocated value.	Device-specific

[SOURce]:BB:ARB:CLOCk:MODE SAMPle \| MSAMple

The command enters the type of externally supplied clock (`:BB:ARB:CLOCk:SOURce EXTernal`). When `MSAMple` is used, a multiple of the sample clock is supplied via the CLOCK connector and the sample clock is derived internally from this.

Example: `":BB:ARB:CLOC:MODE SAMP"`
'selects clock type **Sample**, i.e. the supplied clock is a sample clock.

*RST value	Resolution	SCPI
SAMPle	-	Device-specific

[SOURce]:BB:ARB:CLOCk:SOURce INTernal \| EXTernal

The command selects the source for the digital modulation clock.

Parameter: **INTernal**
The internal clock reference is used.

EXTernal
The external clock reference is supplied to the CLOCK connector.

Example: `":BB:ARB:CLOC:SOUR EXT"`
'selects an external clock reference. The clock is supplied via the CLOCK connector.

`":BB:ARB:CLOC:MODE SAMP"`
'enters clock type sample.

*RST value	Resolution	SCPI
INTernal		Device-specific

[SOURce]:BB:ARB:PRESet

The command sets all ARB generator parameters to their default values.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:ARB:PRES"`
'resets the ARB generator to default values.

*RST value	Dependency	SCPI
-	SOUR:BB:ARB:CLOC 1MHz SOUR:BB:ARB:CLOC:DEL 0 SOUR:BB:ARB:CLOC:SOUR INT SOUR:BB:ARB:SIGN:FREQ 1 kHz SOUR:BB:ARB:SIGN:POFF 90 DEG SOUR:BB:ARB:SIGN:SAMPL 100 SOUR:BB:ARB:STAT OFF SOUR:BB:ARB:TRIG:EXT:DEL 0 SOUR:BB:ARB:TRIG:EXT:INH 0 SOUR:BB:ARB:TRIG:OUTP<n>:STAT OFF SOUR:BB:ARB:TRIG:OUTP<n>:SHIF 0 SOUR:BB:ARB:TRIG:OUTP<n>:MODE REST SOUR:BB:ARB:TRIG:OUTP<n>:PFR 1MHz SOUR:BB:ARB:TRIG:OUTP<n>:PATT #H0,1 SOUR:BB:ARB:TRIG:OUTP<n>:OFFT 1 SOUR:BB:ARB:TRIG:OUTP<n>:ONT 1 SOUR:BB:ARB:TRIG:SEQ AUTO SOUR:BB:ARB:TRIG:SOUR INT	Device-specific

[SOURce]:BB:ARB:SEQuence AUTO | RETRigger | AAUTo | ARETrigger | SINGle

The command selects the trigger mode.

Parameter:

AUTO
The waveform is output continuously.

RETRigger
The waveform is output continuously. A trigger event (internal or external) causes a restart.

AAUTo
The waveform is output only when a trigger event occurs. After the trigger event the waveform is output continuously. Waveform output is stopped with command `SOUR:BB:ARB:TRIG:ARM:EXEC` and started again when a trigger event occurs.

ARETrigger
The waveform is output only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart. Waveform output is stopped with command `SOUR:BB:ARB:TRIG:ARM:EXEC` and started again when a trigger event occurs.

SINGle
The waveform is output only when a trigger event occurs. After the trigger event the waveform is output once to the set sequence length (`SOUR:BB:ARB:TRIG:SLEN`). Every subsequent trigger event causes a restart.

Example: `":BB:ARB:SEQ AAUT"`
'sets the **Armed_auto** trigger mode; the device waits for the first trigger (e.g. with `*TRG`) and then generates the signal continuously.

*RST value	Resolution	SCPI
RETRigger	-	Device-specific

[SOURce]:BB:ARB:STATe ON | OFF

The command switches the ARB generator on. Any other standards or digital modulation that may be in the ON state are automatically turned OFF. `ARB:STAT ON` is only possible after the selection of a waveform. The selected waveform is output straight away (`ARB:SEQ AUTO|RETRigger`) or after the first trigger event (`ARB:SEQ AAUT|ARET`), depending on the trigger setting.

Example: `":BB:ARB:WAV:SEL 'wave1'"`
'loads waveform file 'wave1.wv' from the default directory.

`":BB:ARB:TRIG:SEQ RETR"`
'sets trigger mode Retrigger.

`":BB:ARB:STAT ON"`
'switches on the ARB generator. The selected waveform is output straight away. A trigger event causes signal output to restart.

*RST value	Resolution	Dependency	SCPI
OFF	-	`ARB:STAT ON` switches off other standards and digital modulation on.	Device-specific

[SOURce]:BB:ARB:TRIGger:ARM:EXECute

The command stops waveform output for trigger modes Armed_Auto and Armed_Retrigger. A subsequent internal or external trigger event restart waveform output.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:ARB:TRIG:SOUR INT"`
'sets internal triggering.

`":BB:ARB:TRIG:SEQ ARET"`
'sets Armed_Retrigger mode, i.e. every trigger event causes waveform output to restart.

`":BB:ARB:TRIG:EXEC"`
'executes a trigger, waveform output is started.

`":BB:ARB:TRIG:ARM:EXEC"`
'waveform output is stopped.

`":BB:ARB:TRIG:EXEC"`
'executes a trigger, waveform output is started again.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:TRIGger:EXECute

The command executes a trigger. The internal trigger source must be selected using the command `ARB:TRIGger:SOURce INTernal` and a trigger mode other than `AUTO` must be selected using the command `:ARB:SEQuence`.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:ARB:TRIG:SOUR INT"`
'sets internal triggering.

`":BB:ARB:SEQ RETR"`
'sets Retrigger mode, i.e. every trigger event causes signal output to restart.

`":BB:ARB:TRIG:EXEC"`
'executes a trigger.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:TRIGger[:EXTernal<[1]|2>]:DELay 0 ... 2^32-1 samples

The command specifies the trigger delay (expressed as a number of samples) for external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `":BB:ARB:TRIG:SOUR EXT"`
'selects an external trigger via the TRIGGER 1 connector

`":BB:ARB:TRIG:DEL 200"`
'sets a delay of 200 samples for the trigger.

*RST value	Resolution	SCPI
0	1	Device-specific

[SOURce]:BB:ARB:TRIGger[:EXTernal<[1]|2>]:INHibit 0 ... 2^32-1 samples

The command specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `":BB:ARB:TRIG:SOUR EXT"`
'selects an external trigger via the TRIGGER 1 connector

`":BB:ARB:TRIG:INH 200"`
'sets a restart inhibit for 200 samples following a trigger event.

*RST value	Resolution	SCPI
0	1	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:DELay 0 ... 2^20-1 Symbols

The command defines the delay between the signal on the marker outputs and the start of the signals, expressed in terms of samples. Command `:BB:ARB:TRIGger:OUTPut:DELay:FIXed ON` can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Example: `":BB:ARB:TRIG:OUTP2:DEL 16"`
'sets a delay of 16 samples for the signal on connector MARKER 2.

*RST value	Resolution	SCPI
0 Symbols	1	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut:DELay:FIXed ON | OFF

The command restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is output.

The numeric suffix in `OUTPut` has no significance for this command, since the setting always affects every marker.

Example: `":BB:ARB:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:DELay:MAXimum

The command queries the maximum marker delay for setting `:BB:ARB:TRIGger:OUTPut:DELay:FIXed ON`.

The command is a query only and therefore has no *RST value.

Example: `":BB:ARB:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`":BB:ARB:TRIG:OUTP:DEL:MAX"`
'queries the maximum of the dynamic range.

Response: `"2000"`
'the maximum for the marker delay setting is 2000 samples.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:DELay:MINimum

The command queries the minimum marker delay for setting `:BB:ARB:TRIGger:OUTPut:DELay:FIXed ON`.

The command is a query only and therefore has no *RST value.

Example: `":BB:ARB:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`":BB:ARB:TRIG:OUTP:DEL:MIN"`
'queries the minimum of the dynamic range.

Response: `"0"`
'the minimum for the marker delay setting is 0 samples.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:MODE UNCHanged | RESTart | PULSe | PATTern | RATio | TRIGger

The command defines the signal for the selected marker output.

Parameter:

UNCHanged
A marker signal as defined in the waveform file (tag 'marker mode x') is generated.

RESTart
A marker signal is generated at every waveform start.

PULSe
A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:BB:ARB:TRIG:OUTP:PULS:DIV` command and can be queried with the `SOUR:BB:ARB:TRIG:OUTP:PULS:FREQ?` command.

PATTern
A marker signal is generated with the aid of a user-definable bit pattern. The bit pattern is entered with the aid of command `:BB:ARB:TRIGger:OUTPut:PATTern`. The bit pattern is a maximum of 32 bits long.

RATio
A regular marker signal corresponding to the Time Off / Time On specifications in the commands `:ARB:TRIGger:OUTPut:OFFTime` and `:ARB:TRIGger:OUTPut:ONTime` is generated.

TRIGger
This marker mode is set automatically, if the instrument is configured to work as a slave instrument in a master-slave configuration.
The marker signal is output on the MARKER 1 output (rear panel) of the master instrument and suppied to the TRIGGER IN connector of the slave one.

Example: `":BB:ARB:TRIG:OUTP2:MODE PULS"`
'selects the pulsed marker signal on output MARKER 2.

`":BB:ARB:TRIG:OUTP2:STAT ON"`
'activates the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RESTart	-	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:OFFTime 1 ... max. wavelength -1 sample

The command sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting `:ARB:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example: `":BB:ARB:TRIG:OUTP2:OFFT 20"`
'sets an OFF time of 20 samples for marker signal 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:ONTime 1 ... max. wavelength -1 sample

The command sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting `:ARB:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Example: `":BB:ARB:TRIG:OUTP2:ONT 20"`
'sets an ON time of 20 samples for marker 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:PATTern #B0,1 ... #B111...1,32

The command defines the bit pattern used to generate the marker signal in the setting `SOURce:BB:ARB:TRIGger:OUTPut:MODE PATTern` 0 is marker off, 1 is marker on.

Example: `":BB:ARB:TRIG:OUTP2:PATT #H39FE0000,32"`
'sets a bit pattern.

`":BB:ARB:TRIG:OUTP2:MODE PATT"`
'activates the marker signal according to a bit pattern on output MARKER 2.

*RST value	Resolution	SCPI
0	-	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:PULSe:DIVider 2 ... 2^10

The command sets the divider for the pulsed marker signal in the setting `SOURce:BB:ARB:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by dividing the symbol rate by the divider.

Example: `":BB:ARB:TRIG:OUTP2:PULS:DIV 2"`
'sets the divider for the marker signal on output MARKER 2 to the value 2.

`":BB:ARB:TRIG:OUTP2:FREQ?"`
'queries the resulting pulse frequency of the marker signal

Response: `"66 000"`
'the resulting pulse frequency is 66 kHz.

*RST value	Resolution	SCPI
2	1	Device-specific

[SOURce]:BB:ARB:TRIGger:OUTPut<[1]...2>:PULSe:FREQuency?

The command queries the pulse frequency of the pulsed marker signal in the setting `SOURce:BB:ARB:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by dividing the symbol rate by the divider. The divider is defined with command `:BB:ARB:TRIG:OUTP:PULS:DIV`.

The command is a query only and therefore has no *RST value.

Example: `":BB:ARB:TRIG:OUTP2:PULS:DIV 4"`
'sets the divider for the marker signal on output MARKER 2 to the value 4.

`":BB:ARB:TRIG:OUTP2:MODE PULS"`
'enables the pulsed marker signal.

`":BB:ARB:TRIG:OUTP2:PULS:FREQ?"`
'queries the pulse frequency of the marker signal.

Response: `"33 000"`
'the resulting pulse frequency is 33 kHz.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:TRIGger:RMODe

The command queries the status of waveform output or all trigger modes with ARB on.

The command is a query command and therefore has no *RST value.

Parameter:

RUN
The waveform is output. A trigger event occurred in the triggered mode.

STOP
the waveform is not output. A trigger event did not occur in the triggered modes, or waveform output was stopped by the command `:BB:ARB:TRIG:ARM:EXECute` (armed trigger modes only).

Example: `"SOUR:BB:ARB:TRIG:SOUR EXT"`
'sets external triggering via the TRIGGER 1 connector.

`"SOUR:BB:ARB:TRIG:MODE ARET"`
'selects the Armed_Retrigger mode.

`"SOUR:BB:ARB:TRIG:RMOD?"`
'queries the current status of waveform output.

Response: `"RUN"`
'the waveform is output, an external trigger was executed.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:TRIGger:SLENgth 1 … (2^32-1) Samples

The command defines the length of the signal sequence to be output in the **Single** trigger mode. The unit is defined with command `SOUR:BB:ARB:TRIG:SLUNit`. It is possible to output deliberately just part of the waveform, an exact sequence of the waveform, or a defined number of repetitions of the waveform.

Example: `"SOUR:BB:ARB:SEQ SING"`
'sets trigger mode Single.

`"SOUR:BB:ARB:TRIG:SLUN SAMP"`
'sets unit Samples for the entry of sequence length.

`"SOUR:BB:ARB:TRIG:SLEN 200"`
'sets a sequence length of 200 samples. The first 200 samples of the current waveform will be output after the next trigger event.

*RST value	Resolution	SCPI
1 Waveform length	-	Device-specific

[SOURce]:BB:ARB:TRIGger:SLUNit SAMPle | SEQuence

The command defines the unit for the entry of the length of the signal sequence (`SOUR:BB:ARB:TRIG:SLEN`) to be output in the **Single** trigger mode (`SOUR:BB:ARB:SEQ SING`).

Example: `"SOUR:BB:ARB:SEQ SING"`
'sets trigger mode Single.

`"SOUR:BB:ARB:TRIG:SLUN SEQ"`
'sets unit Sequence length for the entry of sequence length.

`"SOUR:BB:ARB:TRIG:SLEN 2"`
'sets a sequence length of 2 waveforms. The current waveforms will be output twice after the next trigger event.

*RST value	Resolution	SCPI
SEQuence	-	Device-specific

[SOURce]:BB:ARB:TRIGger:SMODe SAME | NEXT | NSEam

The command selects the extended trigger mode for multi segment waveforms.

Parameter: **SAME**
The currently selected segment is output repeatedly.

NEXT
The current segment ceases to be output as soon as a new segment is entered with command `:BB:ARB:WSEG:NEXT` and the new segment starts to be output after a system-imposed signal gap.

NSEam
The segment selected with command `:BB:ARB:WSEG:NEXT` is not output until the whole of the current segment has been output (wrap around). In this case the signal transition is seamless.

Example: "SOUR2:BB:ARB:SEQ AUTO"
'selects trigger mode AUTO.

"SOUR2:BB:ARB:TRIG:SMOD SAME"
'the same segment of the waveform is output repeatedly.

*RST value	Resolution	SCPI
NEXT	-	Device-specific

[SOURce]:BB:ARB:TRIGger:SOURce INTernal | EXTernal

The command selects the trigger source.

Parameter: **INTernal**
Triggering is executed by means of the Trigger command in the case of remote control, and by means of **Execute Trigger** in the case of manual operation.

EXTernal
Triggering is executed by means of the signal on the TRIGGER 1 connector.

Example: ":BB:ARB:TRIG:SOUR INT"
'sets internal triggering.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce]:BB:ARB:TSIGnal:SINE:CREate:NAMed <file name>

Generates a signal and saves it to a waveform file.

The command does not allow a query.

Example: ":BB:ARB:TSIG:SINE:CRE:NAM 'sine_test'"
'generates a test sine signal and saves it into the wavefile sine_test.

*RST value	Resolution	SCPI
-	-	Instrument-specific

[SOURce]:BB:ARB:TSIGnal:SINE:CREate

Generates a signal and uses it as output straight away.

The command does not allow a query.

Example: ":BB:ARB:TSIG:SINE:CRE"
'generates a test sine signal and uses it as output straight away.

*RST value	Resolution	SCPI
-	-	Instrument-specific

[SOURce]:BB:ARB:TSIGnal:SINE:FREQuency 100 Hz ... 40 MHz

The command sets the frequency of the simple sinusoidal test signal. This signal is used as output via the I channel. A sine wave of the same frequency but optionally phase-shifted is generated on the Q path (`ARB:TSIGnal:SINE:POFFset`).

Example: `":BB:ARB:TSIG:SINE:FREQ 100 kHz"`
'sets a sine signal of 100 kHz.

*RST value	Resolution	SCPI
1 kHz	0.01 Hz	Instrument-specific

[SOURce]:BB:ARB:TSIGnal:SINE:PHASe -180.00 Deg ... + 180.00 Deg

The command sets the phase offset of the sine wave on the Q channel relative to the sine wave on the I channel.

Example: `":BB:ARB:TSIG:SINE:PHAS 90"`
'sets a phase offset of 90 degrees.

*RST value	Resolution	SCPI
90 DEG	0.01 DEG	Instrument-specific

[SOURce]:BB:ARB:TSIGnal:SINE:SAMPles 3 ... 1000 samples per period

The command sets the sample rate for the sine signal in samples per period. The resulting clock rate must not exceed the maximum ARB clock rate of 150 or 90 MHz depending on the installed options. The maximum value is automatically restricted by reference to the set frequency.

Example: `":BB:ARB:TSIG:SINE:SAMP 100"`
'sets a sample rate of 100 samples per period.

*RST value	Resolution	Dependency	SCPI
100 samples per period	1	`ARB:SIGN:SAMP MAX` is automatically restricted by frequency x samples <= 150 MHz	Instrument-specific

[SOURce]:BB:ARB:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command `BB:DM:SYNC:MODE` (see section "Synchronous Signal Generation").

Example: `":BB:ARB:SYNC:MODE MAST"`
'the instrument is configured to work as a master one.

`":BB:ARB:SYNC:EXEC`
'all synchronization's settings are adjusted accordingly.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:SYNChronization:MODE NONE |MASTer | SLAVe

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note:
If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.
Avoid unnecessary cable length and branching points.

Parameter: **NONE**
The instrument is working in stand-alone mode.

MASTer
The instrument provides all connected instrument with its synchronization clock (including the trigger signal) and reference clock signal.

SLAVe
The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

Example: `":BB:ARB:SYNC:MODE MAST"`
'the instrument is configured to work as a master one.

*RST value	Resolution	SCPI
NONE	-	Device-specific

SOURce:BB:ARB:MCAR Subsystem - Remote Control Commands

The MCARrrier subsystem contains the commands for setting the Multi Carrier Waveform Generator.

Command	**Parameter**	**Default unit**	**Note**
[SOURce]:BB:ARB:MCARrier:CARRier:COUNt	1 ... 32	-	
[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:DELay	-1s ... +1s	s	
[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:FILE	'file name'		
[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:PHASe	0° ... 360°,	RAD	
[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:POWer	-80... 0 dB	dB	
[SOURce]:BB:ARB:MCARrier:CARRier:SPACing	0 Hz...50 MHz	Hz	
[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:STATe	ON | OFF		
[SOURce]:BB:ARB:MCARrier:CFACtor:MODE	OFF | MAX | MIN		
[SOURce]:BB:ARB:MCARrier:CLOad			No query
[SOURce]:BB:ARB:MCARrier:CLOCk			Query only
[SOURce]:BB:ARB:MCARrier:CREate			No query
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:DELay[:STARt]	-1s ... +1s	s	
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:DELay:STEP	-1s ... +1s	s	
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:EXECute			No query
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:FILE	'file name'		
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:PHASe[:STARt]	0...360DEG	RAD	
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:PHASe:STEP	-360...360DEG	RAD	
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:POWer[:STARt]	-80 ... 0 dB	dB	
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:POWer:STEP	-80 ... 80 dB	dB	
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:STARt	<carrier_index>		
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:STATe	ON | OFF		
[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:STOP	<carrier_index>		
[SOURce]:BB:ARB:MCARrier:OFILe	<file_name>		
[SOURce]:BB:ARB:MCARrier:PRESet	-		
[SOURce]:BB:ARB:MCARrier:SAMPles		sample	Query only
[SOURce]:BB:ARB:MCARrier:SETTing:CATalog			Query only
[SOURce]:BB:ARB:MCARrier:SETTing:LOAD	<file_name>		
[SOURce]:BB:ARB:MCARrier:SETTing:STORe	<file_name>		
[SOURce]:BB:ARB:MCARrier:TIME		s	
[SOURce]:BB:ARB:MCARrier:TIME:MODE	LONG | SHORt | OFF		

[SOURce]:BB:ARB:MCARrier:CARRier:COUNt 1 ... 32

The command sets the number of carriers in the ARB multi carrier waveform.

The total bandwidth *(Number of carriers - 1) * Carrier spacing* is 120 or 60 MHz depending on the installed options .

The number of carriers entered therefore defines the maximum carrier spacing (`:BB:ARB:MCARrier:CARRier:SPACing`).

Example: `":BB:ARB:MCAR:CARR:COUN 10"`
'sets 10 carriers for the multi carrier waveform.

*RST value	Resolution	Dependencies	SCPI
1	1	The carrier spacing (`:BB:ARB:MCAR:CARR:SPAC`) is reduced if the total bandwidth of 120 MHz is not respected when entering the number of carriers.	Device-specific

[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:DELay -1s ... +1s.

The command sets the start delay of the selected carrier.

Example: `":BB:ARB:MCAR:CARR15:DEL 5us"`
'sets a start delay of 50 us for carrier 15.

*RST value	Resolution	SCPI
0 s	1 ns	Device-specific

[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:FILE "file name"

The command selects the file with I/Q data to be modulated onto the selected carrier.

Example:

`":BB:ARB:MCAR:CARR15:FILE 'var/smbv/IQ_wcdma'"`
'selects file 'IQ_wcdma'. The data of the file is modulated onto carrier 15.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:PHASe 0 ... 360 DEG.

The command sets the start phase of the selected carrier.

The phase settings are only valid if optimization of the crest factor is disabled (`:SOURce:BB:ARB:MCARrier:CFACtor:MODE OFF`).

Example: `":BB:ARB:MCAR:CARR15:PHAS 90 DEG"`
'sets a start phase of 90° for carrier 15.

*RST value	Resolution	SCPI
0 DEG	0.01 DEG	Device-specific

[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:POWer 80 dB ... 0 dB

The command sets the gain of the selected carrier.

Example: `":BB:ARB:MCAR:CARR15:POW -50 dB"`
'sets the power of carrier 15 to -50 dB.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce]:BB:ARB:MCARrier:CARRier:SPACing 0 Hz ... 50 MHz

The command sets the frequency spacing between adjacent carriers of the multi carrier waveform.
The carriers are generated symmetrically around the RF carrier. The maximum carrier spacing is limited to *Carrier spacing = Total baseband bandwidth /(Number of carriers - 1)*.
The total baseband bandwidth is 120 or 60 MHz depending on the installed options.

Note:
*In order to avoid wrap-around problems, the effective **Carrier Spacing** might be slightly modified. The **Carrier Spacing** is rounded in that way that the carrier closest to the center RF frequency shows no phase jump assuming that the carrier is unmodulated.*
For odd number of carriers:
RoundedCarrierSpacing=1/OutputSignalDuration round(CarrierSpacing * OutputSignalDuration);*
For even number of carriers:
*RoundedCarrierSpacing=2/OutputSignalDuration*round(0.5 *CarrierSpacing * OutputSignalDuration);*

Example: `":BB:ARB:MCAR:CARR:SPAC 10 MHz"`
'sets a carrier spacing of 10 MHz.

*RST value	Resolution	Dependencies	SCPI
10 kHz	0.01 Hz	The maximum carrier spacing is automatically reduced so that the maximum total bandwidth of 120 MHz is not exceeded on entering the number of carriers (`:BB:ARB:MCAR:CARR:COUN`).	Device-specific

[SOURce]:BB:ARB:MCARrier:CARRier<0...31>:STATe ON | OFF

The command switches the selected carrier on or off.

Example: `":BB:ARB:MCAR:CARR15:STAT ON"`
'switches carrier 15 on.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce]:BB:ARB:MCARrier:CFACtor:MODE OFF **|** MIN **|** MAX

The command sets the mode for optimizing the crest factor by calculating the carrier phases.

Parameter: **OFF**
There is no automatic setting for minimizing or maximizing the crest factor. The **Phase** setting (command `BB:ARB:MCAR:CARR:PHAS`) is in use.

MIN
The crest factor is minimized by internally calculating optimized carrier phases. The Phase setting (command `BB:ARB:MCAR:CARR:PHAS`) is invalid.

MAX
The crest factor is maximized by internally calculating optimized carrier phases. The Phase setting (command `BB:ARB:MCAR:CARR:PHAS`) is invalid.

Example: `":BB:ARB:MCAR:CFAC:MODE OFF"`
'switches off automatic crest factor optimization. The setting `SOUR:BB:ARB:MCAR:CARR:PHAS` has an effect.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce]:BB:ARB:MCARrier:CLOad <file_name>

This command creates a multi carrier waveform using the current entries of the carrier table.

This multi carrier waveform is saved with the file name specified with command `SOUR:BB:ARB:MCAR:OFIL` . The file extension is ***. wv**. Digital standard **ARB** is activated, the new multi carrier waveform is loaded and is output in accordance to the trigger settings.

This command triggers an event and therefore has no *RST value and no query form.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:MCAR:OFIL 'mcar1_2'"`
'defines the file name `mcar1_2.wv` for the multi carrier waveform.

`":BB:ARB:MCAR:CLO"`
'creates multi carrier waveform `mcar1_2.wv`.
The new multi carrier waveform is loaded and digital standard **ARB** is activated.

*RST value	Dependencies	SCPI
-	`SOUR:BB:ARB:WAV:SEL = <new Waveform>` `SOUR:BB:ARB:STATe = ON`	device-specific

[SOURce]:BB:ARB:MCARrier:CLOCk

The command queries the resulting sample rate at which the multi carrier waveform is output by the arbitrary waveform generator. The output clock rate depends on the number of carriers, carrier spacing and input sample rate of the leftmost or rightmost carriers.

The command is a query command and therefore has no *RST value.

Example: `":BB:ARB:MCAR:CLOC?"`
'queries the ARB multi carrier output clock rate.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:MCARrier:CREate

This command creates a multi carrier waveform using the current settings of the carrier table. The multi carrier waveform is saved into the file defined with command `SOUR:BB:ARB:MCAR:OFIL`. The file extension is ***. wv**.

This command triggers an event and therefore has no *RST value and no query form.

Example: "`MMEM:CDIR 'var/smbv/user/waveform`"
'sets the default directory to var/smbv/user/waveform.

"`:BB:ARB:MCAR:OFIL 'multi_wv1'`"
'defines the file name `multi_wv1.wv` for the multi carrier waveform.

"`:BB:ARB:MCAR:CRE`"
'creates multi carrier waveform `multi_wv1.wv.`

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:DELay[:STARt] -1s ... +1s

The command sets the start delay for the individual carriers in the defined carrier range. If the command `:BB:ARB:MCAR:EDIT:CARR:DEL:STEP` is used to define a step width, the delay entered here applies only to the starting carrier. The delays of the remaining carriers are stepped up or down by the delay value specified in the `:BB:ARB:MCAR:EDIT:CARR:DEL:STEP` command.

Example: "`:BB:ARB:MCAR:EDIT:CARR:DEL 5us`"
'sets a start delay of 5 us for the carriers in the carrier range.

*RST value	Resolution	SCPI
0 s	1 ns	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:DELay:STEP -1s ... +1s

The command sets the step width by which the start delays of the carriers in the defined carrier range will be incremented.

Example: "`:BB:ARB:MCAR:EDIT:CARR:DEL 5 us`"
'sets a start delay of 5 us for the carriers in the carrier range.

"`:BB:ARB:MCAR:EDIT:CARR:DEL:STEP 1 us`"
'the start delay is incremented by 1us for each carrier, i.e. the first carrier has a start delay of 5us, the second a start delay of 6 us, etc.

*RST value	Resolution	SCPI
0s	1 ns	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:EXECute

The command adopts the settings for the carrier range which has been defined using the `:BB:ARB:MCAR:EDIT:CARR:...` commands.

Example: `":BB:ARB:MCAR:EDIT:CARR:STAR 4"`
'the carrier range starts at carrier 2.

`":BB:ARB:MCAR:EDIT:CARR:STOP 20"`
'the carrier range stops at carrier 20.

`":BB:ARB:MCAR:EDIT:CARR:STAT ON"`
'sets all the carriers in the carrier range (2 to 20) to ON.

`":BB:ARB:MCAR:EDIT:CARR:EXEC"`
'transfers the assistant settings for carrier 2 to 20 into the carrier table.

*RST value	Resolution	SCPI
		Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:FILE "file name"

The command selects the input file with I/Q data to be modulated onto the carriers in the defined carrier range.

Example: `":BB:ARB:MCAR:EDIT:CARR:FILE 'var/smbv/IQ_wcdma'"`
'selects input file 'IQ_wcdma' The data of the file are modulated onto the carriers in the defined carrier range.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:PHASe[:STARt] 0 ... 360 DEG.

The command sets the start phase for the individual carriers in the defined carrier range. If the command `:BB:ARB:MCAR:EDIT:CARR:PHAS:STEP` is used to define a step width, the phase entered here applies only to the starting carrier. The phases of the remaining carriers are stepped up or down by the phase value specified in the `:BB:ARB:MCAR:EDIT:CARR:PHAS:STEP` command.

The phase settings are only valid if optimization of the crest factor is disabled (`:SOURce:BB:ARB:MCARrier:CFACtor:MODE OFF`).

Example: `":BB:ARB:MCAR:EDIT:CARR:PHAS 90 DEG"`
'sets a start phase of 90° for the carriers in the carrier range.

*RST value	Resolution	SCPI
0 DEG	0.01 DEG	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:PHASe:STEP 0 ... 360 DEG.

The command sets the step width by which the start phases of the carriers in the defined carrier range will be incremented.

The phase settings are only valid if optimization of the crest factor is disabled (`:SOURce:BB:ARB:MCARrier:CFACtor:MODE OFF`).

Example: `":BB:ARB:MCAR:EDIT:CARR:PHAS 90 DEG"`
'sets a start phase of 90° for the carriers in the carrier range.

`":BB:ARB:MCAR:EDIT:CARR:PHAS:STEP 1 DEG"`
'the start phase is incremented by 1° for each carrier, i.e. the first carrier has a start phase of 90°, the second a start phase of 91°, etc.

*RST value	Resolution	SCPI
0 DEG	0.01 DEG	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:POWer[:STARt] 80 dB ... 0 dB

The command sets the power for the individual carriers in the defined carrier range. If the command `:BB:ARB:MCAR:EDIT:CARR:POW:STEP` is used to define a step width, the power entered here applies only to the starting carrier. The power of the remaining carriers is stepped up or down by the power specified in the `:BB:ARB:MCAR:EDIT:CARR:POW:STEP` command.

Example: `":BB:ARB:MCAR:EDIT:CARR:POW -50 dB"`
'sets the power of the carriers in the carrier range to -50 dB.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:POWer:STEP - 80 dB ... +80 dB.

The command sets the step width by which the starting power of the carriers in the defined carrier range will be incremented.

Example: `":BB:ARB:MCAR:EDIT:CARR:POW -80dB"`
'sets a power of -80 dB for the carriers in the carrier range.

`":BB:ARB:MCAR:EDIT:CARR:POW:STEP 1 dB"`
'the power is incremented by 1dB for each carrier, i.e. the first carrier has -80dB, the second -79dB, etc.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:STARt <carrier_index>

The command selects the first carrier in the carrier range to which the settings with the `SOUR:BB:ARB:MCAR:EDIT:CARR:..` commands shall apply.

Example: `":BB:ARB:MCAR:EDIT:CARR:STAR 1"`
'the carrier range starts at carrier 1.

*RST value	Resolution	SCPI
0		Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:STATe ON | OFF

The command switches all the carriers in the selected carrier range on or off.

Example: `":BB:ARB:MCAR:EDIT:CARR:STAT ON"`
'sets all the carriers in the carrier range to ON.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce]:BB:ARB:MCARrier:EDIT:CARRier:STOP <carrier_index>

The command selects the last carrier in the carrier range to which the settings with the `:BB:ARB:MCAR:EDIT:CARR:..` commands shall apply.

Example: `":BB:ARB:MCAR:EDIT:CARR:STOP 4"`
'the carrier range stops at carrier 4.

*RST value	Resolution	SCPI
0		Device-specific

[SOURce]:BB:ARB:MCARrier:OFILe <file_name>

This command defines the output file name for the multi carrier waveform. This file name is used when a waveform is calculated (command `SOUR:BB:ARB:MCAR:CLOad` or `SOUR:BB:ARB:MCAR:CREate`). The file extension is *.wv.

This command triggers an event and therefore has no *RST value and no query form.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:MCAR:OFIL 'mcar1_2'"`
'defines the file name `mcar1_2.wv` for the multi carrier waveform file

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:MCARrier:PRESet

The command sets all ARB multi carrier parameters to their default values.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:ARB:MCAR:PRES"`
'resets the ARB multi carrier parameters to default values.

*RST value	Dependency	SCPI
-	`SOUR:BB:ARB:MCAR:COUN 0` `SOUR:BB:ARB:MCAR:SPAC 0`	Device-specific

[SOURce]:BB:ARB:MCARrier:SAMPles

The command queries the resulting file size. The file size is returned in samples.

This command is a query and therefore has no *RST value.

Example: `":BB:ARB:MCAR:SAMP?"`
'queries the file size of the currently calculated multi carrier waveform.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:MCARrier:SETTing:CATalog?

This command queries the available settings files in the specified default directory. The settings files are used to set the ARB multi carrier submenu. Only files with the file extension ***.arb_multcarr** will be listed.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:MCAR:SETT:CAT?"`
'reads out all the settings files in the default directory.

Response: "`mcar1, mcar2`"
'the directory contains the configuration files `'mcar1.arb_multcarr'` and `'mcar2.arb_multcarr'`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:MCARrier:SETTing:LOAD <file_name>

The command loads the settings file in the default directory. A path can also be specified, in which case the files in the specified directory are selected. If a settings file with the specified name does not yet exist, it is created. The file extension may be omitted. Only files with the file extension ***.arb_multcarr** will be loaded or created.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:MCAR:SETT:LOAD 'new'"`
'creates settings file `new.arb_multcarr` in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:MCARrier:SETTing:STORe <file_name>

The command stores the current settings of submenu **ARB Multi Carrier** in a file in the default directory. A path can also be specified, in which case the files are stored in the specified directory. The file extension may be omitted, the files are stored with the file extension ***.arb_multcarr**.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.
`":BB:ARB:MCAR:SETT:STOR 'mcarr2'"`
'stores settings file `mcarr2.arb_multcarr` in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:MCARrier:TIME 1E-12s ... 1E9s

The command sets the user-defined signal period. This setting is only possible for Signal Period Mode User (`BB:ARB:MCAR:TIME:MODE USER`).

Example: `":BB:ARB:MCAR:TIME:MODE USER"`
'selects Signal Period Mode User.
`":BB:ARB:MCAR:TIME 10 s"`
'sets a signal period of 10 seconds

*RST value	Resolution	SCPI
0		device-specific

[SOURce]:BB:ARB:MCARrier:TIME:MODE LONG | SHORt | USER

The command selects the mode for calculating the resulting signal period of the multi carrier waveform. The resulting period is always calculated for all carriers in the carrier table irrespective of their state (ON/OFF).

Parameter: **LONG**
The resulting signal period is defined by the longest I/Q file in the carrier table. Shorter I/Q files are periodically repeated.

SHORt
The resulting signal period is defined by the shortest I/Q file in the carrier table. Only the first part of longer I/Q files is used.

USER
The signal period can be set with command `SOUR:BB:ARB:MCARr:TIME`. Shorter I/Q files are repeated periodically, and only the first part of longer I/Q files is used.

Example: `":BB:ARB:MCAR:TIME:MODE LONG"`
'selects signal period mode long

*RST value	Resolution	SCPI
LONG	-	device-specific

SOURce:BB:ARB:WSEG Subsystem - Remote Control Commands

The WSEGment subsystem contains the commands for setting the Multi Segment Waveform Generator.

Command	Parameter	Default unit	Note
[SOURce]:BB:ARB:WAVeform:CATalog?			Query only
[SOURce]:BB:ARB:WAVeform:CATalog:LENGth?			Query only
[SOURce]:BB:ARB:WAVeform:DATA	<file_name>[,<block>]		
[SOURce]:BB:ARB:WAVeform:DATA?	<file_name>, <tag>		
[SOURce]:BB:ARB:WAVeform:DELete	<name_of_waveform_file>		No query
[SOURce]:BB:ARB:WAVeform:FREE			Query only
[SOURce]:BB:ARB:WAVeform:POINts			Query only
[SOURce]:BB:ARB:WAVeform:SELect	<name_of_waveform_file>		
[SOURce]:BB:ARB:WAVeform:TAG?	'comment' | 'copyright' | 'date' | 'lacpfilter' | 'marker name' | 'poweroffset'		
[SOURce]:BB:ARB:WSEGment			Query only
[SOURce]:BB:ARB:WSEGment:CLOad			No query
[SOURce]:BB:ARB:WSEGment:CONFigure:CATalog			Query only
[SOURce]:BB:ARB:WSEGment:CONFigure:CLOCk	max Sample Rate ... 150 MHz		
[SOURce]:BB:ARB:WSEGment:CONFigure:CLOCk:MODE	UNCHanged | HIGHest | USER		
[SOURce]:BB:ARB:WSEGment:CONFigure:COMMent	<string>		
[SOURce]:BB:ARB:WSEGment:CONFigure:DELete			No query
[SOURce]:BB:ARB:WSEGment:CONFigure:LEVel[:MODE]	UNCHanged | ERMS		
[SOURce]:BB:ARB:WSEGment:CONFigure:OFILe	<file_name>		
[SOURce]:BB:ARB:WSEGment:CONFigure:SEGMent:APPend	<file_name>		
[SOURce]:BB:ARB:WSEGment:CONFigure:SEGMent:CATalog			Query only
[SOURce]:BB:ARB:WSEGment:CONFigure:SELect	<file_name>		
[SOURce]:BB:ARB:WSEGment:CREate			No query
[SOURce]:BB:ARB:WSEGment:NEXT	1 ... 1999		

[SOURce]:BB:ARB:WAVeform:CATalog? <path>

This command reads out the files in the default directory. The default directory is set using command `MMEM:CDIRectory`. When the names of the waveform files are returned they are separated by commas. Only files with the file extension ***.wv** will be listed.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/user/smbv/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:WAV:CAT?"`
'reads out all the files in the default directory.

Response: `"sin1, wave"`
'the directory contains the waveform files `'sin1.wv'` and `'wave.wv'`.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:CATalog:LENGth? <path>

This command reads out the number of files in the default directory for waveform files (var/smbv/lists/ARB/wave). Only files with the file extension ***.wv** will be listed.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory.

`":BB:ARB:WAV:CAT:LENG?"`
'reads out the number of files in the default waveform directory.

Response: "'1"
'there is 1 file in the default waveform directory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:DATA <waveform filename>[,<binary data block>]

This command writes the block data <binary data block> to the file identified by <file_name>. The IEC bus delimiter should be set to EOI when this is done, in order to ensure trouble-free data transmission.

The complete content of the waveform file is transmitted as binary data block.

The associated query command transmits the specified file from the R&S Signal Generator to the control computer via the IEC bus. Please note that the buffer on the control computer must be big enough to accept the file. The setting for the IEC bus delimiter is of no significance.

Using this command, waveforms can be read out directly from or sent directly to the instrument.

The structure of the binary data block is as follows: #234<binarydata block>

#	is always used to introduce the binary block
<number>	states how many places in the following length data (in the example 2)
<number>	defines the number of following bytes (in the example 34)
<binary data block>	binary block data of the specified length.

Only the file name has to be entered, the file extension may be omitted. Waveform data is stored only in files with the specific file extensions ***.wv**. The default directory is set using command MMEM:CDIRectory. A path can also be specified, in which case the files in the specified directory are read.

Example:

":BB:ARB:WAV:DATA 'var/smbv/user/TEST1.WV',#3767<bin data block>"
'writes the block data to file 'test1.wv' in the var/smbv/user directory.

":BB:ARB:WAV:DATA? 'var/smbv/user/TEST1.WV'
'sends the data from file 'Test1.wv' in the var/smbv/user directory from the R&S Signal Generator to the control computer in the form of a binary block.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:DATA? <filename>,<tag>

The command queries the content of the specified tag of the selected Waveform file (see section "R&S Signal Generator Waveform and List Format"). The default directory is set using command MMEM:CDIRectory. A path can also be specified, in which case the files in the specified directory are read.

The command is a query command and therefore has no *RST value.

Parameter: 'comment' | 'copyright' | 'date' | 'lacpfilter' | 'marker name' | 'poweroffset'

Example: BB:ARB:WAV:SEL 'var/smbv/user/wave1.wv'

BB:ARB:WAV:TAG? 'comment'
'queries the content of the 'comment' tag of file wave1.wv in the user directory.

Response: "Sine wave for test purposes"

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:DELete <waveform filename>

The command deletes the specified waveform file. If the file is not on the default path, the path must be specified at the same time. The file extension may be omitted. Only files with the file extension ***.wv** will be deleted.

Example:

":BB:ARB:WAV:DEL 'var/smbv/user/wave1.wv'"
'deletes waveform file 'wave1.wv' from the var/smbv/user directory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:FREE?

The command queries the free disk space on the default path of the R&S Signal Generator harddisk.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform

`":BB:ARB:WAV:FREE?"`
'queries the free disk space in directory var/smbv/user/waveform.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:POINts? <waveform filename>

The command queries the number of samples in the waveform file selected using command `:ARB:WAV:SEL`. Only the file name has to be entered. Only files with the file extension ***.wv** will be read out.

The command is a query command and therefore has no *RST value.

Example: `":BB:ARB:WAV:POINt?`
'queries the number of I/Q values pairs in the waveform file.

`Response: "401"`
'the waveform file contains 401 I/Q values pairs.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:SELect <waveform filename>

The command selects the waveform file. If the file is not on the default path, the path must be specified at the same time. If no file of the specified name exists, it is created. The file extension may be omitted. Only files with the file extension ***.wv** will be created or loaded.

Example: `":BB:ARB:WAV:SEL 'var/smbv/user/wave1.wv'"`
'selects waveform file 'wave1.wv' from the var/smbv/user directory and loads it.

`":BB:ARB:TRIG:SEQ AAUT"`
'sets trigger mode Armed_Auto.

`":BB:ARB:TRIG:SOUR INT"`
'selects internal triggering.

`":BB:ARB:STAT ON"`
'switches on the ARB generator.

`":BB:ARB:TRIG:EXEC"`
'starts generating the selected waveform.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WAVeform:TAG? <tag name>

The command queries the content of the specified tag of the selected Waveform file (see section "R&S Signal Generator Waveform and List Format").

The command is a query command and therefore has no *RST value.

Example: `":BB:ARB:WAV:TAG? 'comment'"`
'queries the content of the 'comment' tag.

Response: `"Sine wave for test purposes"`

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WSEGment?

This command queries the currently output segment of the multi segment waveform.

The command is a query command and therefore has no *RST value.

Example: `":BB:ARB:WSEG?"`
'queries the currently output segment.

Response "2"
'segment 2 is currently output.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:ARB:WSEGment:CLOad <configuration file_name>

This command creates a multi segment waveform using the current entries of the specified configuration file.

This multi segment waveform is saved with the file name specified in the configuration file . The file extension is ***. wv**. Digital standard **ARB** is activated, the new multi segment waveform is loaded and the first segment is output in accordance to the trigger settings.

This command triggers an event and therefore has no *RST value and no query form.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:WSEG:CONF:SEL 'multi_sin'"`
'creates the configuration file `multi_sin.inf_mswv` in the default directory.

`":BB:ARB:WSEG:CONF:SEGM:APP 'sinus1'"`
'includes waveform `sinus1.wv` as segment 1 in the configuration file. The waveform must be available in the default directory.

`":BB:ARB:WSEG:CONF:SEGM:APP 'sinus2'"`
'includes waveform `sinus1.wv` as segment 2 in the configuration file. The waveform must be available in the default directory.

`":BB:ARB:WSEG:CONF:OFIL 'mseg1_2'"`
'defines the file name `mseg1_2.wv` for the multi segment waveform.

`":BB:ARB:WSEG:CLO 'multi_sin'"`
'creates multi segment waveform `mseg1_2.wv` using the settings of the configuration file `multi_sin.inf_mswv`.
The new multi segment waveform is loaded and digital standard **ARB** is activated.

*RST value	Dependencies	SCPI
-	`SOUR:BB:ARB:WAV:SEL = <new Waveform>` `SOUR:BB:ARB:STATe = ON`	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:CATalog?

This command queries the available configuration files in the specified default directory. The configuration files are used to create multi segment waveform files..

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:WSEG:CONF:CAT?"`
'reads out all the configuration files in the default directory.

Response: `"mulit1, multi2"`
'the directory contains the configuration files `'multi1.inf_mswv'` and `'multi2.inf_mswv'`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:CLOCk max sample rate .. 150 MHz

This command defines the clock rate used for multi segment waveform output in case of Clock Mode **User** (`:BB:ARB:WSEG:CONF:CLOCk:MODE USER`).

Example: `":BB:ARB:WSEG:CONF:CLOC:MODE USER"`
'selects Clock Mode User.

`":BB:ARB:WSEG:CONF:CLOC 50MHz"`
'defines a clock rate of 50 MHz.

*RST value	Resolution	SCPI
Max. Sample Rate	0.001 Hz	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:CLOCk:MODE UNCHanged | HIGHest | USER

This command selects the clock rate mode for the multi segment waveform.

Parameter: **UNCHanged**
The segments are output with the clock rate defined in the waveform file. Extended Trigger Mode **Next Segment Seamless** (`:BB:ARB:TRIG:SMOD NSEam`) can only be selected if all segments have the same clock rate. Extended Trigger Mode **Next Segment** (`:BB:ARB:TRIG:SMOD NEXT`) can only be selected if trigger mode **Internal** is selected.(`:BB:ARB:TRIG:SOUR INT`).

HIGHest
The segments are output at the highest available clock rate.

USER
The segments are output with the clock rate defined with command`:BB:ARB:WSEG:CONF:CLOC`.

Example: `":BB:ARB:WSEG:CONF:CLOC:MODE UNCH"`
'selects clock mode unchanged. The segments are output with the clock rate defined in the waveform file.

*RST value	Resolution	SCPI
UNCHanged	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:COMMent <string>

This command enters a comment for the configuration file. The configuration file must be specified with command `:BB:ARB:WSEG:CONF:SEL`.

Example: `":BB:ARB:WSEG:CONF:COMM <3gpp_up>"`
'enters comment "3gpp_up".

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:DELete

This command deletes the configuration file. The configuration files are used to create multi segment waveform files.

This command triggers an event and therefore has no *RST value and no query form.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory to var/smbv/user/waveform.

`":BB:ARB:WSEG:CONF:DEL 'multi1'"`
'deletes configuration file `multi1.inf_mswv`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:LEVel[:MODE] UNCHanged | ERMS

This command selects the level mode for the multi segment waveform.

Parameter:

UNCHanged
The segments are output exactly as defined in the files.

ERMS
The segments are output so that all segments have the same rms value.

Example: `":BB:ARB:WSEG:CONF:LEV:MODE UNCH"`
'selects level mode unchanged. The segments are output as defined in the waveform file.

*RST value	Resolution	SCPI
UNCHanged	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:OFILe <file_name>

This command defines the file name for the multi segment waveform. This file name is stored in the configuration file and is used when a waveform is created (command `:BB:ARB:WSEG:CLOad` or `:BB:ARB:WSEG:CREate`). The file extension is *.wv.

This command triggers an event and therefore has no *RST value and no query form.

Example: "`MMEM:CDIR 'var/smbv/user/waveform`"
'sets the default directory to var/smbv/user/waveform.

"`:BB:ARB:WSEG:CONF:SEL 'multi1'`"
'creates the configuration file `multi1.inf_mswv` in default directory.

"`:BB:ARB:WSEG:CONF:OFIL 'mseg1_2'`"
'defines the file name `mseg1_2.wv` for the multi segment waveform file created using configuration file `multi1.inf_mswv`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:SEGMent:APPend <file_name>

This command appends the specified waveform to the configuration file.

This command triggers an event and therefore has no *RST value and no query form.

Example: "`MMEM:CDIR 'var/smbv/user/waveform`"
'sets the default directory to var/smbv/user/waveform.

"`:BB:ARB:WSEG:CONF:SEL 'new'`"
'creates the configuration file `new.inf_mswv` in the default directory.

"`:BB:ARB:WSEG:CONF:SEGM:APP 'arb1'`"
'appends waveform `arb1.wv` to configuration file `new`. Waveform `arb1` will be the first segment of a multi segment waveform created with configuration file `new`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:SEGMent:CATalog?

This command queries the segments of the currently selected configuration file.

The command is a query command and therefore has no *RST value.

Example: "`MMEM:CDIR 'var/smbv/user/waveform`"
'sets the default directory.

"`:BB:ARB:WSEG:CONF:SEL 'multi_sin'`"
'selects the configuration file `multi_sin.inf_mswv` .

"`:BB:ARB:WSEG:CONF:SEGM:CAT?`"
'queries the segments of the selected configuration file.

Response: "`arb4, arb2`"
'The configuration file includes the segments `'arb4.wv'` and `'arb2.wv'`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CONFigure:SELect <file_name>

The command selects the configuration file in the default directory A path can also be specified, in which case the files in the specified directory are selected. If a configuration file with the specified name does not yet exist, it is created. The file extension may be omitted. Only files with the file extension ***.inf_mswv** will be selected or created.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory.

`":BB:ARB:WSEG:CONF:SEL 'new'"`
'create configuration file `new.inf_mswv` in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:CREate <file_name>

This command creates a multi segment waveform using the current settings of the specified configuration file. The multi segment waveform is saved into the file defined in the configuration file. The file extension is ***. wv**.

This command triggers an event and therefore has no *RST value and no query form.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory.

`":BB:ARB:WSEG:CONF:SEL 'new'"`
'creates the configuration file `new.inf_mswv` in the default directory.

`":BB:ARB:WSEG:CONF:SEGM:APP 'arb1.wv'"`
"includes waveform `arb1.wv` as segment 1 in the configuration file. The waveform must be available in the default directory.

`":BB:ARB:WSEG:CONF:OFIL 'multi_wv1'"`
'defines the file name `multi_wv1.wv` for the multi segment waveform.

`":BB:ARB:WSEG:CRE 'new'"`
'creates multi segment waveform `multi_wv1.wv` using the settings of the configuration file `new.inf_mswv`.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce]:BB:ARB:WSEGment:NEXT 0 ... 2000

This command selects the segment to be output.

Example: `"MMEM:CDIR 'var/smbv/user/waveform"`
'sets the default directory.

`":BB:ARB:WSEG:NEXT 2"`
'selects segment 2 to be output.

`":BB:ARB:TRIG:SMOD NEXT"`
'selects extended trigger mode next, i.e. the segment specified with command `:BB:ARB:WSEG:NEXT` will be output.

`":BB:ARB:SEQ AUTO"`
'selects trigger mode Auto.

`":BB:ARB:WAV:SEL 'multi_wv1'"`
'loads multi segment waveform `multi_wv1.wv`. Generation of segment 2 starts.

`":BB:ARB:WSEG:NEXT 3"`
'switched at once to output of segment 3.

*RST value	Resolution	SCPI
0	-	device-specific

R&S Signal Generator Waveform and List Format

The R&S Signal Generator uses a tag-oriented format for externally or internally generated waveforms as well as for data and control lists. The data can be transmitted via the IEC bus from an external computer to the R&S Signal Generator and vice versa. For these purposes the file is transmitted as a binary data block, using IEC bus command `SOUR:BB:ARB:WAV:DATA`.

Note:
A waveform version number is not necessary due to the flexible, tag-based form.

Tags are self-contained information units. Their general format is:

{Name: Data} or **{Name-Length: Data}**

The colon separates the name part and the data part. The colon can be followed by a space for the sake of legibility.

The **Name** identifies the tag. It is always expressed in capital letters.

The **Data** is tag-specific, and in most cases it is in ASCII plain text.

The **Length** specifies the number of bytes in a WAVEFORM tag or DATA LIST tag (from ':' to '}, ASCII integer)'
Each waveform file must begin with the TYPE tag. The sequence of the remaining tags is arbitrary. For each tag an indication shows whether it *must* be included in the file concerned (mandatory) or *may* be included (optional).
Unknown tags are not analyzed by the R&S Signal Generator. On the other hand they are left unchanged, are saved without an error message and can be read back again.
R&S AMIQ waveforms can also be loaded on the R&S Signal Generator, where they are converted internally into an R&S Signal Generator waveform.

The following sections first describe the mandatory TYPE tag which identifies the file and is always located at the start of the file. The rest of the tags used in the R&S Signal Generator are then described in alphabetical order. Most tags are valid for all three file types. If a tag is valid only for a single file type, e.g. only for a waveform, this fact is indicated in the description.

{TYPE: magic, xxxxxxxx} (mandatory, must be the first tag in the file)

The *TYPE* tag identifies the file as a valid R&S Signal Generator file. It must be present and must be the first in the waveform. If a file of the same name already exists on the target medium, it is overwritten.

Note:
AMIQ waveforms can also be loaded on the R&S Signal Generator, where they are converted internally into an R&S Signal Generator waveform.

magic 'magic' designates the file type and has the following values:

SMU-WV
The file contains a valid R&S Signal Generator waveform.

SMU-DL
The file contains a valid R&S Signal Generator data list.

SMU-CL
The file contains a valid R&S Signal Generator control list.

xxxxxxxx: 'xxxxxxxx' is an ASCII-coded checksum of the data part of the WAVEFORM tag in the file. This value is always 0 for data lists and control lists.

The checksum for waveforms is used for detecting transmission errors. If the *TYPE* tag contains 0 or a non-numeric value for the checksum, it is ignored.

It is calculated in accordance with the following algorithm, where 'start' is a pointer to the first byte after the '#' character in the WAVEFORM tag and 'length' is the number of bytes between 'start' and the closing curly bracket (excluding the latter; 'length' must be divisible by 4 without a remainder):

```
UINT32 checksum(void *start, UINT32 length)
{
  UINT32 i, result = 0xA50F74FF;

  for(i=0; i < length/4; i++)
    result = result ^ ((UINT32 *)start)[i];

  return(result);
}
```

Example: `{TYPE: SMU-WV,106656}`

IEC bus query: `":BB:ARB:WAV:TAG? 'TYPE'"`
'queries the content of the 'TYPE' tag.

`Response: "'SMU-WV,106656'"`
'this is a valid waveform.

{CLOCK: frequency} (mandatory for waveforms)

The tag specifies the clock frequency at which the waveform has to be output, in Hz. A query of `ARB:CLOCk?` after loading the waveform returns the value set using the CLOCK tag. This value can subsequently be altered with the aid of the `ARB:CLOCk` command.

Example: `{CLOCK: 54000000}`

IEC bus query: `":BB:ARB:WAV:TAG? 'CLOCK'"`
'queries the content of the `'CLOCK'` tag.

Response: `"54000000"`
'the clock frequency is set to 54 MHz.

{COMMENT: string} (optional)

The tag contains a plain text ASCII string of arbitrary length. The string is not analyzed in the R&S Signal Generator. It is used to describe the file. The string is allowed to contain all printable ASCII characters except the closing curly bracket.

Example: {COMMENT: File with data for 3GPP enhanced channels}

IEC bus query: `":BB:ARB:WAV:TAG? 'COMMENT'"`
'queries the content of the `'COMMENT'` tag of the selected waveform file.

Response: `"File with data for 3GPP enhanced channels"`
'the comment on the waveform reads "File with data for 3GPP enhanced channels".

{COPYRIGHT: string} (optional for waveforms)

The tag contains an ASCII string of arbitrary length. The string is not analyzed in the R&S Signal Generator. It is used to store copyright information about the file content.

Example: {COPYRIGHT: Rohde&Schwarz}

IEC bus query: `":BB:ARB:WAV:TAG? 'COPYRIGHT'"`
'queries the content of the `'COPYRIGHT'` tag of the selected waveform file.

Response: `"'Rohde&Schwarz'"`
'copyright resides with Rohde&Schwarz.

{DATA BITLENGTH: BitLength} (mandatory for data lists)

The tag contains the length of the data held in the "DATA LIST“ tag in bits in ASCII format.

Example: {DATA BITLENGTH: 444}

IEC bus query: `":BB:DM:DLIS:TAG? 'DATA BITLENGTH'"`
'queries the content of the `'DATA BITLENGTH'` tag of the selected data list file.

Response: `"'444'"`
'the data list is 444 bits long.

{DATA LIST-Length: #$d_0d_1...d_x...d_{N-1}$…} (mandatory for data lists)

The tag contains the actual bit sequence of the data list in binary format.

Length 'Length' defines the number of bytes in the DATA LIST tag in ASCII Format (for format see WAVEFORM length).

d_x Data bits in binary format (8-bit unsigned characters, MSB first).

Example: {DATA LIST-56: #01110000101010101001010101010100.....001010}

Example: `":BB:DM:DLIS:TAG? 'DATA LIST'"`
'queries the content of the `'DATA LIST'` tag of the selected data list file.

Response: `"56"`
'transmits a data list which is 56 bytes long from ':' to '}'.

{DATE: yyyy-mm-dd;hh:mm:ss} (optional)

The tag contains the date and time at which the file was created. The year must be expressed as four digits. The R&S Signal Generator does not analyze this tag.

Example: {DATE: 2003-04-02;14:32:12}

IEC bus query: `":BB:ARB:WAV:TAG? 'DATE'"`
'queries the content of the `'DATE'` tag of the selected waveform file.

Response: `"'2003-04-02;14:32:12'"`
'the waveform was created on April 2, 2003 at 14 hrs 32 min.

{CONTROL LENGHT: ControlLength} (optional)

The tag contains the length of the control list in ASCII format. If this tag is not used, the control list length is determined by the highest position used in one of the LIST tags. It is recommended to set this value to be equal to the number of samples in order to keep marker signals and wave data synchronized.

Example: {CONTROL LENGTH: 444}

IEC bus query: `":BB:ARB:WAV:TAG? 'CONTROL LENGTH'"`
'queries the length of the control list.

Response: `"'444'"`

{LEVEL OFFS: RMSOffset_dB,PeakOffset_dB} (optional for waveforms)

The tag determines the level of the ARB signal in the waveform file. The offset levels define the offset of rms and peak value relative to the 16-bit full scale modulation (-32767 to + 32767) = 0 dB.

RMSOffset_dB 'RMSOffset_dB' defines the rms level offset of the signal relative to full scale ARB signal in the "WAVEFORM" tag. The offset is defined in ASCII float format. The value is always positive. A 3dB value indicates that the rms level of the signal is 3 dBs below the full scale (full scale = max. amplitude of vector of I/Q samples = |SIQ|max = sqrt(I2+Q2)max = 0 dB)

PeakOffset_dB 'PeakOffset_dB' defines the peak level offset of the signal relative to full scale for the ARB signal in the "WAVEFORM" tag. The offset is defined in ASCII float format. The value usually equals 0 dB as in the majority of cases the I/Q samples (signed 16-bit integer values) are modulated to full scale: Full scale = 0 dB = max. amplitude of vector of I/Q samples = |SIQ|max = sqrt(I2+Q2)max = (2°15)-1 = 32767.

A positive PeakOffset_dB value indicates that a headroom to full scale is provided when generating the waveform. A negative PeakOffset_dB value indicates that overrange is likely for some samples, i.e. clipping might occur.

The crest factor can be calculated from the two values as follows:

crest factor = |PeakOffset_dB - RMSOffset_dB|

Example: {LEVEL OFFS: 3.45,2}

IEC bus query: `":BB:ARB:WAV:TAG? 'LEVEL OFFS'"`
'queries the content of the `'LEVEL OFFS'` tag of the selected waveform file.

Response: `"'3.45,2'"`
'the level of the waveform is below full scale, clipping will not occur.

{SAMPLES: Samples} (optional for waveforms)

The tag contains the number of I/Q samples in the waveform in ASCII format.

Example: {SAMPLES: 4333}

IEC bus query: `":BB:ARB:WAV:TAG? 'SAMPLES'"`
'queries the content of the 'SAMPLES' tag of the selected waveform file.

Response: `"'4333'"`
'the waveform contains 4333 I/Q samples.

{[TRACE] LIST [#]: Pos_0:Val_0;Pos_1:Val_1;...Pos_x:Val_x;...Pos_{N-1}:Val_{N-1}}
mandatory for control lists / optional for waveforms)

The tag contains the data for the marker and control signals in the control list or the marker signals of ARB waveforms. To select which of these signals is defined, [TRACE] and the associated number are used. For ARB waveforms it is only meaningful to define marker signals.

[TRACE] [TRACE] specifies the name of the marker or control signal: You may choose from the following names: MARKER; BURST; LEVATT; CW MODE; HOP

[#] [#] specifies the number in the case of control signals and marker signals with the same name. There is a choice between 4 markers and 3 LEVATT signals. Lines LEVATT 1 and 2 are needed for internal purposes and should not be used.

Pos Pos specifies in ASCII format the number of the position in the sequence, with effect from which the binary state of the marker or of the control signal changes from 0 to 1 or from 1 to 0.

Val Val specifies the binary state of the marker or of the control signal{0; 1} from Pos_x to Pos_{x+1} exclusive in ASCII format.

Example: {MARKER LIST 1: 0:0;10:1;20:0;30:1}

IEC bus query: `":BB:DM:CLIS:TAG? 'MARKER LIST 1'"`
'queries the content of the `'MARKER LIST 1'` tag of the selected control list file.

Response: `"'0:0;10:1;20:0;30:1'"`
'the marker setting for samples 0 to 9 = 0 (low), for 10 to 19 = 1 (high) and for 20 to 29 = 0. From sample 30 onward the marker setting = 1.

Example: {LEVATT LIST 1: 0:0;10:1;20:0;30:1}

IEC bus query: `":BB:DM:CLIS:TAG? 'LEVATT LIST 1'"`
'queries the content of the `'LEVATT LIST 1'` tag of the selected control list file.

Response: `"'0:0;10:1;20:0;30:1'"`
'level attenuation applies to data values 10 to 19 (high) and from data value 30 onward.

{WAVEFORM-Length: #$I_0Q_0I_1Q_1...I_xQ_x...I_{N-1}Q_{N-1}$…} (mandatory for waveforms)

The tag contains the actual waveform data and consists of the following:

Length 'Length' specifies the number of bytes in a WAVEFORM tag and consists of the following:

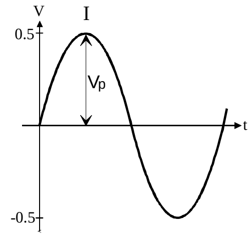
+ Length of ",#" (1 byte)

+ Number of I/Q pairs * 4 (2 bytes per I and per Q value).

I_xQ_x… represents binary data (16-bit signed integer in 2's complement notation) containing the I and Q component alternately and starting with the I component. Each component consists of two bytes, least significant byte (LSB) first.

The values of the two bytes in an I component and a Q component are in the range -32767 to +32767. This value is transferred to the D/A converter.

At 50 Ω between the inner and outer conductors of the I and Q outputs, an amplitude V_p of +/-0.5 Volt arises on the I/Q output connectors of the R&S Signal Generator. When a PEP offset is defined (PEP OFFSET tag) the amplitude is correspondingly reduced.



(The illustration also applies to the Q output)

Example: {WAVEFORM-401:#I,Q,I,Q,I,Q...I,Q} (100 I/Q pairs with 4 bytes each are transmitted are transmitted)

IEC bus query: The data is transmitted using IEC bus command `BB:ARB:WAVE:DATA`.

Creating a Waveform Manually

We will use the example of a sine function in the I channel and a cosine function in the Q channel, each with 20 points, to explain how a waveform file SICO.WV is generated.

The sine and cosine values are calculated by a short program written in the programming language C (see the following example for creating a C-program). They are stored in the file SICO.TXT as follows:

Contents of SICO.TXT:

Sine (I) Cosine (Q)

```
0.000000 1.000000
0.309017 0.951057
0.587785 0.809017
0.809017 0.587785
0.951057 0.309017
1.000000 -0.000000
0.951056 -0.309017
0.809017 -0.587785
0.587785 -0.809017
0.309017 -0.951056
-0.000000 -1.000000
-0.309017 -0.951057
-0.587785 -0.809017
-0.809017 -0.587785
-0.951056 -0.309017
-1.000000 0.000000
-0.951056 0.309017
-0.809017 0.587785
-0.587785 0.809017
-0.309017 0.951057
```

The decimal values in SICO.TXT should be normalized such that they are between –1.0 and +1.0.

The waveform file SICO.WV will be based on the contents of this file.

To be read by the R&S Signal Generator these waveform data must be coded binary and packed into an appropriate WAVEFORM tag.

A tag consists of a name and a data set and is enclosed in curved brackets. The tag is a kind of label carrying information about what the R&S Signal Generator should do with the data set (see above and step 3 of the following instructions).

The following steps outline how to create the waveform file SICO.WV:

Step 1

The values from the file SICO.TXT must be converted into binary format consisting of integer numbers without a sign and with 16-bit width. The numeric range between –1.0 and +1.0 corresponds to the modulation range of the waveform D/A converter of 65535 (2^{16}-1).

+1.0 ->	32767	= 0x7FFF
0.0 ->	0	= 0x0000
-1.0 ->	-32767	= 0x8001

A further C-program is suitable for creating the binary data set from the ASCII values stored in SICO.TXT file (see following example for creating a C-program). This program stores the binary data set to a file called SICO.WV.

The contents of the file SICO.WV reads as follows:

IQIQIQIQIQIQIQI ... IQ

Explanation:

There is no readable representation for binary values in this document. This is why we use the sequence IQIQIQ to characterize the binary code in the present example.

Step 2

The file SICO.WV now contains the binary data set corresponding to the 20 I/Q pairs. Before this binary data set can be further processed in step 3, the TYPE and the CLOCK tag

`{TYPE: SMU-WV, xxxxxxx}`
`{CLOCK: yyy}` must be placed in front.

The TYPE tag must be the first entry in a WAVEFORM. The TYPE tag identifies the waveform as a valid R&S Signal Generator waveform.

SMU-WV denotes that the waveform is self-contained.

Xxxxxxx is the checksum of the waveform. To simplify our example **0** is used, i.e., the R&S Signal Generator does not evaluate a checksum.

The TYPE tag informs the R&S Signal Generator about the clock rate of the waveform.

yyy is the clock frequency at which the waveform has to be output, in Hz

To enter the TYPE tag in the SICO.WV file an ASCII editor which is able to handle binary data as well, e.g. the Microsoft Windows editor **NOTEPAD.EXE,** must be used.

Now the contents of the SICO.WV file read:

```
{TYPE: SMU-WV, 0}
{CLOCK: 10e6}
IQIQIQIQIQIQIQIQIQI ... IQ
```

Step 3

The binary data must now be packed into a WAVEFORM tag with the following structure:

`{WAVEFORM-Length:␣#`*`IQIQIQIQIQIQIQIQIQI ... IQ`*`}`

The WAVEFORM tag consists of the following characters and data:

`{` Opens each tag.

`WAVEFORM` Name of the tag for waveform.

`-` Separates the name from the length indication.

`Length` Length of the data set

Length indicates the number of bytes of the data set and consists of:

- \+ length of ",#" (1 byte)
- \+ number of I/Q pairs * 4 (2 bytes per I and per Q value).

In our example containing a sine and a cosine with 20 pairs for each wave, the resulting length is **81**.

`:␣` Separates the name and length from the remainder of the data set. The blank␣ can be omitted.

#	Indicates the beginning of the binary data.
IQIQIQ	Binary data set. The binary data contain the I and Q values in alternate order, the first value is an I value. Each value consists of 2 Bytes, starting with the least significant bit.
}	Terminates each tag.

The editor mentioned above which can handle binary data is now used to place the string "**{WAVEFORM-81: #**" in front and '**}**' at the end of the data set.

The contents of the waveform file SICO.WV for 20 I/Q pairs is now ready for operation and reads.

```
{TYPE: SMU-WV,0}
{CLOCK: 10e6}          20 I/Q pairs = 80 bytes
{WAVEFORM-81: #IQIQIQIQ ...IQ }
                      81bytes
```

The tags TYPE, CLOCK and WAVEFORM are mandatory for each waveform. All other tags are optional and can be inserted after the TYPE tag in arbitrary order, e.g.

```
{TYPE: SMU-WV,0}
{COMMENT: I/Q=sine/cosine, 20 points, clock 10 MHz}
{CLOCK: 10e6}
{Samples:20}
{WAVEFORM-81:#IQIQIQIQIQIQ ... IQ}
```

C-program for creating the file SICO.TXT containing 20 sine and cosine pairs:

```
#include <stdlib.h>
#include <stdio.h>
#include <math.h>

void main(void)
{
    const unsigned int samples = 20;
    const float pi = 3.141592654;
    float grad, rad;
    FILE *fp;
    int i;

    fp = fopen("SICO.TXT", "w");
    if (fp == 0)
        return;

    for (i=0; i<samples; i++)
    {
        grad = (360.0 / (float)samples) * (float)i;
        rad = grad * (pi / 180.0);

        fprintf(fp, "%f %f\n", sin(rad), cos(rad));
    }
    fclose(fp);
}
```

Contents of the file SICO.TXT:

Sine (I)	Cosine (Q)
0.000000	1.000000
0.309017	0.951057
0.587785	0.809017
0.809017	0.587785
0.951057	0.309017
1.000000	-0.000000
0.951056	-0.309017
0.809017	-0.587785
0.587785	-0.809017
0.309017	-0.951056
-0.000000	-1.000000
-0.309017	-0.951057
-0.587785	-0.809017
-0.809017	-0.587785
-0.951056	-0.309017
-1.000000	0.000000
-0.951056	0.309017
-0.809017	0.587785
-0.587785	0.809017
-0.309017	0.951057

Extract from a C-program generating a binary data set from the I/Q pairs in the file SICO.TXT and storing the result to file SICO.WV:

```
#include <stdlib.h>
#include <stdio.h>
#include <math.h>

void main(void)
{
    const unsigned int samples = 20;  // Number of samples to convert
    FILE *fp_sour, *fp_dest;
    float i_float, q_float;
    unsigned short i_usint, q_usint;
    int i;

    fp_sour = fopen("SICO.TXT", "rt");
    if (fp_sour == 0)
        return;
    fp_dest = fopen("SICO.WV", "wb");
    if (fp_dest == 0)
    {
        fclose(fp_sour);
        return;
    }

    // Write required tags to waveform file
    fprintf(fp_dest, "{TYPE: SMU-WV,0}");
    fprintf(fp_dest, "{CLOCK: 10e6}");
    fprintf(fp_dest, "{SAMPLES: %d}", samples);
    fprintf(fp_dest, "{WAVEFORM-%d:#", (samples * 4) + 1);

    for (i=0; i<samples; i++)
    {
        // Read I/Q pair from ASCII file
        if (fscanf(fp_sour, "%f %f", &i_float, &q_float) == EOF)
            break;

        // Convert I/Q pair to unsigned short
        i_usint = (unsigned short)floor((i_float * 32767.0) + 0.5);
        q_usint = (unsigned short)floor((q_float * 32767.0) + 0.5);

        // Write converted I/Q pair to waveform file
        fwrite(&i_usint, 2, 1, fp_dest);
        fwrite(&q_usint, 2, 1, fp_dest);
    }

    fprintf(fp_dest, "}");

    fclose(fp_dest);
    fclose(fp_sour);
}
```

SOURce:BB:DM Subsystem - Remote-Control Commands

Introduction - DM General Remote-Control Commands

The commands in the Source:BB:DM subsystem are described in two sections, separated into configuring digital modulation and lists for digital modulation.

The following section contains the commands for generating the digital modulation signal.

The keyword SOURce is optional and can be omitted.

Table of Commands - DM General Remote-Control Commands

Command	Parameter	Default unit	Note
[SOURce]:BB:DM:ASK:DEPTh	0 ... 100	PCT	
[SOURce]:BB:DM:CLOCk			Query only
[SOURce]:BB:DM:CLOCk:MODE	SYMBol		
[SOURce]:BB:DM:CLOCk:MULTiplier	1 ... 64		
[SOURce]:BB:DM:CLOCk:SOURce	INTernal | EXTernal		
[SOURce]:BB:DM:CODing	OFF| APCO25 | APCO25FSK | CDMA2000 | DIFF| DPHS| DGRay | EDGE | GRAY| GSM| ICO| NADC| PDC| PHS| TETRa | PWT| TFTS| INMarsat | VDL | WCDMa		
[SOURce]:BB:DM:FILTer:PARameter:APCO25	0.15 ... 2.5		
[SOURce]:BB:DM:FILTer:PARameter:COSine	0.05 ... 0.99		
[SOURce]:BB:DM:FILTer:PARameter:GAUSs	0.15 ... 2.5		
[SOURce]:BB:DM:FILTer:PARameter:LPASs	0.05 … 2.0		
[SOURce]:BB:DM:FILTer:PARameter:PGAus	0.15 ... 2.5		
[SOURce]:BB:DM:FILTer:PARameter:RCOSine	0.05 ... 0.99		
[SOURce]:BB:DM:FILTer:PARameter:SPHase	0.15 ... 2.5		
[SOURce]:BB:DM:FILTer:TYPE	RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | USER | DIRac | ENPShape | EWPShape		
[SOURce]:BB:DM:FLISt:CATalog			Query only
[SOURce]:BB:DM:FLISt:DELete	<file name>		
[SOURce]:BB:DM:FLISt:FREE			Query only
[SOURce]:BB:DM:FLISt:POINTs			Query only
[SOURce]:BB:DM:FLISt:SELect	<file name>		

Command	Parameter	Default unit	Note
[SOURce]:BB:DM:FORMat	ASK | BPSK | P2DBpsk | QPSK | QPSK45 | OQPSk | P4QPsk | P4DQpsk | PSK8 | P8D8psk | P8EDge | QAM16 | QAM32 | QAM64 | QAM128 | QAM256 | QAM1024 | QAM16EDge | QAM32EDge | MSK | FSK2 | FSK4 | USER | FSKVar | QEDGe		
[SOURce]:BB:DM:FSK:DEViation	0.1 x Symbol Rate ... 1.5 x Symbol Rate	Hz	
[SOURce]:BB:DM:FSK:VARiable:TYPE	4FSK | 8FSK | 16 FSK		
[SOURce]:BB:DM:FSK:VARiable:SYMBol<0...15>:DEViation	-1.5 x Symbol Rate ... 1.5 x Symbol Rate (max 10 MHz)	Hz	
[SOURce]:BB:DM:MDELay?			Query only
[SOURce]:BB:DM:PATTern	#B0 ... #B111...1, 1...64		
[SOURce]:BB:DM:PRAMp:ATTenuation	0.0 ... 50	dB	
[SOURce]:BB:DM:PRAMp:FDELay	-4.0 ... +4.0 symbols		
[SOURce]:BB:DM:PRAMp:RDELay	-4.0 ... +4.0 symbols		
[SOURce]:BB:DM:PRAMp:SHAPe	LINear | COSine		
[SOURce]:BB:DM:PRAMp:SOURce	INTernal		
[SOURce]:BB:DM:PRAMp[:STATe]	ON | OFF		
[SOURce]:BB:DM:PRAMp:TIME	0.25 ... 32 symbols		
[SOURce]:BB:DM:PRBS[:LENGth]	9 | 11 | 15 | 16 | 20 | 21 | 23		
[SOURce]:BB:DM:PRESet			
[SOURce]:BB:DM:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger | SINGle		
[SOURce]:BB:DM:SOURce	ZERO | ONE | PRBS | PATTern | DLISt		
[SOURce]:BB:DM:SRATe	400 Hz ... 15 MHz (FSK) / 27 MHz	Hz	
[SOURce]:BB:DM:STANdard	USER | BLUetooth | CFORward | CREVerse | DECT | ETC | GSM | GSMEdge | NADC | PDC | PHS | TDSCdma | TETRa | TFTS | W3GPp | WORLdspace		
[SOURce]:BB:DM:STATe	ON | OFF		
[SOURce]:BB:DM:SWITching:SOURce	INTernal | EXTernal		
[SOURce]:BB:DM:SWITching:STATe	ON | OFF		
SOURce:BB:DM:SYNChronization:EXECute			
SOURce:BB:DM:SYNChronization:MODE	NONE | MASTer | SLAVe		
[SOURce]:BB:DM:TRIGger:ARM:EXECute	-		No query
[SOURce]:BB:DM:TRIGger:EXECute	-		No query
[SOURce]:BB:DM:TRIGger[:EXTernal<[1]|2>]:DELay	0 ... 2^16 - 1 Symbols		
[SOURce]:BB:DM:TRIGger[:EXTernal<[1]|2>]:INHibit	0 ... 2^26 -1 Symbols		
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:DELay	0 ... 2^20 -1 Symbols		

Command	Parameter	Default unit	Note
[SOURce]:BB:DM:TRIGger:OUTPut:DELay:FIXed	ON | OFF	Hz	
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:DELay:MAX?			Query only
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:DELay:MIN?			Query only
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:MODE	CLISt | PULSe | PATTern | RATio | TRIGger		
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:OFFTime	1 ... (2^20 - 1) symbols		
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:ONTime	1 ... (2^20 - 1) symbols		
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:PATTern	#B0, 1 ... #B111...1,32		
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:PULSe:DIVider	2 ... 2^10		
[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:PULSe:FREQ?			Query only
[SOURce]:BB:DM:TRIGger:RMODe			Query only
[SOURce]:BB:DM:TRIGger:SLENgth	1 ...2^32-1 symbols		
[SOURce]:BB:DM:TRIGger:SOURce	INTernal | EXTernal		

[SOURce]:BB:DM:ASK:DEPTh 0 ... 100 PCT

The command sets the ASK modulation depth when modulation type ASK is selected.

Example: `":BB:DM:FORM ASK"`
'selects the ASK modulation type.

`":BB:DM:ASK:DEPT 50 PCT"`
'sets a modulation depth of 50 percent.

*RST value	Resolution	SCPI
100 PCT	0.1 PCT	Device-specific

[SOURce]:BB:DM:CLOCk:MODE SYMBol

The command enters the type of externally supplied clock (`:BB:DM:CLOCk:SOURce EXTernal`).

Example: `":BB:DM:CLOC:MODE SYMB"`
'selects clock type **Symbols**, i.e. the supplied clock is a symbol clock.

*RST value	Resolution	Dependencies	SCPI
SYMBol	-		Device-specific

[SOURce]:BB:DM:CLOCk:SOURce INTernal | EXTernal

The command selects the source for the digital modulation clock.

Parameter: **INTernal**
The internal clock reference is used.

EXTernal
The external clock reference is supplied to the CLOCK connector.

Example: `":BB:DM:CLOC:SOUR INT"`

'selects the internal clock reference.

*RST value	Resolution	Dependencies	SCPI
INTernal	-		Device-specific

[SOURce]:BB:DM:CODing OFF| APCO25 | APCO25FSK | CDMA2000 | DIFF| DPHS| DGRay | EDGE | GRAY| GSM| ICO| NADC| PDC| PHS| TETRa | PWT| TFTS| INMarsat | VDL | WCDMa

The command selects the modulation coding.

Parameter: **DPHS**
Phase Difference

DGRay
Difference + Gray

...

Example: `":BB:DM:COD GRAY"`
'selects GRAY coding. This coding is valid for all modulation types.

*RST value	Resolution	Dependencies	SCPI
INTernal	-	If the modulation type selected (`:BB:DM:FORM`) is not possible with the coding that has been set, it is automatically set to OFF (`:BB:DM:COD OFF`). When a standard is selected (`:BB:DM:STAN`), the coding is set to the default value.	Instrum-ent-specific

[SOURce]:BB:DM:FILTer:PARameter?

Queries the filter parameter of the selected filter.

Example: `":BB:DM:FILT:TYPE?"`
'queries the filter type.

Response: `LPAS`

`":BB:DM:FILT:PAR?"`
'queries the filter parameter.

Response: `0.5`

*RST value	Resolution	SCPI
-	0.01	Device-specific

[SOURce]:BB:DM:FILTer:PARameter:APCO25 0.05 ... 0.99

The command sets the roll-off factor for filter type APCO25.

Example: `":BB:DM:FILT:PAR:APCO25 0.2"`
'sets the roll-off factor to 0.2 for filter type APCO25.

*RST value	Resolution	Dependencies	SCPI
0.20	0.01	On selecting filter APCO25, the filter parameter is set to the default value.	Device-specific

[SOURce]:BB:DM:FILTer:PARameter:COSine 0.05 ... 0.99

The command sets the roll-off factor for the Cosine filter type.

Example: ":BB:DM:FILT:PAR:COS 0.35"
'sets the roll-off factor to 0.35 for filter type Cosine.

*RST value	Resolution	Dependencies	SCPI
0.35	0.01	On selecting the Cosine filter , the filter parameter is set to the default value.	Device-specific

[SOURce]:BB:DM:FILTer:PARameter:GAUSs 0.15 ... 2.5

The command sets the roll-off factor for the Gauss filter type.

Example: ":BB:DM:FILT:PAR:GAUS 0.5"
'sets B x T to 0.5 for the Gauss filter type.

*RST value	Resolution	Dependencies	SCPI
0.3	0.01	On selecting the GAUSS filter or a standard (:BB:DM:STAN) which uses the GAUSS filter, the filter parameter is set to the default value.	Device-specific

[SOURce]:BB:DM:FILTer:PARameter:PGAuss 0.15 ... 2.5

The command sets the roll-off factor for the Pure Gauss filter type.

Example: ":BB:DM:FILT:PAR:PGA 0.5"
'sets B x T to 0.5 for the Pure Gauss filter type.

*RST value	Resolution	Dependencies	SCPI
0.3	0.01	On selecting the Pure GAUSS filter the filter parameter is set to the default value.	Device-specific

[SOURce]:BB:DM:FILTer:PARameter:LPASs 0.05 ... 2.0

The command sets the cut off frequency factor for the Lowpass filter type. The value range depends on the set symbol rate.

Example: ":BB:DM:FILT:PAR:LPAS 0.5"
'the cut of frequency factor is set to 0.5.

*RST value	Resolution	SCPI
0.50		Device-specific

[SOURce]:BB:DM:FILTer:PARameter:RCOSine 0.05 ... 0.99

The command sets the roll-off factor for the Root Cosine filter type.

Example: ":BB:DM:FILT:PAR:RCOS 0.22"
'sets the roll-off factor to 0. 22 for filter type Root Cosine.

*RST value	Resolution	Dependencies	SCPI
0.35	0.01	On selecting the Root Cosine filter or a standard (:BB:DM:STAN) which uses the Root Cosine filter, the filter parameter is set to the default value.	Device-specific

[SOURce]:BB:DM:FILTer:PARameter:SPHase 0.15 ... 2.5

The command sets B x T for the Split Phase filter type.

Example: `":BB:DM:FILT:PAR:SPH 0.5"`
'sets B x T to 0.5 for the Split Phase filter type.

*RST value	Resolution	Dependencies	SCPI
2	0.01	On selecting the Split Phase filter or a standard (`:BB:DM:STAN`) which uses the Split Phase filter, the filter parameter is set to the default value.	Device-specific

[SOURce]:BB:DM:FILTer:TYPE RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | USER | DIRac | ENPShape | EWPShape

The command selects the filter type.

Example: `":BB:DM:FILT:TYPE COS"`
'selects the Cosine filter type.

*RST value	Resolution	Dependencies	SCPI
GAUSs	-	When a standard is selected (`:BB:DM:STAN`), the filter type and filter parameter are set to the default value.	Device-specific

[SOURce]:BB:DM:FORMat ASK | BPSK | P2DBpsk | QPSK | QPSK45 | OQPSk | P4QPsk | P4DQpsk | PSK8 | P8D8psk | P8EDge | QAM16 | QAM32 | QAM64 | QAM128 | QAM256 | QAM1024 | QAM16EDge | QAM32EDge | MSK | FSK2 | FSK4 | USER | FSKVar | QEDGe

The command selects the modulation type.

Example: `":BB:DM:FORM QPSK"`
'selects modulation type QPSK.

*RST value	Resolution	Dependencies	SCPI
MSK	-	If the coding that is set (`:BB:DM:COD`) is not possible with the modulation type selected, it is automatically set to OFF (`:BB:DM:COD OFF`). When a standard is selected (`:DM:STAN`), the modulation type is set to the default value.	Device-specific

[SOURce]:BB:DM:FSK:DEViation <numeric_value>

The command sets the frequency deviation when FSK modulation is selected. The range of values depends on the symbol rate that is set (see data sheet) and the maximum deviation is 10 MHz.

Example: `":BB:DM:FORM FSK"`
'selects FSK modulation.

`":BB:DM:FSK:DEV 10 MHz"`
'sets the frequency deviation to 10 MHz.

*RST value	Resolution	Dependencies	SCPI
Symbol rate/2	0.5 Hz	If the symbol rate that is set exceeds the maximum possible value for the chosen frequency deviation, it is suitably adapted (`:BB:DM:SRAT`).	Device-specific

[SOURce]:BB:DM:FSK:VARiable:SYMBol<0...15>:DEViation <numeric_value>

The command sets the deviation of the selected symbol for variable FSK modulation mode. The number of symbols (and therefore the suffix range) depends on the selected FSK modulation type. The range of values depends on the symbol rate that is set (see data sheet) and the maximum deviation is 10 MHz.

Example: `":BB:DM:FORM FSKV"`
'selects Variable FSK modulation.
`":BB:DM:FSK:VAR:TYPE FSK16"`
'selects 16FSK modulation.
`":BB:DM:FSK:VAR:SYMB0:DEV 135000"`
'sets the frequency deviation of the least significant symbol to 135 kHz.

*RST value	Resolution	SCPI
-	0.5 Hz	Device-specific

[SOURce]:BB:DM:FSK:VARiable:TYPE FSK4 | FSK8 | FSK16

The command selects the modulation type for Variable FSK.

Example: `":BB:DM:FORM FSKV"`
'selects Variable FSK modulation.
`":BB:DM:FSK:VAR:TYPE FSK16"`
'selects 16FSK modulation.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:MDELay?

The command queries the digital modulation delay from the data input to the I/Q output in the case of external modulation.

This command is a query and therefore has no *RST value.

Example: `"BB:DM:MDEL?"`
'queries the delay in the case of external modulation.
Response: '`0.4 ms`'
'the delay is 0.4 ms.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:PATTern #B0 ... #B111...1, 1...64

The command selects the data pattern for the internal data when PATTern is selected as the data source. The maximum length is 64 bits.

Example: `":BB:DM:SOUR PATT"`
'selects Pattern as the data source for digital modulation.
`":BB:DM:PATT #B01110111010101010,17"`
'generates the user-defined sequence of 0/1 data.

*RST value	Resolution	SCPI
#B0,1	-	Device-specific

[SOURce]:BB:DM:PRAMp:ATTenuation 0.0 ... 70 dB

The command sets the level attenuation for signal ranges that are flagged with level attribute **attenuated** by the LEV_ATT control signal.

Example: `":BB:DM:PRAM:ATT 15 dB"`
'sets a level attenuation of 15 dB.

*RST value	Resolution	SCPI
15 dB	0.01 dB	Device-specific

[SOURce]:BB:DM:PRAMp:FDELay - 4.0 ... + 4.0 Symbols

The command sets the delay in the falling edge. A positive value gives rise to a delay and a negative value causes an advance. The setting is expressed in symbols.

Example: `":BB:DM:PRAM:FDEL 1"`
'the falling edge starts 1 symbol later.

*RST value	Resolution	SCPI
0 symbols	0.1 symbol	Device-specific

[SOURce]:BB:DM:PRAMp:RDELay - 4.0 ... + 4.0 Symbols

The command sets the delay in the rising edge. A positive value gives rise to a delay and a negative value causes an advance. The setting is expressed in symbols.

Example: `":BB:DM:PRAM:RDEL 1"`
'the rising edge starts 1 symbol later.

*RST value	Resolution	SCPI
0 symbols	0.1 symbol	Device-specific

[SOURce]:BB:DM:PRAMp:SHAPe LINear | COSine

The command sets the edge shape of the ramp envelope.

Example: `":BB:DM:PRAM:SHAP COS"`
'selects a cosine-shaped rise and fall for the transmitted power edge.

*RST value	Resolution	SCPI
COSine	-	Device-specific

[SOURce]:BB:DM:PRAMp:SOURce INTernal

The command sets the source for the power ramp control signals.

Parameter: **INTernal**
The internal control signals LEV_ATT and BURST are used. Control signals are stored in dedicated lists. When remote control is in use, the list to be used is defined, selected and enabled with the aid of `SOURce:BB:DM:CLISt:...` commands.

Example: `":BB:DM:PRAM:SOUR INT"`
'enables the use of internal control signals for power ramp control.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce]:BB:DM:PRAMp[:STATe] ON | OFF

The command enables or disables power ramping.

Example: `":BB:DM:PRAM:STAT ON"`
'switches power ramping on.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce]:BB:DM:PRAMp:TIME 0.25 ... 16 Symbols

The command sets the power ramping rise time and fall time for a burst.

Example: `":BB:DM:PRAM:TIME 2"`
'sets a time of 2 symbols for the edges to rise and fall.

*RST value	Resolution	SCPI
1 symbol	0.1 symbol	Device-specific

[SOURce]:BB:DM:PRBS[:LENGth] 9 | 11 | 15 | 16 | 20 | 21 | 23

The command defines the length of the pseudo-random sequence in accordance with the following equation:

Length = (2^LENGth) - 1

Example: `":BB:DM:SOUR PRBS"`
'the internal pseudo-random generator is used as the data source.

`":BB:DM:PRBS 9"`
'an internal pseudo-random sequence of 511 bits will be generated.

*RST value	Resolution	SCPI
9	-	Device-specific

[SOURce]:BB:DM:PRESet

The command calls the default settings for digital modulation.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:PRES"`
'calls the default settings for DM.

*RST value	Dependencies	SCPI
-	:BB:DM:CLOC:DEL 0 :BB:DM:CLOC:MODE SYMB :BB:DM:CLOC:SOUR INT :BB:DM:CLOC:COD GSM :BB:DM:FILT:PAR:APC 0.2 :BB:DM:FILT:PAR:COS 0.35 :BB:DM:FILT:PAR:GAUS 0.5 :BB:DM:FILT:PAR:RCOS 0.22 :BB:DM:FILT:PAR:SPH 0.1 :BB:DM:FILT:TYPE RCOS :BB:DM:FORM MSK :BB:DM:FSK:DEV 135.417kHz :BB:DM:PATT #H0,1 :BB:DM:PRAM:ATT 15 dB :BB:DM:PRAM:ROFF 0 :BB:DM:PRAM:FOFF 0 :BB:DM:PRAM:SHAP COS :BB:DM:PRAM:SOUR INT :BB:DM:PRAM OFF :BB:DM:PRAM:TIME 1 Symb :BB:DM:PRBS 9 :BB:DM:SEQ AUTO :BB:DM:SOUR PRBS :BB:DM:SRAT 270.833 kHz :BB:DM:STAN GSM :BB:DM:TRIG:DEL 0 :BB:DM:TRIG:INH 0 :BB:DM:TRIG:OUTP:DEL 0 :BB:DM:TRIG:OUTP:MODE FRAM :BB:DM:TRIG:OUTP:PER 1 :BB:DM:TRIG:SOUR INT	Device-specific

[SOURce]:BB:DM:SEQuence AUTO | RETRigger | AAUTo | ARETrigger | SINGle

The command selects the trigger mode.

Parameter:

AUTO
The modulation signal is generated continuously.

RETRigger
The modulation signal is generated continuously. A trigger event (internal or external) causes a restart.

AAUTo
The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command `SOUR:BB:DM:TRIG:ARM:EXEC` and started again when a trigger event occurs.

ARETrigger
The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart. Signal generation is stopped with command `SOUR:BB:DM:TRIG:ARM:EXEC` and started again when a trigger event occurs.

SINGle
The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated once to the set sequence length (`SOUR:BB:DM:TRIG:SLEN`). Every subsequent trigger event causes a restart.

Example: `":BB:DM:SEQ AAUT"`
'sets the **Armed_auto** trigger mode; the device waits for the first trigger (e.g. with `*TRG`) and then generates the signal continuously.

*RST value	Resolution	SCPI
AUTO	-	Device-specific

[SOURce]:BB:DM:SOURce ZERO | ONE | PRBS | PATTern | DLISt

The command selects the data source.

Parameter:

ZERO
An internally generated 0 data sequence is used.

ONE
An internally generated 1 data sequence is used.

PRBS
The pseudo-random sequence generator is used as the data source. The length of the random sequence is defined with the aid of command `SOURce:BB:DM:PRBS`.

PATTern
Internally generated data with a fixed pattern is used. The data pattern is defined using command `SOURce:BB:DM:PATTern`.

DLISt
Data from the selected data list is used.

Example: `":BB:DM:SOUR DLIS"`
'the internal data generator is used.

`":BB:DM:DLIS:SEL 'test'"`
'the data list 'test.dm_iqd' is used.

*RST value	Resolution	SCPI
PRBS	-	Device-specific

[SOURce]:BB:DM:SRATe 400 Hz ... 15 MHz (FSK) / 25 MHz

The command sets the symbol rate. The value range is dependent on the selected modulation type. On changing to an FSK modulation type, excessively high values are automatically limited to the maximum value that can be set for FSK (see data sheet). The symbol rate can be entered in Hz/kHz/MHz or Symb/s / kSymb/s and MSymb/s.

When a standard is selected (`DM:STANdard`), the symbol rate is automatically set to the appropriate default value.

Example: `":BB:DM:SRAT 10 MHz"`
'sets a symbol rate of 10 MHz.

*RST value	Resolution	Dependencies	SCPI
270.833 kHz	0.001 Hz	The value range is dependent on the selected modulation type (`:BB:DM:FORM`). When a standard is selected (`:BB:DM:STAN`), the symbol rate is set to the default value.	Device-specific

[SOURce]:BB:DM:STANdard USER | BLUetooth | CFORward | CREVerse | DECT | ETC | GSM | GSMEdge | NADC | PDC | PHS | TDSCdma | TETRa | TFTS | W3GPp | WORLdspace

The command selects the standard. After selection, modulation parameters **Modulation Type**, **Symbol Rate**, **Filter** and **Coding** are automatically set in accordance with the standard. The USER parameter cannot be set. A query returns this value if a user-defined Custom Dig Mod setting was loaded or if one of the associated settings was changed subsequent to the selection of a standard. The user defined settings are stored and loaded with commands `:BB:DM:STAN:ULIS:...` (see following section "Introduction - DM Lists - Remote-Control Commands").

Example: `":BB:DM:STAN DECT"`
'selects digital modulation according to the DECT standard.

*RST value	Resolution	Dependency	SCPI

GSM	-	Each selection sets the parameters
		`:BB:DM:FORMat`
		`:BB:DM:SRATe`
		`:BB:DM:FILTer:TYPE`
		`:BB:DM:FILTer:PARameter:...`
		`:BB:DM:CODing` and if necessary
		`:BB:DM:FSK:DEV`
		to the appropriate default values.
			Device-specific

[SOURce]:BB:DM:STATe ON | OFF

The command enables or disables digital modulation. Switching on digital modulation turns off all the other digital standards.

Example: `":BB:DM:STAT ON"`
'switches digital modulation on.

*RST value	Resolution	Dependency	SCPI
OFF	-	`:BB:DM:STAT ON` turns off all the other standards.	Device-specific

[SOURce]:BB:DM:SWITching:SOURce INTernal | EXTernal

The command selects the source of the CW control signal for switching between a modulated and an unmodulated signal.

Parameter: **INTernal**
The CW signal in the control list is used for the control.

Example: `":BB:DM:SWIT INT"`
'the CW signal in the control list is used for the control.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce]:BB:DM:SWITching:STATe ON | OFF

The command enables switching between a modulated and an unmodulated signal.

Example: `":BB:DM:SWIT:STAT INT"`
'CW switching is active.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce]:BB:DM:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the synchronization mode, set with the command `BB:DM:SYNC:MODE` (see section "Synchronous Signal Generation").

Example: `":BB:DM:SYNC:MODE MAST"`
'the instrument is configured to work as a master one.

`":BB:DM:SYNC:EXEC`
'all synchronization's settings are adjusted accordingly.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:SYNChronization:MODE NONE |MASTer | SLAVe

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note:
If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.
Avoid unnecessary cable length and branching points.

Parameter: **NONE**
The instrument is working in stand-alone mode.

MASTer
The instrument provides all connected instrument with its synchronization clock (including the trigger signal) and reference clock signal.

SLAVe
The instrument receives the synchronization and reference clock signal from another instrument working in a master mode.

Example: `":BB:DM:SYNC:MODE MAST"`
'the instrument is configured to work as a master one.

*RST value	Resolution	SCPI
NONE	-	Device-specific

[SOURce]:BB:DM:TRIGger:ARM:EXECute

The command stops signal generation for trigger modes Armed_Auto and Armed_Retrigger. A subsequent internal or external trigger event restart signal generation.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:TRIG:SOUR INT"`
'sets internal triggering.

`":BB:DM:TRIG:SEQ ARET"`
'sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.

`":BB:DM:TRIG:EXEC"`
'executes a trigger, signal generation is started.

`":BB:DM:TRIG:ARM:EXEC"`
'signal generation is stopped.

`":BB:DM:TRIG:EXEC"`
'executes a trigger, signal generation is started again.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:TRIGger:EXECute

The command executes a trigger. The internal trigger source must be selected using the command `:BB:DM:TRIG:SOUR INT` and a trigger mode other than `AUTO` must be selected using the command `:BB:DM:TRIG:SEQ`.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:TRIG:SOUR INT"`
'sets internal triggering.

`":BB:DM:TRIG:SEQ RETR"`
'sets Retrigger mode, i.e. every trigger event causes signal generation to restart.

`":BB:DM:TRIG:EXEC"`
'executes a trigger.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:TRIGger[:EXTernal<[1]|2>]:DELay 0 ... 2^16-1 Symbols

The command specifies the trigger delay (expressed as a number of symbols) for external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `":BB:DM:TRIG:SOUR EXT"`
'selects an external trigger via the TRIGGER 1 connector.

`":BB:DM:TRIG:DEL 50"`
'sets a delay of 50 symbols for the trigger.

*RST value	Resolution	SCPI
0 symbols	1 symbol for `:BB:DM:CLOC:SOUR EXT` 0.01 symbols for `:BB:DM:CLOC:SOUR INT`	Device-specific

[SOURce]:BB:DM:TRIGger[:EXTernal<[1]|2>]:INHibit 0 ... 2^26-1 Symbols

The command specifies the number of symbols by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `":BB:DM:TRIG:SOUR EXT"`
'selects an external trigger via the TRIGGER 1 connector.
`":BB:DM:TRIG:INH 200"`
'sets a restart inhibit for 200 symbols following a trigger event.

*RST value	Resolution	SCPI
0 symbols	1 symbol	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:DELay 0 ... 100 000 Symbols

The command defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of symbols. Command `:BB:DM:TRIGger:OUTPut:DELay:FIXed` can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Example: `":BB:DM:TRIG:OUTP2:DEL 16"`
'sets a delay of 16 symbols for the signal on connector MARKER 2.

*RST value	Resolution	SCPI
0 symbols	1 symbol	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut:DELay:FIXed ON | OFF

The command restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is generated.

The numeric suffix in `OUTPut` has no significance for this command, since the setting always affects every marker.

Example: `":BB:DM:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:DELay:MAXimum

The command queries the maximum marker delay for setting `:BB:DM:TRIG:OUTP:DEL:FIX ON`.

The command is a query only and therefore has no *RST value.

Example: `":BB:DM:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.
`":BB:DM:TRIG:OUTP:DEL:MAX"`
'queries the maximum of the dynamic range.
Response: `"2000"`
'the maximum for the marker delay setting is 2000 symbols.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:DELay:MINimum

The command queries the minimum marker delay for setting `:BB:DM:TRIGger:OUTPut:DELay:FIXed ON`.

The command is a query only and therefore has no *RST value.

Example: `":BB:DM:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`":BB:DM:TRIG:OUTP:DEL:MIN"`
'queries the minimum of the dynamic range.

Response: `"0"`
'the minimum for the marker delay setting is 0 symbols.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:MODE CLISt | PULSe | PATTern | RATio | TRIGger

The command defines the signal for the selected marker output.

Parameter:

CLISt
A marker signal that is defined in the selected control list is generated.

PULSe
A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:BB:DM:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:DM:TRIG:OUTP:PULSe:FREQuency?` command.

PATTern
A marker signal is generated with the aid of a user-definable bit pattern. The bit pattern is entered with the aid of command `SOURce:BB:DM:TRIGger:OUTPut:PATTern` . The bit pattern is a maximum of 32 bits long.

RATio
A regular marker signal corresponding to the Time Off / Time On specifications in the commands `SOURce:BB:DM:TRIGger:OUTPut:OFFT` and `SOURce:BB:DM:TRIGger:OUTPut:ONT` is generated.

TRIGger
This marker mode is set automatically, if the instrument is configured to work as a slave instrument in a master-slave configuration.
The marker signal is output on the MARKER 1 output (rear panel) of the master instrument and suppied to the TRIGGER IN connector of the slave one.

Example: `":BB:DM:TRIG:OUTP2:MODE PULS"`
'selects the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RATio	-	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:OFFTime 1 ... 2^20 -1 symbol

The command sets the number of symbols in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:DM:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example: `":BB:DM:TRIG:OUTP2:OFFT 20"`
'sets an OFF time of 20 symbols for marker signal 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:ONTime 1 ... 2^20 -1 symbol

The command sets the number of symbols in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:DM:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Example: `":BB:DM:TRIG:OUTP2:ONT 20"`
'sets an ON time of 20 symbols for marker 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:PATTern #B0,1 ... #B111...1, 2

The command defines the bit pattern used to generate the marker signal in the setting `SOURce:BB:DM:TRIGger:OUTPut:MODE PATTern`. 0 is marker off, 1 is marker on.

Example: `":BB:DM:TRIG:OUTP2:PATT #B000000011111111,15"`
'sets a bit pattern.

`":BB:DM:TRIG:OUTP2:MODE PATT"`
'activates the marker signal according to a bit pattern on output MARKER 2.

*RST value	Resolution	SCPI
#B,1	-	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:PULSe:DIVider 2 ... 2^10

The command sets the divider for Pulse marker mode (`SOUR:BB:DM:TRIGr:OUTP:MODE PULSe`.). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Example: `":BB:DM:TRIG:OUTP2:PULS:DIV 2"`
'sets the divider to 2 for the marker signal on output MARKER 2.

`":BB:DM:TRIG:OUTP2:FREQ?"`
'queries the resulting pulse frequency of the marker signal.

Response: `"66 000"`
'the resulting pulse frequency is 66 kHz.

*RST value	Resolution	SCPI
2	1	Device-specific

[SOURce]:BB:DM:TRIGger:OUTPut<[1]...2>:PULSe:FREQuency?

The command queries the pulse frequency of the pulsed marker signal in the setting `SOURce:BB:DM:TRIGger:OUTPut:MODE PULSe`. The pulse frequency is derived by dividing the symbol rate by the divider.

The command is a query command and therefore has no *RST value.

Example: `":BB:DM:TRIG:OUTP2:PULS:DIV 2"`
'sets the divider marker signal on output MARKER 2 to the value 2.

`":BB:DM:TRIG:OUTP2:MODE PULS"`
'enables the pulsed marker signal.

`":BB:DM:TRIG:OUTP2:PULS:FREQ?"`
'queries the pulse frequency of the marker signal.

Response: `"33 000"`
'the resulting pulse frequency is
33 kHz.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:TRIGger:RMODe

The command displays the status of signal generation for all trigger modes with digital modulation on.

The command is a query command and therefore has no *RST value.

Parameter: **RUN**
The signal is generated. A trigger event occurred in the triggered mode.

STOP
The signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command `:BB:DM:TRIG:ARM:EXECute` (armed trigger modes only).

Example: `"SOUR:BB:DM:TRIG:SOUR EXT"`
'sets external triggering via the TRIGGER 1 connector.

`"SOUR:BB:DM:TRIG:MODE ARET"`
'selects the Armed_Retrigger mode

`"SOUR:BB:DM:TRIG:RMOD?"`
'queries the current status of signal generation.

Response: `"RUN"`
'the signal is generated, an external trigger was executed.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:TRIGger:SLENgth 1 … (2^32-1) Symbols

The command defines the length of the signal sequence to be output in the **Single** trigger mode.

Example: `"SOUR:BB:DM:SEQ SING"`
'sets trigger mode Single.

`"SOUR:BB:DM:TRIG:SLEN 200"`
'sets a sequence length of 200 symbols. 200 symbols will be output after the next trigger event.

*RST value	Resolution	SCPI
1000 Symbols	-	Device-specific

[SOURce]:BB:DM:TRIGger:SOURce INTernal | EXTernal

The command selects the trigger source.

Parameter: **INTernal**
Triggering is executed by means of the Trigger command `SOURce:BB:DM:TRIGger:EXECute, TRIGger:BB:DM:IMMediate` or `*TRG` in the case of remote control and by means of **Execute Trigger** in the case of manual operation.

EXTernal
Triggering is executed by means of the signal on the TRIGGER 1 connector.

Example: `":BB:DM:TRIG:SOUR EXT"`
'sets external triggering via the TRIGGER 1 connector.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

Introduction - DM Lists - Remote-Control Commands

The following section brings together the commands for defining and managing the data lists and control lists for digital modulation.

Lists are stored as files with specific file extensions in a user-definable directory (see table). The directory which applies to the commands that follow is defined using the command `MMEMory:CDIR`. Files in this directory can be accessed by quoting the file name. The path and extension are not needed.

List type	Content	File extension
Data List	Digital modulation data	*.dm_iqd
Control List	Digital modulation control data	*.dm_iqc
User Standards	User settings of digital modulation	*.dm_stu

It is not possible to use other file extensions with the commands. Attempting to do so will cause an error message. If the file extension is changed in any other way (e.g. by directly accessing the file system) the lists are no longer recognized and therefore invalid.

Table of Commands - DM Lists

Command	Parameter	Default unit	Note
[SOURce]:BB:DM:CLISt:CATalog?			Query only
[SOURce]:BB:DM:CLISt:COPY	<new_control_list_name>		No query
[SOURce]:BB:DM:CLISt:DATA	0 | 1, {0 | 1} | block data		No query
[SOURce]:BB:DM:CLISt:DELete	<control_list_name>		No query
[SOURce]:BB:DM:CLISt:POINts			Query only
[SOURce]:BB:DM:CLISt:SELect	<control_list_name>		Query only
[SOURce]:BB:DM:CLISt:TAG?	<control_list_name>, <tag_name>		Query only
[SOURce]:BB:DM:DLISt:CATalog?			Query only
[SOURce]:BB:DM:DLISt:COPY	<new_data_list_name>		No query
[SOURce]:BB:DM:DLISt:DATA	0 | 1, {0 | 1} | block data		
[SOURce]:BB:DM:DLISt:DATA:APPend	0 | 1, {0 | 1} | block data		
[SOURce]:BB:DM:DLISt:DELete	<data_list_name>		No query
[SOURce]:BB:DM:DLISt:POINts			
[SOURce]:BB:DM:DLISt:SELect	<data_list_name>		
[SOURce]:BB:DM:DLISt:TAG?	<data_list_name>, <tag_name>		Query only
[SOURce]:BB:DM:MLISt:CATlog			Query only
[SOURce]:BB:DM:MLISt:DELete	<user_mapping_list_name>		
[SOURce]:BB:DM:MLISt:FREE			Query only
[SOURce]:BB:DM:MLISt:POINts			Query only
[SOURce]:BB:DM:MLISt:SELect	<user_mapping_list_name>		
[SOURce]:BB:DM:SETTing:CATalog?			Query only
[SOURce]:BB:DM:SETTing:DELete	"setting_file"		No query
[SOURce]:BB:DM:SETTingt:LOAD	"setting_file"		No query
[SOURce]:BB:DMSETTing:STORe	"setting_file"		No query
[SOURce]:BB:DM:STANdard:ULISt:CATalog?			Query only
[SOURce]:BB:DM:STANdard:ULISt:DELete	"user_list"		No query
[SOURce]:BB:DM:STANdard:ULISt:LOAD	"user_list"		No query
[SOURce]:BB:DM:STANdard:ULISt:STORe	"user_list"		No query

[SOURce]:BB:DM:CLISt:CATalog?

The command queries the control lists present in the default directory. The default directory is set using command `MMEM:CDIRectory`. When the names of the lists are returned they are separated by commas. The command only reads out files with the ***.dm_iqc** extension.

The control lists contain the control signals for digital modulation.

The command is a query command and therefore has no *RST value.

Example: `MMEM:CDIR 'var/user/dm'`
'sets the default directory.

`BB:DM:CLIS:CAT?`
'queries which control lists are present in the default directory.

Response: `"c_list1","c_list2","c_list3"`
'control lists `c_list1`, `c_list2`, and `c_list3` are present.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:CLISt:COPY <list name>

The command copies the selected control list into the control list specified by <list_name>. If a control list with the specified name does not yet exist, it is created.

The source file has to be available in the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can be specified, in which case the source file is copied into the file <list_name> in the specified directory. The file extension may be omitted. Only files with the file extension ***.dm_iqc** will be copied.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:CLIS:SEL 'c_list1'"`
'selects control list c_list1.

`":BB:DM:CLIS:COPY 'c_list4'"`
'copies the content of control list c_list1 into control list c_list4. If this list already exists, its content is overwritten. If the list does not yet exist, it is created.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:CLISt:DATA 0...255 | block data

The command sends the data to the currently selected control list. If the list already contains data, it is overwritten. This command only writes data into the data section of the file.

The values for the control signals are sent, arranged in a 8-bit value as follows:

Signal	Order	Decimal value of bits
Marker 1	LSBit	1
Marker 2		2
Burst =		16
LevAtt1		32
CWMod		64
Hop	MSBit	128

The data can also be sent as a binary block, each binary block being a 2-byte value in which the 16 bits represent the binary values (16-bit unsigned integer, 2 bytes, LSByte first). When binary data transmission is in use, command `:SYSTem:COMMunicate:GPIB:LTERminator EOI` should be used to set the termination character mode to 'EOI control data message only' so that a random LF in the data sequence is not interpreted as End, thereby prematurely terminating the data transmission. The command `...LTER STANdard` resets the mode.

For query purposes, the command `:FORMat ASCii | PACKed` can be used to switch between the formats. The byte sequence is defined in the IEC bus standard as 'most significant byte first'.

*RST has no effect on data lists. This command is without query.

Example: `":BB:DM:CLIS:SEL 'c_list1'"`
'selects the control list.

`":BB:DM:CLIS:DATA 0,0,0,0,8,8,8,0,0,0,0..."`
'enters the control values in list c_list1. In the example, only ramps for marker 4 are set.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:CLISt:DELete <list name>

The command deletes the specified control list from the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are deleted. The file extension may be omitted. Only files with the file extension ***.dm_iqc** will be deleted.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:CLIS:DEL 'c_list3'"`
'deletes control list c_list3.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:CLISt:POINts?

The command queries the number of lines (2 bytes) in the currently selected list.

The command is a query command and therefore has no *RST value.

Example: `":BB:DM:CLIS:SEL "c_list1""`
'selects control list c_list1.

`":BB:DM:CLIS:POIN?"`
'queries the number of lines in the control list.

Response: `"20"`
'the control list consists of 20 lines.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:CLISt:TAG? <control_list_name>, <tag_name>

The command queries the content of the specified tag in the selected file.

The command is a query command and therefore has no *RST value.

Example: `":BB:DM:CLIS:TAG 'c_list1','date"`
'queries the Date tag in control list c_list1.

Response: "10.10.2003"
'the control list was created on 10.10.2003.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:CLISt:SELect <list name>

The command selects the control list in the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are selected. If a control list with the specified name does not yet exist, it is created. The file extension may be omitted. Only files with the file extension ***.dm_iqc** will be selected or created.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:CLIS:SEL 'c_list1'"`
'selects control list c_list1.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:CATalog?

The command queries the data lists present in the default directory. The default directory is set using command `MMEM:CDIRectory`. When the names of the lists are returned they are separated by commas. The command only reads out files with the ***.dm_iqd** extension.

The data lists contain the modulation data for digital modulation.

The command is a query command and therefore has no *RST value.

Example: `MMEM:CDIR 'var/user/dm'`
'sets the default directory.

`BB:DM:DLIS:CAT?`
'queries which data lists are present.

Response: `"d_list1","d_list2","d_list3"`
'data lists d_list1, d_list2, d_list3 are present.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:COPY <list name>

The command copies the selected data list into the data list specified by <list_name>. If a data list with the specified name already exists, it is overwritten. If it does not yet exist, it is created.

The source file has to be available in the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can be specified, in which case the source file is copied into the file <list_name> in the specified directory. The file extension may be omitted. Only files with the file extension ***.dm_iqc** will be copied.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:DLIS 'd_list1'"`
'selects data list d_list1.

`":BB:DM:DLIS:COPY 'd_list2'"`
'copies the content of data list d_list1 into data list d_list2. Any existing content in data list d_list2 is overwritten.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:DATA 0 | 1 {,0 | 1 }.| block data

[SOURce]:BB:DM:DLISt:DATA? [<start>[,<length>]]

The setting command sends the bit data to the data list selected with the aid of `:BB:DM:DLISt:SELect`. Any existing content in the data list is overwritten. This command only writes data into the data section of the file.

This command sends the bit data to the selected data list, which is overwritten. The data can also be sent as block data in binary or PACKed format (see section Parameters, block data), each byte being interpreted as 8 data bits. In this case, command `:SYSTem:COMMunicate:GPIB:LTERminator EOI` should be used to set the termination character mode to ‘EOI control data message only’ so that a random LF in the data sequence is not interpreted as End, thereby prematurely terminating the data transmission. The command `...LTER STAN` resets the mode.

Example: `":BB:DM:DLIS:SEL 'dlist1'"`
'selects data list `dlist1`. If the file does not yet exist, it is created.

`":BB:DM:DLIS:DATA 1,1,1,0,0,0,1,1,0,1..."`
'sends the specified data to file `dlist1`. Any data already present is overwritten.

The query reads out the data part of the data list. If the query is expanded by using the two parameters <start> and <length>, the list is read out in smaller sections. Start and Length are expressed in bits. Without the parameters the total length is always read out starting from address 1. The command `:FORMat ASCii | PACKed` can be used to select the data format. The byte sequence is defined in the IEC bus standard (read/write most significant byte first).

Example: `":BB:DM:DLIS:SEL 'dlist1'"`
'selects data list dlist1.

`"FORM ASCI"`
'selects ASCII data transmission format.

`":BB:DM:DLIS:DATA? 2048,1024"`
'queries the data starting at bit 2048 for 1024 bits.

*RST has no effect on data lists.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:DATA:APPend 0 | 1 {,0 | 1 }.| block data

The command appends the bit data onto the end of the existing data in the selected data list. This means that existing content in the data list is not overwritten. By this means very long data lists can be built up piecemeal. The data format is as specified in command `SOURce:BB:DM:DLISt:DATA`.

The command cannot be used with an empty data list, such as one that has just been created, for example. In this case the command `SOURce:BB:DM:DLISt:DATA` must first be used to enter modulation data in the list.

*RST has no effect on data lists.

Example 1: `":BB:DM:DLIS:SEL ' d_list2'"`
'selects data list d_list2.

`"FORM ASC"`
'selects ASCII data transmission format.

`":BB:DM:DLIS:DATA:APP 1,1,1,0,0,0,1,1,0,1..."`
'adds the specified numeric data to the existing data in data list d_list2.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:DELete <list name>

The command deletes the specified data list. from the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are deleted. The file extension may be omitted. Only files with the file extension ***.dm_iqd** will be deleted.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:DLIS:DEL ' d_list2'"`
'deletes data list d_list2.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:POINTs <n>

The command defines the number of bits in the selected data list to be utilized. When a list is being filled with block data, this data is only ever sent in multiples of 8 bits. However the exact number of bits to be exploited can be set to a different figure. The superfluous bits in the list are then ignored.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:DLIS:POIN 234"`
'defines the number of bits in the data list to be utilized as 234 bits. If the list was filled with block data, at least the last 6 bits will be ignored.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:SELect <list name>

The command selects the data list in the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are selected. If a data list with the specified name does not yet exist, it is created. The file extension may be omitted. Only files with the file extension ***.dm_iqd** will be selected or created.

The modulation data in this data list is used when the data source is selected using the command `"SOURce:BB:DM:SOURce DLISt"`.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:DLIS:SEL ' d_list2'"`
'selects data list d_list2.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:DLISt:TAG? <control_list_name>, <tag_name>

The command queries the content of the specified tag in the selected file.

The command is a query command and therefore has no *RST value.

Example: `":BB:DM:DLIS:TAG 'D_list1','date"`
'queries the Date tag in control list D_list1.

Response: `"10.10.2003"`
'the data list was created on 10.10.2003.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:FLISt:CATalog?

Queries the user filter files present in the default directory. The default directory is set using command `MMEM:CDIRectory`. When the names of the files are returned they are separated by commas. The command only reads out files with the ***.vaf** extension.

The command is a query command and therefore has no *RST value.

Example: `":BB:DM:FILT:TYPE USER"`
'selects the User filter type.

`"MMEM:CDIR 'var/smbv/Filter_List'"`
'selects the directory for the user-defined filters.

`":BB:DM:FLIS:CAT?`
'queries the user-defined filters in the directory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:FLISt:DELete <file name>

Deletes the secified user filter file. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension ***.vaf** will be deleted.

Example: `":BB:DM:FILT:TYPE USER"`
'selects the User filter type.

`"MMEM:CDIR 'var/smbv/Filter_List'"`
'selects the directory for the user-defined filters.

`":BB:DM:FLIS:DEL user_filter3`
'deletes the user-defined filter.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:FLISt:FREE?

Queries the user filter free memory.

Example: `":BB:DM:FILT:TYPE USER"`
'selects the User filter type.

`":BB:DM:FLIS:FREE?"`
'queries the free memory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:FLISt:POINts?

Queries the user filter list length.

Example: `":BB:DM:FILT:TYPE USER"`
'selects the User filter type.

`":BB:DM:FLIS:POIN?"`
'queries the list length.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:FLISt:SELect <file name>

The command selects the user-defined filter (*.vaf).

The directory applicable to the following command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name is required, without the path and the file extension.

Example: `":BB:DM:FILT:TYPE USER"`
'selects the User filter type.

`"MMEM:CDIR 'var/smbv/Filter_List'"`
'selects the directory for the user-defined filters.

`":BB:DM:FLIS:SEL user_filter3"`
'selects the user-defined filter.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:MLISt:CATalog?

Queries the user mapping lists present in the default directory. The default directory is set using command `MMEM:CDIRectory`. When the names of the files are returned they are separated by commas. The command only reads out files with the ***.vam** extension.

The command is a query command and therefore has no *RST value.

Example: `":BB:DM:FORM USER"`
'selects the User modulation type.

`"MMEM:CDIR 'var/smbv/mapping_List'"`
'selects the directory for the user mapping lists.

`":BB:DM:MLIS:CAT?`
'queries the user mapping lists in the directory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:MLISt:DELete <file name>

Deletes the secified user mapping file. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension ***.vam** will be deleted.

Example: `":BB:DM:FORM USER"`
'selects the User modulation type.

`"MMEM:CDIR 'var/smbv/mapping_List'"`
'selects the directory for the user mapping lists.

`":BB:DM:MLIS:DEL user_mapping3`
'deletes the user mapping list.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:MLISt:FREE?

Queries the user modulation mapping list free memory.

Example: `":BB:DM:FORM USER"`
'selects the User modulation type.
`":BB:DM:FLIS:FREE?"`
'queries the free memory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:MLISt:POINts?

Queries the user modulation mapping list length.

Example: `":BB:DM:FORM USER"`
'selects the User modulation type.
`":BB:DM:MLIS:POIN?"`
'queries the list length.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:MLISt:SELect <mapping_list_name>

The command selects the user mapping list in the default directory. The default directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are selected. If a user mapping list with the specified name does not yet exist, it is created. The file extension may be omitted. Only files with the file extension ***.vam** will be selected or created.

The command triggers an action and therefore has no *RST value and no query form.

Example: `":BB:DM:MLIS:SEL 'c_list1'`
'selects the user mapping list c_list1.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:SETTing:CATalog?

This command reads out the files with Custom Digital Modulation settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension ***.dm** will be listed.

The command is a query command and therefore has no *RST value.

Example: `MMEM:CDIR 'var/smbv/user/dig_mod`
'sets the default directory to var/smbv/user/dig_mod.
`BB:DM:SETT:CAT?`
'reads out all the files with Custom Digital Modulation settings in the default directory.
Response: `"'DM_1'"`
'the file '`DM_1`' with Custom Digital Modulation settings is available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:SETTing:DELete <file_name>

This command deletes the selected file with Custom Digital Modulation settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension ***.dm** will be deleted.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:STAN:ULIS:DEL 'DM_1'"`
'deletes file 'DM_1'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:SETTing:LOAD <file_name>

This command loads the selected file with Custom Digital Modulation settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension ***.dm** will be loaded.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:STAN:ULIS:LOAD 'DM_1'"`
'loads file 'DM_1'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:SETTing:STORe <file_name>

This command stores the current Custom Digital Modulation settings into the selected file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. User Standards are stored as files with the specific file extensions ***.dm**.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:STAN:ULIS:STOR 'DM_QAM'"`
'stores the current Custom Digital Modulation settings into file '`DM_QAM`'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:STANdard:ULISt:CATalog?

This command reads out the files with Digital Standard settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension ***.dm_stu** will be listed.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/user/dig_mod"`
'sets the default directory to var/smbv/user/dig_mod.

`":BB:DM:STAN:ULIS:CAT?"`
'reads out all the files with Digital Standard settings in the default directory.

Response: "'DM_QAM'"
'the file 'DM_QAM' with Digital Standard settings is available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:STANdard:ULISt:DELete <file_name>

This command deletes the selected file with Digital Standard settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension ***.dm_stu** will be deleted.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:STAN:ULIS:DEL 'DM_QAM'"`
'deletes file 'DM_QAM'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:STANdard:ULISt:LOAD <file_name>

This command loads the selected file with Digital Standard settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. The file extension may be omitted. Only files with the file extension ***.dm_stu** will be loaded.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:STAN:ULIS:LOAD 'DM_QAM'"`
'loads file 'DM_QAM'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce]:BB:DM:STANdard:ULISt:STORe <file_name>

This command stores the current Digital Standard settings into the selected file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. User Standards are stored as files with the specific file extensions ***.dm_stu**.

This command triggers an event and therefore has no *RST value and no query form.

Example: `":BB:DM:STAN:ULIS:STOR 'DM_QAM'"`
'stores the current Digital Standard settings into file 'DM_QAM'.

*RST value	Resolution	SCPI
-	-	Device-specific

SOURce-BB-IMPairment Subsystem

This subsystem contains the commands for the digital I/Q impairments. Included in this section is also the description of command `SOURce:BB:IQOutput:SOURce` that determined the source for the I/Q output connectors.

The keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce<[1]|2>:]BB:IMPairment:DELay	-500ns .. +500ns		
[SOURce<[1]|2>:]BB:IMPairment:IQRatio	-1 dB ... +1 dB	dB	
[SOURce<[1]|2>:]BB:IMPairment:LEAKage:I	0 ... 50.0 PCT	PCT	
[SOURce<[1]|2>:]BB:IMPairment:LEAKage:Q	0 ... 50.0 PCT	PCT	
[SOURce<[1]|2>:]BB:IMPairment:OPTimization:MODE	FAST | QHIGh		
[SOURce<[1]|2>:]BB:IMPairment:OPTimization:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:IMPairment:QUADrature[:ANGLe]	-10.0...10.0 DEG	DEG	
[SOURce<[1]|2>:]BB:IMPairment:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:IQGain	AUTO | DBM3 | DB0 | DB3 | DB6		
[SOURce:]BB:IQOutput:SOURce	A | B		

[SOURce<[1]|2>:]BB:IMPairment:DELay -500ns ... +500ns

Sets the time delay of both I and Q vectors relative to the selected trigger and marker or relative the other instrument(s) working in the master-slave synchronous mode (see section "Synchronous Signal Generation").

A positive value means that the I and Q vectors delay relative to the marker/trigger or to the other instrument and vice versa.

Examples: `"BB:IMP:DEL 32.0E-9"`
'sets the I/Q delay.

*RST value	Resolution	SCPI
0ns	1ps	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:IQRatio -1 dB ... +1 dB

This command sets the ratio of I modulation to Q modulation (amplification “imbalance”). The input may be either in dB or %. The resolution is 0.001 dB, an input in percent is rounded to the closest valid value in dB. A query returns the value in dB.

Examples: `"BB:IMP:IQR 3 PCT"`
'sets the imbalance to 3 percent.

`"BB:IMP:IQR?"`
'queries the imbalance.

Response: `"0.259000"`
'the value is returned in dB

`"BB:IMP:IQR 1"`
'sets the imbalance to 1 dB.

*RST value	Resolution	SCPI
0 dB	0.001 dB	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:LEAKage:I -10 ... 10 PCT

This command sets the carrier leakage amplitude for the I-signal component.

Example: "BB:IMP:LEAK:I 3 PCT"
'sets the leakage for the I-component to 3 percent.

*RST value	Resolution	SCPI
0 PCT	0.05 PCT	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:LEAKage:Q -10 ... 10 PCT

This command sets the carrier leakage amplitude for the Q-signal component.

Example: "BB:IMP:LEAK:Q 3 PCT"
'sets the leakage for the Q-component to 3 percent.

*RST value	Resolution	SCPI
0 PCT	0.05 PCT	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:OPTimization:MODE FAST | QHIGh

This command sets the optimization mode.

Parameters: **FAST**
Optimization is reached by compensation for I/Q skew.

QHIGh
Optimization is reached by compensation for I/Q skew and frequency response correction.

Example: "BB:IMP:OPT:MODE FAST"
'sets the optimization mode Fast.

*RST value	Resolution	SCPI
FAST	-	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:OPTimization:STATe ON | OFF

This command activates and deactivates internal compensation of signal distortions by the I/Q modulator.

Example: "BB:IMP:OPT:STAT ON"
'activates internal compensation of signal distortions.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:QUADrature[:ANGLe] -10.0 ... 10.0 DEG

This command sets the quadrature offset for the digital I/Q signal.

Example: "BB:IMP:QUAD:ANGL -5DEG"
'sets the quadrature offset to -5 degrees.

*RST value	Resolution	SCPI
0 DEG	0.02 DEG	Device-specific

[SOURce<[1]|2>:]BB:IMPairment:STATe ON | OFF

The command activates (ON) and deactivates (OFF) the three impairment or correction values LEAKage, QUADrature and IQRatio for the digital baseband signal prior to input into the I/Q modulator.

Example: `"BB:IMP:STAT OFF"`
'deactivates digital impairment.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>:]BB:IQGain AUTO | DBM3 | DB0 | DB3 | DB6

This command specifies the baseband gain for the internal or (in case of two-path instruments, external) baseband signal.
Thus, the modulation of the I/Q modulator can be optimized for any measurement requirement. The gain settings for an external analog wideband signal (**Analog Wideband I/Q In**) are performed with command `:SOURce:IQ:GAIN`

Parameters:

AUTO
Activates automatic setting. The modulation is automatically optimized for the internally set baseband signal.

DBM3
Activates -3 dB gain. With this setting, signal distortions are minimized.

DBM3
Activates 0 dB gain. With this setting, signal distortions are minimized.

DB0
Activates 0 dB gain (standard settings).

DB3
Activates 3 dB gain.

DB6
Activates 6 dB gain. With this setting, signal noise is minimized.

DB3
Activates 0 dB gain.

DB6
Activates 0 dB gain. With this setting, signal noise is minimized.

Example: `"IQ:SOUR BAS"`
'selects the internal baseband signal as the input signal of the I/Q modulator.
`"BB:IQG DB6"`
'sets gain 6dB (best for low noise).

*RST value	Resolution	SCPI
Auto	0.01 dB	Device-specific

[SOURce:]BB:IQOutput:SOURce A | B

This command selects the output signal at the I/Q OUT connectors for a two-path instrument.

Example: `"BB:IQO:SOUR A"`
'the I/Q components of path A baseband signal are output at the I/Q OUT connectors.

*RST value	Resolution	SCPI
A		Device-specific

SOURce:CORRection Subsystem

The output level is corrected in the CORRection subsystem. Correction is performed by user-defined table values being added to the output level for the respective RF frequency. In the R&S Vector Signal Generator, this subsystem is used to select, transfer and activate user correction tables.

Each list is stored as a file. The name of the user correction file can be freely selected. The file extension ***.uco** is assigned automatically and cannot be changed.

The files can be stored in a freely selectable directory and opened from there. The default directory is set using command `MMEMory:CDIRectory`. In the case of files which are stored in the default directory, only the file name has to be specified in commands. Otherwise, the complete absolute path has to be specified with every command. The extension can be omitted in any case.

The amplitude can also be linearized automatically by means of a R&S NRP power sensor connected to the generator output signal. With the aid of the `SOURce:CORRection:CSET:DATA:POWER:SONCe` command, a list with correction values for external test assemblies can be automatically determined, e.g. for compensating the frequency response of cables. The correction values can be acquired any time irrespective of the modulation settings of the generator.
Multi level measurements allow to take into account the changing VSWR for the different attenuator settings (`SOURce:CORRection:CSET:DATA:POWER:MLEVel`).

Note

In the following command examples, the files are stored in the default directory.

For one path instruments, the keyword SOURce is optional and can be omitted.

Command	**Parameters**	**Default unit**	**Remark**
[SOURce:]CORRection:CSET:CATalog?	-		Query only
[SOURce:]CORRection:CSET:DATA:FREQuency	300 kHz...RF$_{max}$ {,300 kHz...RF$_{max}$ }	HZ	
[SOURce:]CORRection:CSET:DATA:FREQuency:POINts?			Query only
[SOURce:]CORRection:CSET:DATA:POWer	-40 dB...6dB {,-40 dB...6 dB}	dB	
[SOURce:]CORRection:CSET:DATA:POWer:POINts?			Query only
[:SOURce]:CORRection:CSET:DATA[:SENSor<[1]|2|3>][:POWer]:SONCe			No query
[SOURce:]CORRection:CSET:DELete	<table name>		No query
[SOURce]:CORRection:CSET[:SELect]	<table name>		
[SOURce]:CORRection:DEXChange:AFILe:CATalog?			Query only
[SOURce]:CORRection:DEXChange:AFILe:EXTension	TXT | CSV		
[SOURce]:CORRection:DEXChange:AFILe:SELect	<ASCII file name>		
[SOURce]:CORRection:DEXChange:AFILe:SEParator:COLumn	TABulator | SEMicolon | COMMa | SPACe		
[SOURce]:CORRection:DEXChange:AFILe:SEParator:DECimal	DOT | COMMa		
[SOURce]:CORRection:DEXChange:EXECute			No query
[SOURce]:CORRection:DEXChange:MODE	IMPort | EXPort		
[SOURce]:CORRection:DEXChange:SELect	<list mode file>		
[SOURce]:CORRection[:STATe]	ON | OFF		
[SOURce]:CORRection:VALue		dB	Query only

[SOURce:]CORRection:CSET:CATalog?

The command requests a list of user correction tables. The individual lists are separated by commas.

The lists are stored with the fixed file extensions ***.uco** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

This command is a query command and has no *RST value. The numerical suffix at SOURce must not be used for this command.

Example: `"MMEM:CDIR 'var/smbv/Lists/ucor'"`
'selects the directory for the user correction files.

`"CORR:CSET:CAT?"`
'queries which correction tables are available.

Response: `"UCOR1,UCOR2,UCOR3"`
'the correction tables `UCOR1`, `UCOR2` and `UCOR3` are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET:DATA:FREQuency 300 kHz...RF_{max} {, 300 kHz...RF_{max}}, (RF_{max} depending on model)

The command transfers the frequency data to the table selected with `:CORRection:CSET:SELect`.

*RST does not affect data lists. The numerical suffix at SOURce must not be used for this command.

Example: `"CORR:CSET 'var/smabv/Lists/ucor/ucor1'"`
'selects the table ucor1.

`"CORR:CSET:DATA:FREQ 100MHz,102MHz,103MHz,..."`
'enters the frequency value in the table UCOR1.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET:DATA:FREQuency:POINts?

The command queries the number of frequency values in the selected table.

The command is a query command and therefore has no *RST value. The numerical suffix at SOURce must not be used for this command.

Example: `"CORR:CSET 'var/smbv/Lists/ucor/ucor1'"`
'selects the table ucor1.

`"CORR:CSET:DATA:FREQ:POIN?"`
'queries the number of frequency values in the table ucor1.

Response: `"440"`
'the table ucor1 contains 440 frequency values.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET:DATA:POWer -40dB ... 6dB {,-40dB ... 6dB}

The command transfers the level data to the table selected with `:CORRection:CSET:SELect`.

*RST does not affect data lists. The numerical suffix at SOURce must not be used for this command.

Example: `"CORR:CSET 'var/smbv/Lists/ucor/ucor1'"`
'selects the table ucor1.

`"CORR:CSET:DATA:POW 1dB, 0.8dB, 0.75dB,..."`
'enters the level values in the table ucor1.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET:DATA:POWer:POINts?

The command queries the number of level values in the selected table.

The command is a query command and therefore has no *RST value. The numerical suffix at SOURce must not be used for this command.

Example: `"CORR:CSET 'var/smbv/Lists/ucor/ucor1'"`
'selects the table ucor1.

`"CORR:CSET:DATA:POW:POIN?"`
'queries the number of level values in the table ucor1.

Response: `"440"`
'the table ucor1 contains 440 level values.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET:DATA[:SENSor<[1]|2|3]>][:POWer]:SONCe

The command activates the filling of the user correction list with level values acquired by the power sensor.

The command activates the filling of the user correction list with level values acquired by the selected power sensor. All level correction values for the given frequency values are entered in the selected list. The power sensor used is selected by the suffix in key word SENSe of the command header.Suffix 1 denotes the sensor connected to the SENSOR connector, suffix 2 the sensor connected first to one of the USB interfaces and suffix 3 the sensor connected second to one of the USB interfaces.

The command is an event and therefore has no *RST value and no query.

Example: `"CORR:CSET:DATA:SENS:POW:SONC"`
' fills the user correction list with level values acquired by the power sensor connector to the SENSOR connector.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET:DELete <table name>

The command deletes the specified table.

The lists are stored with the fixed file extensions ***.uco** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:CORR:CSET:CAT?`, in which case the file in the specified directory is deleted.

The command is an event and therefore has no *RST value. The numerical suffix under SOURce is irrelevant.

Example: `"MMEM:CDIR 'var/smbv/Lists/ucor'"`
'selects the directory for the user correction files.
`"CORR:CSET:DEL 'UCOR1'"`
'deletes the table `ucor1`.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of user correction data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions ***.txt** or *.**csv** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

The command is a query command and therefore has no *RST value.

Example: `MMEM:CDIR 'var/smbv/lists/ucor/import'`
'selects the directory for the ASCII files with frequency and level value pairs.
`CORR:DEXC:AFIL:EXT TXT`
'selects that ASCII files with extension *.txt are listed.
`CORR:DEXC:AFIL:CAT?`
'queries the available files with extension *.txt.
Response: `'ucor1,ucor2'`
'the ASCII files `ucor1`.txt and `ucor2`.txt are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:DEXChange:AFILe:EXTension TXT | CSV

The command selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Example: `MMEM:CDIR 'var/smbv/lists/ucor/import'`
'selects the directory for the ASCII files with frequency and level value pairs.
`CORR:DEXC:AFIL:EXT TXT`
'selects that ASCII files with extension *.txt are listed.
`CORR:DEXC:AFIL:CAT?`
'queries the available files with extension *.txt.
Response: `'list1,list2'`
'the ASCII files `ucor1`.txt and `ucor2`.txt are available.

*RST value	Resolution	SCPI
TXT	-	Device-specific

[SOURce:]CORRection:DEXChange:AFILe:SELect <ascii_file_name>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions ***.txt** or *.**csv** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the specified directory.

Example: `CORR:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.

`CORR:DEXC:AFIL:SEL 'var/smbv/user/ucor/import/ucor.csv'`
'selects that ASCII file ucor.csv is imported.

`CORR:DEXC:SEL 'var/smbv/user/ucor/import/ucor_imp'`
'selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:DEXChange:AFILe:SEParator:COLumn TABulator | SEMicolon | COMMa | SPACe

The command selects the separator between the frequency and level column of the ASCII table.

Example: `CORR:DEXC:MODE EXP`
'selects that the user correction list is exported into an ASCII file.

`CORR:DEXC:AFIL:SEL 'var/smbv/user/ucor/import/ucor.csv'`
'selects ASCII file ucor.csv as destination for the user correction list data.

`CORR:DEXC:AFIL:SEP:COL TAB`
'the pairs of frequency and level values are separated by a tabulator.

`CORR:DEXC:AFIL:SEP:DEC DOT`
'selects the decimal separator dot.

`CORR:DEXC:SEL 'var/smbv/user/ucor/import/ucor_imp'`
'selects that the user correction list ucor_imp is imported into ASCII file ucor.csv.

*RST value	Resolution	SCPI
SEMicolon	-	Device-specific

[SOURce:]CORRection:DEXChange:AFILe:SEParator:DECimal DOT | COMMa

The command the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Example: `CORR:DEXC:MODE EXP`
'selects that the user correction list is exported into an ASCII file.

`CORR:DEXC:AFIL:SEL 'var/smbv/user/ucor/import/ucor.csv'`
'selects ASCII file ucor.csv as destination for the user correction list data.

`CORR:DEXC:AFIL:SEP:COL TAB`
'the pairs of frequency and level values are separated by a tabulator.

`CORR:DEXC:AFIL:SEP:DEC DOT`
'selects the decimal separator dot.

`CORR:DEXC:SEL 'var/smbv/user/ucor/import/ucor_imp'`
'selects that the user correction list ucor_imp is imported into ASCII file ucor.csv.

*RST value	Resolution	SCPI
DOT	-	Device-specific

[SOURce:]CORRection:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected, the ASCII file is imported as user correction list. When export is selected, the user correction list is exported into the selected ASCII file.

The command triggers an event and therefore has no *RST value.

Example: `CORR:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.

`CORR:DEXC:AFIL:SEL 'var/smbv/user/ucor/import/ucor.csv'`
'selects that ASCII file ucor.csv is imported.

`CORR:DEXC:SEL 'var/smbv/user/ucor/import/ucor_imp'`
'selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

`CORR:DEXC:EXEC`
'starts the import of the ASCII file data into the user correction file.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:DEXChange:MODE IMPort | EXPort

The command selects if user correction lists should be imported or exported. Depending on the selection her, the file select command define either the source or the destination for user correction lists and ASCII files.

Example: `CORR:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.

`CORR:DEXC:AFIL:SEL 'var/smbv/user/ucor/import/ucor.csv'`
'selects that ASCII file ucor.csv is imported.

`CORR:DEXC:SEL 'var/msbv/user/ucor/import/ucor_imp'`
'selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:DEXChange:SELect <list_name>

The command selects the user correction list to be imported or exported.

The user correction files are stored with the fixed file extensions ***.uco** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:CORR:DEXC:SEL`, in which case the files are stored or loaded in the specified directory.

Example: `CORR:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into user correction lists.

`CORR:DEXC:AFIL:SEL 'var/smbv/user/ucor/import/ucor.csv'`
'selects that ASCII file ucor.csv is imported.

`CORR:DEXC:SEL 'var/smbv/user/ucor/import/ucor_imp'`
'selects that the ASCII file ucor.csv is imported into user correction list ucor_imp.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection:CSET[:SELect] <table name>

The command selects the table for user correction. Level correction must also be activated with the command `SOURce<[1]|2>:CORRection:CSET:STATe ON`.

The lists are stored with the fixed file extensions ***.uco** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:CORR:CSET:SEL`, in which case the files in the specified directory are selected.

The command is an event and therefore has no *RST value.

Example: `"CORR:CSET 'var/smbv/Lists/ucor/ucor1'"`
'selects the table ucor1 for RF output A.

`"CORR ON"`
'activates level correction for RF output A. Correction is performed using the table ucor1.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]CORRection[:STATe] ON | OFF

The command activates/deactivates level correction. Level correction is performed using the table which has been selected with the command `CORRection:CSET:SELect`.

Example: `"SOUR2:CORR:CSET 'ucor1"`
'selects the table `ucor1` for RF output B.

`"SOUR2:CORR ON"`
'activates user correction for RF output B.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce:]CORRection:VALue?

The command requests the current value for user correction.

This command is a query command and has no *RST value.

Example: "CORR:VAL?"
'queries the value currently used for level correction.

Response: "-3"
'the correction value is - 3dB.

*RST value	Resolution	SCPI
-	-	Device-specific

SOURce:FM Subsystem

The FM subsystem contains the commands for checking the frequency modulation. The settings for the internal modulation source (LF generator) are made in the SOURce:LFOutput subsystem.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]FM[:DEViation]	0 Hz...10 MHz	Hz	
[SOURce:]FM:EXTernal:COUPling	AC | DC		
[SOURce:]FM:MODE	NORMal | LNOise | HDEViation		
[SOURce:]FM:SENSitivity?			Query only
[SOURce:]FM:SOURce	EXT | INT | INT, EXT		
[SOURce:]FM:STATe	ON | OFF		

[SOURce:]FM[:DEViation] 0 Hz ... 10 MHz

The command sets the modulation deviation of the frequency modulation in Hz. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

Example: `"FM 5E3"`
'sets the FM modulation deviation to 5 kHz.

*RST value	Resolution	SCPI
10 kHz	See data sheet	Compliant

[SOURce:]FM:EXTernal:COUPling AC | DC

The command selects the coupling mode for the external modulation input (EXT MOD) in the case of frequency modulation.

Note:
Coupling for external feed via input EXT MOD can be set independently for modulations AM, FM and PhiM.

Parameters: **AC**
The DC voltage component is disconnected from the modulation signal.

DC
The modulation signal is not changed.

Example: `"FM:EXT:COUP AC"`
'selects the coupling mode AC for external frequency modulation.

*RST value	Resolution	SCPI
AC	-	Compliant

[SOURce:]FM:MODE NORMal |LNOise | HDEViation

The command selects the mode for the frequency modulation.

Parameters: **NORMal**
The maximum range for modulation bandwidth and FM deviation is available.

LNOise
Frequency modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and FM deviation is reduced (see data sheet).

HDEViation
Frequency modulation with full setting range for FM deviation. The range for modulation bandwidth is reduced (see data sheet).

Example: `"FM:MODE LNO"`
'selects Low Noise mode for frequency modulation.

*RST value	Resolution	SCPI
NORMal	-	Compliant

[SOURce:]FM:SENSitivity?

The command queries the input sensitivity of the EXT MOD input in Hz/V. The command is only effective if the external modulation source is selected (`SOUR:FM:SOUR EXT`). The returned value depends on the modulation deviation setting (`SOUR:FM:DEViation`). This value is assigned to the voltage value for full modulation of the input signal.

The command is a query command and therefore has no *RST value.

Example: `"FM:DEV 5E3"`
'sets a modulation deviation of 5 kHz.

`"FM:SENS?"`
'queries the input sensitivity at the EXT MOD input.

Response: `"5E3"`
'since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 5000Hz/V.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]FM:SOURce EXT | INT | INT,EXT

The command selects the modulation source for frequency modulation. INT is the LF generator. The frequency of the internal modulation signal can be set in the SOURce:LFOutput subsystem. The external signal is input at the EXT MOD connector. Internal and external modulation source can be selected at the same time.

Example: `"FM:SOUR INT"`
'selects the internal modulation source.

*RST value	Resolution	SCPI
INTernal	-	Compliant

[SOURce:]FM:STATe ON | OFF

The command activates/deactivates frequency modulation.

Activation of frequency modulation deactivates phase modulation.

Example: `"FM:STAT ON"`
'activates FM modulation.

*RST value	Resolution	Correlation	SCPI
OFF	-	FM ON deactivates phase modulation.	Compliant

SOURce:FREQuency Subsystem

This subsystem contains the commands used to define the frequency settings for the RF sources and sweeps.

In case of one-path instruments, the keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]FREQuency:CENTer	300 kHz...RF_{max}	Hz	RF_{max} depending on model
[SOURce:]FREQuency:LOSCillator:MODE	INTernal | EXTernal		
[SOURce:]FREQuency:LOSCillator:OUTPut:STATe	ON | OFF		
[SOURce:]FREQuency[:CW|:FIXed]	300 kHz...RF_{max}	Hz	RF_{max} depending on model
[SOURce:]FREQuency[:CW|:FIXed]:RCL	INCLude | EXCLude		
[SOURce:]FREQuency:MANual	300 kHz...RF_{max}	Hz	RF_{max} depending on model
[SOURce:]FREQuency:MODE	CW|FIXed | SWEep | LIST		
[SOURce:]FREQuency:OFFSet	50 ...+50 GHz	Hz	
[SOURce:]FREQuency:SPAN	0...RF_{max}	Hz	RF_{max} depending on model
[SOURce:]FREQuency:STARt	300 kHz...RF_{max}	Hz	RF_{max} depending on model
[SOURce:]FREQuency:STOP	300 kHz...RF_{max}	Hz	RF_{max} depending on model
[SOURce:]FREQuency:STEP[:INCRement]	0...RF_{max} - 100 kHz	Hz	
[SOURce:]FREQuency:STEP:MODE	USER | DECimal		

[SOURce:]FREQuency:CENTer 300 kHz...RF_{max} (RF_{max} depending on model)

The command sets the center frequency of the sweep. This setting in combination with the span setting (`[SOURce:]FREQuency:SPAN`) defines the sweep range.

This command is linked to the commands `[SOURce:]FREQuency:STARt` and `[SOURce:]FREQuency:STOP`, i.e. changing these values causes the `CENTer` value to change, and vice versa:

`CENTer` = (`STARt` + `STOP`)/2.

As with the **Frequency** value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula.

300 kHz + `OFFSet` ... RF_{max} +`OFFSet`

Example: `"FREQ:CENT 400 MHz"`
'sets the center frequency for the frequency sweep to 400 MHz.

`"FREQ:SPAN 200 MHz"`
'sets a span of 200 MHz. This sets the sweep range to 300 MHz to 500 MHz.

*RST value	Resolution	Correlation	SCPI
300 MHz	0.01 Hz	`CENTer` = (`STARt` + `STOP`)/2	Compliant

[SOURce:]FREQuency:LOSCillator:MODE INTernal | EXTernal

Selects the mode of the local oscillator coupling.

Parameters: **INTernal**
The signal of the internal local oscilltor is used. This mode corresponds to a normal operation.

EXTernal
An external signal is used.

Note:
*Selection of LO Coupling **External** mode, disables all paramters of the SOURce-FREQuency Subsystem.*

Example: `"FREQ:LOSC:MODE EXT"`
'sets the LO coupling mode to External.

*RST value	Resolution	SCPI
INT	-	Compliant

[SOURce:]FREQuency:LOSCillator:OUTPut:STATe ON | OFF

Switches on/off the LO output.

Example: `"FREQ:LOSC:OUTP:STAT ON"`
'switches on the LO output state.

*RST value	Resolution	SCPI
OFF	-	Compliant

[SOURce:]FREQuency[:CW|:FIXed] 300 kHz ... RF_{max}

The command sets the frequency of the RF output signal for CW mode (`SOURce:FREQuency:MODE CW`). In Sweep mode (`SOURce:FREQuency:MODE SWEep`), this value is linked to the current sweep frequency.

In addition to a numerical value, it is also possible to specify `UP` and `DOWN`. The frequency is then increased or decreased by the value which is set under `[SOURce<[1]|2>:]FREQuency:STEP`.

As with the **FREQ** value entered in the display, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to `0`. The value range for other `OFFset` values can be calculated using the following formula:

300 kHz + `OFFSet` ... RF_{max} + `OFFSet`

Example: `"FREQ 500kHz"`
'sets the frequency of RF output signal A to 500 kHz.

*RST value	Resolution	Correlation	SCPI
1 GHz	0.01 Hz	`:FREQ` for `FREQ:MODE SWE` linked to sweep frequency.	Compliant

[SOURce:]FREQuency[:CW|:FIXed]:RCL INCLude | EXCLude

The command determines whether the current frequency setting is retained or whether the stored frequency setting is adopted when an instrument configuration is loaded.

*RST does not affect this setting.

Parameters: **INCLude**
The stored frequency is also loaded when a stored instrument configuration is loaded.

EXCLude
The RF frequency is not loaded when a stored instrument configuration is loaded. The current frequency is retained.

Example: `"FREQ:RCL INCL"`
'the stored frequency is set if the Recall command is called.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]FREQuency:MANual STARt ... STOP

In Sweep mode (`:SOUR:FREQ:MODE SWE`) the command sets the frequency for the next sweep step in the **Step** sweep mode (`SOUR:SWE:MODE MAN`). Here only frequency values between the settings `[SOUR]:FREQ:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `SOUR:FREQ:MAN` command.

As with the **Frequency** value entered in the header, the `OFFSet` value is also taken into consideration with this command. The specified value range is therefore only effective if `OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula.

`STARt + OFFSet` ... `STOP +OFFSet`

Example: `"SWE:MODE MAN"`
'sets the **Step** sweep mode.

`"FREQ:MAN 500MHz"`
'sets an RF frequency of 500 MHz for the next step in the **Step** sweep mode.

`"FREQ:MODE SWE"`
'sets the Frequency Sweep mode. An RF frequency of 500 MHz is output.

`"FREQ:MAN 550MHz"`
'triggers the next sweep step with an RF frequency of 550 MHz.

*RST value	Resolution	SCPI
100 MHz	0.01 Hz	Compliant

[SOURce:]FREQuency:MODE CW|FIXed | SWEep | LIST

The command sets the instrument operating mode and therefore also the commands used to set the output frequency.

Parameters: **CW|FIXed**
The instrument operates in fixed-frequency mode. CW and FIXed are synonyms. The output frequency is set with
`:SOURce:FREQuency:CW|FIXed`.

SWEep
The instrument operates in SWEep mode. The frequency is set using the commands `SOURce:FREQuency:STARt; STOP; CENTer; SPAN; MANual`.

LIST
The instrument processes a list of frequency and level settings. The List mode settings are made in the SOURce:LIST subsystem. The setting `SOURce:FREQuency:MODE LIST` also sets the command `SOURce:POWer:MODE` automatically to `LIST`.

Example: `"FREQ:MODE SWE"`
'sets the SWEep mode. The settings under `SOURce:FREQuency:STARt; STOP; CENTer; SPAN; MANual` become effective.

*RST value	Resolution	Correlation	SCPI
CW	-	`FREQ:MODE LIST` sets `POW:MODE LIST`	Compliant

[SOURce:]FREQuency:OFFSet -50 GHz ... + 50 GHz

The command sets the frequency offset of a downstream instrument, e.g. a mixer. If a frequency offset is entered, the frequency entered with `SOURce:FREQuency:...` no longer corresponds to the RF output frequency. The following correlation applies:

`SOURce:FREQuency:...` = RF output frequency `+ SOURce:FREQuency:OFFSet`.

Entering an offset does not change the RF output frequency, but rather the query value of `SOURce:FREQuency:....`.

Example: `FREQ:OFFS 500kHz`
'sets the frequency offset to 500 kHz.

*RST value	Resolution	SCPI
0 Hz	0.01 Hz	Compliant

[SOURce:]FREQuency:SPAN 0...RF_{max} (RF_{max} depending on model)

This command specifies the span for the sweep. This setting in combination with the center frequency setting (`[SOUR]:FREQ:CENT`) defines the sweep range.

This command is linked to the commands `[SOUR]:FREQ:STAR` and `[:SOUR]:FREQ:STOP`, i.e. changing these values causes the `SPAN` value to change, and vice versa:

`SPAN` = `(STOP - STARt)`

Negative values for SPAN are permitted; STARt > STOP then applies.

Example: `"FREQ:CENT 400 MHz"`
'sets the center frequency of the frequency sweep to 400 MHz.

`"FREQ:SPAN 200 MHz"`
'sets a span of 200 MHz. This sets the sweep range to 300 MHz to 500 MHz.

*RST value	Resolution	Correlation	SCPI
400 MHz	0.01 Hz	`SPAN` = `(STOP - STARt)`	Compliant

[SOURce:]FREQuency:STARt 300 kHz...RF_{max} (RF_{max} depending on model)

This command sets the start frequency for the sweep mode. STARt can be greater than STOP.

This command is linked to the commands [SOUR]:FREQ:CENT and [SOUR]:FREQ:SPAN, i.e. changing these values causes the STARt value to change, and vice versa:

STARt = (CENTer - SPAN/2).

As with the **Frequency** value entered in the header, the OFFSet value is also taken into consideration with this command. The specified value range is therefore only effective if OFFSet is set to 0. The value range for other OFFset values can be calculated using the following formula:

300 kHz + OFFSet ... RF_{max} + OFFSet

Example: "FREQ:STARt 1 MHz"
'sets the start frequency for the frequency sweep to 1 MHz.

"FREQ:STOP 2 GHz"
'sets the stop frequency for the frequency sweep to 2 GHz.

*RST value	Resolution	Correlation	SCPI
100 MHz	0.01 Hz	STARt = (CENTer - SPAN/2)	Compliant

[SOURce:]FREQuency:STOP 300 kHz...RF_{max} (RF_{max} depending on model)

This command sets the stop frequency for the sweep mode. STOP can be less than STARt.

This command is linked to the commands [:SOUR]:FREQ:CENt and [:SOUR]:FREQ:SPAN, i.e. changing these values causes the STARt value to change, and vice versa:

STOP = (CENTer + SPAN/2).

As with the **Frequency** value entered in the header, the OFFSet value is also taken into consideration with this command. The specified value range is therefore only effective if OFFSet is set to 0. The value range for other OFFset values can be calculated using the following formula:

300 kHz + OFFSet ... RF_{max} + OFFSet

Example: "FREQ:STOP 2 GHz"
'sets the stop frequency for the frequency sweep to 2 GHz.

"FREQ:STAR 1 MHz"
'sets the start frequency for the frequency sweep to 1 MHz.

*RST value	Resolution	Correlation	SCPI
500 MHz	0.01 Hz	STOP = (CENTer + SPAN/2)	Compliant

[SOURce:]FREQuency:STEP[:INCRement] 0 Hz ... RF_{max} - 100 kHz

The command sets the step width for the frequency setting if the frequency values UP/DOWN are used and variation mode SOUR:FREQ:STEP:MODE USER is selected. The command is linked to **Variation Step** for manual control, i.e. the command also sets the step width of the rotary knob for **Variation Active on**.

Example: "FREQ:STEP 50 kHz"
'sets the step width for the frequency setting to 50 kHz.

*RST value	Resolution	SCPI
1 MHz	0.01 Hz	Device-specific

[SOURce:]FREQuency:STEP:MODE USER | DECimal

This command activates (`USER`) or deactivates (`DECimal`) the user-defined step width used when varying the frequency value with the frequency values `UP/DOWN`. The command is linked to the command **Variation Active** for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the frequency value with the rotary knob.

Example: `"FREQ:STEP 50 kHz"`
'sets the step width for the frequency setting to 50 kHz.

`"FREQ:STEP:MODE USER"`
'actives this step width for frequency variation with the rotary knob (manual control) and with frequency values `UP/DOWN` (remote control).

*RST value	Resolution	SCPI
DECimal	-	Device-specific

SOURce:LFOutput Subsystem

This subsystem contains the commands for setting the LF signal source in CW and Sweep mode as well as for analog modulation. An LF generator is always available in the instrument.

An LF sweep is set in several steps which are shown in the following example:

1. Set the sweep range.

```
LFOutput:FREQuency:STARt  4 kHz
LFOutput:FREQuency:STOP  10 kHz
```

2. Select linear or logarithmic sweep spacing.

```
LFOutput:SWEep[:FREQuency]:SPACing LIN
```

3. Set the step width and dwell time.

```
LFOutput:SWEep[:FREQuency]:STEP[:LINear]  100 Hz
LFOutput:SWEep[:FREQuency]:DWELl 20 ms
```

4. Determine the sweep mode.

```
LFOutput:SWEep:MODE AUTO
```

5. Determine the trigger.

```
TRIGger0:SOURce SINGle
```

6. Activate the sweep.

```
LFOutput:FREQuency:MODE SWEep
```

7. Trigger the sweep (depending on the mode).

```
LFOutput:SWEep:EXECute
```

The keyword SOURce is optional and can be omitted. An error message is displayed if a suffix is specified.

Command	Parameters	Default unit	Remark
[SOURce:]LFOutput:FREQuency	0.1 Hz...1 MHz	Hz	
[SOURce:]LFOutput:FREQuency:MANual	0.1 Hz...1 MHz	Hz	
[SOURce:]LFOutput:FREQuency:MODE	CW|FIXed | SWEep		
[SOURce:]LFOutput:FREQuency:STARt	0.1 Hz...1 MHz	Hz	
[SOURce:]LFOutput:FREQuency:STOP	0.1 Hz...1 MHz	Hz	
[SOURce:]LFOutput[:STATe]	ON | OFF		
[SOURce:]LFOutput:SHAPe	SINE | SQUare		
[SOURce:]LFOutput:SWEep[:FREQuency]:DWELl	2 ms ... 10 s	s	
[SOURce:]LFOutput:SWEep[:FREQuency]:EXECute	-		
[SOURce:]LFOutput:SWEep[:FREQuency]:MODE	AUTO | MANual | STEP		
[SOURce:]LFOutput:SWEep[:FREQuency]:POINts	<numeric_value>		
[SOURce:]LFOutput:SWEep[:FREQuency]:SHAPe	SAWTooth | TRIangle		
[SOURce:]LFOutput:SWEep[:FREQuency]:SPACing	LINear | LOGarithmic		
[SOURce:]LFOutput:SWEep[:FREQuency]:STEP[:LINear]	0 ... (STOP - STARt)	Hz	
[SOURce:]LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic	0.01 ... 50 PCT	PCT	
[SOURce:]LFOutput:VOLTage	0 V ... 4 V	V	

[SOURce:]LFOutput:FREQuency 0.1 Hz... 1 MHz

The command sets the frequency of the LF signal for CW mode (`:SOUR:MODE CW` mode). The setting is valid for all analog modulations (AM/FM/PhiM/Pulse) with internal modulation source.

In Sweep mode (`SOUR:LFO:FREQ:MODE SWE`), the frequency is linked to the sweep frequency.

Example: `"LFO:FREQ 5kHz"`
'sets the frequency of the LF signal to 5 kHz.

*RST value	Resolution	Correlation	SCPI
1 kHz	0.1 Hz	`LFO:FREQ` for `LFO:FREQ:MODE SWE` linked to sweep frequency	Compliant

[SOURce:]LFOutput:FREQuency:MANual STARt ... STOP

In Sweep mode (`SOUR:LFO:FREQ:MODE SWE`) the command sets the frequency for the next sweep step in the **Step** sweep mode (`SOUR:LFO:SWE:MODE MAN`). Here only frequency values between the settings `SOUR:LFO:FREQ:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `SOUR:LFO:FREQ:MAN` command.

Example: `"LFO:SWE:MODE MAN"`
'sets the **Step** sweep mode.

`"LFO:FREQ:MAN 5 kHz"`
'sets an LF frequency of 5 kHz for the next step in the **Step** sweep mode.

`"LFO:FREQ:MODE SWE"`
'sets the LF Sweep mode. An LF frequency of 5 kHz is output.

`"LFO:FREQ:MAN 5.1 kHz"`
'triggers the next sweep step with a frequency of 5.1 kHz.

*RST value	Resolution	SCPI
1 kHz	0.1 Hz.	Compliant

[SOURce:]LFOutput:FREQuency:MODE CW|FIXed | SWEep

The command sets the instrument operating mode and therefore also the commands used to set the output frequency.

Parameters: **CW|FIXed**
The instrument operates in fixed-frequency mode. CW and FIXed are synonyms. The output frequency is set with `[SOURce:]LFOutput:FREQuency`.

SWEep
The instrument operates in SWEep mode. The frequency is set using the commands `SOURce:LFOutput:FREQuency:STARt; STOP or MANual`.

Example: `"LFO:FREQ:MODE SWE"`
'sets the SWEep mode. The settings under `SOURce:LFOutput:FREQuency:STARt`; `STOP`; `MANual` become effective.

*RST value	Resolution	SCPI
CW	-	Compliant

[SOURce:]LFOutput:FREQuency:STARt 0.1 Hz... 1 MHz

This command sets the start frequency for the LF Sweep mode.

Example: `"RST*"`
'activates all presettings.

`"LFO:SWE:MODE AUTO"`
'sets the AUTO sweep mode, i.e. each trigger triggers a complete sweep.

`"TRIG0:SOUR SING"`
'sets the SINGle trigger mode, i.e. the sweep is triggered by the command `:LFOutput:SWEep:EXECute` or `*TRG`.

`"LFO:FREQ:STAR 100 kHz"`
'sets the start frequency for the LF sweep to 100 kHz.

`"LFO:FREQ:STOP 200 kHz"`
'sets the stop frequency of the LF sweep to 200 kHz.

`"LFO:FREQ:MODE SWE"`
'sets the LF sweep mode.

`"LFO:SWE:EXEC"`
'a one-off LF sweep from 100 kHz to 200 kHz is performed. The linear step width is 1 kHz with a dwell time of 15 ms (preset values).

*RST value	Resolution	SCPI
1 kHz	0.1 Hz	Compliant

[SOURce:]LFOutput:FREQuency:STOP 0.1 Hz... 1 MHz

This command sets the stop frequency for the LF sweep.

Example: `"LFO:FREQ:STOP 200 kHz"`
'sets the stop frequency for the LF sweep to 200 kHz.

`"LFO:FREQ:STAR 100 kHz"`
'sets the start frequency for the LF sweep to 100 kHz.

*RST value	Resolution	SCPI
50 kHz	0.1 Hz	Compliant

[SOURce:]LFOutput[:STATe] ON | OFF

The command activates/deactivates the LF output.

Example: `"LFO ON"`
'activates the LF output. The settings under `LFO:FREQ` and `LFO:SWE` become effective.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce:]LFOutput:SWEep[:FREQuency]:DWELl 2 ms...10 s

The command sets the dwell time for each frequency step of the sweep.

Example: `"LFO:SWE:DWEL 20 ms"`
'sets a dwell time of 20 ms.

*RST value	Resolution	SCPI
10 ms	0.1 ms	Device-specific

[SOURce:]LFOutput:SWEep[:FREQuency]:EXECute

The command immediately starts an LF sweep. The MODE setting determines which sweep is executed, e.g. `SOURce:LFOutput:SWEep:FREQuency:MODE STEP`. The command corresponds to the manual-control command EXECUTE SINGLE SWEEP.

This command triggers an event and therefore has no *RST value.

Example: `"LFO:SWE:MODE STEP`
'sets the step-by-step processing of the LF sweep.

`"LFO:SWE:EXEC"`
'starts a step of the LF sweep.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LFOutput:SWEep[:FREQuency]:MODE AUTO | MANual | STEP

The command sets the cycle mode of the LF sweep.

The assignment of the IEC/IEEE-bus commands to the sweep modes is given in the description of the sweep menus.

Parameters: **AUTO**
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each frequency step of the sweep is triggered individually, either by varying the **Current Frequency** value using the rotary knob under manual control or by means of a `:LFOutput:FREQ:MAN` command under remote control. With manual control, the frequency increases or decreases (depending on the direction of the rotary encoder) by the value specified under `:LFOutput:FREQ:STEP:INCRement`. With remote control, the frequency is set directly with the command `:LFOutput:FREQ:MAN`.

STEP
Each trigger triggers one sweep step only. The frequency increases by the value entered under `[SOURce:]LFOutput:SWEep:STEP`.

Example: `"LFO:SWE:MODE AUTO"`
'selects **Mode Auto**.

*RST value	Resolution	SCPI
AUTO	-	Device-specific

[SOURce:]LFOutput:SWEep[:FREQuency]:POINts <numeric_value>

The command sets the number of steps in an LF sweep. The command is linked to the command `:LFOutput:SWEep[:FREQuency]:STEP` as follows:

The following applies for linear sweeps and `STARt < STOP`: `POINts = ((STOP-STARt) / STEP:LIN) + 1`

The following applies for logarithmic sweeps and `STARt < STOP`:
`POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Two separate POINts values are used for linear or logarithmic sweep spacing (`LFOutput:SWEep[:FREQuency]:SPACing LIN | LOG`). The command is always effective for the currently set sweep spacing.

Example: `"LFO:FREQ:STAR"`
'sets the start frequency to 2 kHz.

`"LFO:FREQ:STOP"`
'sets the stop frequency to 20 kHz.

`"LFO:SWE:SPAC LIN"`
'sets linear sweep spacing.

`"LFO:SWE:POIN 11"`
'sets 11 sweep steps for linear sweep spacing. The sweep step width (`STEP`) is automatically set to 2 kHz.

*RST value	Resolution	Correlation	SCPI
100	1	The value of `:LFO:SWE:STEP` is adjusted automatically.	Device-specific (adapted to instrument properties)

[SOURce:]LFOutput:SWEep[:FREQuency]:SHAPe SAWTooth | TRIangle

The command sets the cycle mode for a sweep sequence (shape).

Parameters:

SAWTooth
One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

Example: `SOUR:LFO:SWE:SHAP TRI`
'selects the sweep cycle with alternating ascending and descending sweep directions.

*RST value	Resolution	Options	SCPI
SAWTooth	-		Device-specific

[SOURce:]LFOutput:SHAPe SINE | SQUare

The command selects the shape of the LF generator.

Example: `LFO:SHAP SQU`
'selects a rectangular shape for the signal of the LF generator.

*RST value	Resolution	Options	SCPI
SINE			Compliant

[SOURce:]LFOutput:SWEep[:FREQuency]:SPACing LINear | LOGarithmic

The command selects linear or logarithmic sweep spacing.

Example: `"LFO:SWE:SPAC LIN"`
'selects linear sweep spacing.

*RST value	Resolution	SCPI
LINear	-	Device-specific

[SOURce:]LFOutput:SWEep[:FREQuency]:STEP[:LINear] 0 ... (STOP - STARt)

The command sets the step width for the linear sweep.

This command is linked to the command `:LFOutput:SWEep[:FREQuency]:POINts` as follows:

The following applies for `STARt < STOP`: `POINts = (((STOP-STARt) / STEP:LIN) + 1`

If `STEP:LIN` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

Example: `"LFO:FREQ:STAR"`
'sets the start frequency to 2 kHz.

`"LFO:FREQ:STOP"`
'sets the stop frequency to 20 kHz.

`"LFO:SWE:SPAC LIN"`
'sets linear sweep spacing.

`"LFO:SWE:STEP 2 kHz"`
'sets the sweep step width to 2 kHz. The number of sweep steps for linear sweep spacing (`POINts`) is automatically set to 11.

*RST value	Resolution	Correlation	SCPI
1kHz	0.1 Hz	The value of `:LFO:SWE:POIN` is adjusted automatically.	Device-specific

[SOURce:]LFOutput:SWEep[:FREQuency]:STEP:LOGarithmic 0.01 ... 100 PCT

The command specifies the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated (for `STARt` < `STOP`) using the following formula:

New frequency = Old frequency + `STEP:LOG` x Old frequency

`STEP:LOG` therefore gives the fraction of the old frequency. The frequency is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in percent, whereby the suffix `PCT` must always be used.

The command is linked to the command `:LFOutput:SWEep[:FREQuency]:POINts` as follows:

The following applies for logarithmic sweeps and `STARt < STOP`:

`POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `STEP:LOG` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

Example: `"LFO:FREQ:STAR"`
'sets the start frequency to 1 kHz.

`"LFO:FREQ:STOP"`
'sets the stop frequency to 100 kHz.

`"LFO:SWE:SPAC LOG"`
'sets logarithmic sweep spacing.

`"LFO:SWE:STEP:LOG 10PCT"`
'sets the step width for logarithmic sweep spacing to 10% of the previous frequency in each instance.

*RST value	Resolution	Correlation	SCPI
1 PCT	0.01 PCT	The value of `:LFO:SWE:POIN` is adjusted automatically.	Device-specific

[SOURce:]LFOutput:VOLTage 0 V...4 V

The command sets the output voltage of the LF output.

Example: `"LFO:VOLT 3 V"`
'sets the voltage of the LF output to 3 V.

*RST value	Resolution	SCPI
1 V	0.001 V	Device-specific

SOURce:LIST Subsystem

This subsystem contains the commands for the List mode of the instrument.

The following settings are required to operate the instrument in List mode:

1. Create a list.
   If a list which does not exist is selected with the `:LIST:SEL` command, an empty list with the name of the selected list is created.
   `SOURce1:LIST:SEL "New_list"`
2. Fill the list with values.
   All list components must be of the same length. This does not apply to components of length 1. This is interpreted as if the component has the same length as the other components and as if all values are the same as the first value.
   `SOURce1:LIST:FREQ 100 MHz, 110 MHz, 120 MHz,...`
   `SOURce1:LIST:POW 2dBm, -1dBm, 0dBm,...`
3. Select a list.
   If a new empty file has been created with the `:LIST:SEL` command, this file is selected, otherwise an existing list must be selected before the List mode is activated.
   `SOURce1:LIST:SEL "Old_list"`
4. Set the dwell time.
   The dwell time determines the duration of the individual list steps.
   `SOURce1:LIST:DWELl 3ms`
5. Set the List mode.
   The List mode determines the way in which the list is processed.
   In the example the list is processed once only or repeatedly depending on the trigger setting.
   `SOURce1:LIST:MODE AUTO`
6. Determine the trigger.
   In the example each trigger causes the list to be processed once from beginning to end.
   `SOURce:LIST:TRIGger:SOURce SINGle`
7. Activate the List mode.
   SOURce1:FREQuency:MODE LIST
8. Trigger the list (depending on the mode).
   `SOURce1:LIST:TRIGger:EXECute`
9. Deactivate the List mode.
   `SOURce1:FREQuency:MODE CW`

Note:
SCPI refers to the individual lists as segments.

For one-path instruments, the keyword SOURce is optional and can be omitted.

The same lists are, however, accessed for both paths. File operations such as creating, deleting and querying lists are therefore path-independent. In this case, the suffix under SOURce must be omitted. An error message is displayed if the suffix is specified.

Command	Parameters	Default unit	Remark
[SOURce:]LIST:CATalog?			Query only
[SOURce:]LIST:DELete	<list name>		
[SOURce:]LIST:DELete:ALL			
[SOURce:]LIST:DEXChange:AFILe:CATalog?			Query only
[SOURce:]LIST:DEXChange:AFILe:EXTension	TXT | CSV		
[SOURce:]LIST:DEXChange:AFILe:SELect	<ASCII file name>		
[SOURce:]LIST:DEXChange:AFILe:SEParator:COLumn	TABulator | SEMicolon | COMMa | SPACe		
[SOURce:]LIST:DEXChange:AFILe:SEParator:DECimal	DOT | COMMa		
[SOURce:]LIST:DEXChange:EXECute			No query
[SOURce:]LIST:DEXChange:MODE	IMPort | EXPort		
[SOURce:]LIST:DEXChange:SELect	<list mode file>		
[SOURce:]LIST:DWELl	1 ms ... 1 s	s	
[SOURce:]LIST:FREQuency	300kHz..RF_{max} {, 300kHz..RF_{max}} | block data	Hz	RF_{max} depending on model
[SOURce:]LIST:FREQuency:POINts?			Query only
[SOURce:]LIST:INDex:STARt	0 ... list length		
[SOURce:]LIST:INDex:STOP	0 ... list length		
[SOURce:]LIST:LEARn			No query
[SOURce:]LIST:MODE	AUTO | STEP		
[SOURce:]LIST:POWer	-145 ... 30 dBm {, -145 ... 30 dBm} | block data	dBm	
[SOURce:]LIST:POWer:POINts?			Query only
[SOURce:]LIST:RESet			No query
[SOURce:]LIST:SELECT	<list name>		
[SOURce:]LIST:TRIGger:EXECute			No query
[SOURce:]LIST:TRIGger:SOURce	AUTO|IMMediate | SINGle|BUS | EXTernal		

[SOURce:]LIST:CATalog?

The command requests a list of available lists. The individual lists are separated by commas.

The lists are stored with the fixed file extensions ***.lsw** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

The command is a query command and therefore has no *RST value.

Example: `"MMEM:CDIR 'var/smbv/Lists/Listmode'"`
'selects the directory for the list mode files.

`"LIST:CAT?"`
'queries the available lists.

Response: `'list1,list2'"`
'the lists `list1` and `list2` are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DELete '<list file name>'

The command deletes the specified list.

The files are stored with the fixed file extensions ***.lsw** in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. To access the files in this directory, only the file name has to be given, without the path and the file extension. A path can also be specified in command `:SOUR:LIST:CAT?`, in which case the file in the specified directory is deleted.

*RST does not affect data lists.

Example: `"MMEM:CDIR 'var/smbv/Lists/Listmode'"`
'selects the directory for the list mode files.

`"LIST:DEL 'LIST1'"`
'deletes the list `list1`.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DELete:ALL

The command deletes all lists in the set directory. The List mode must be deactivated beforehand to ensure that no lists are selected when this command is called (`SOUR:FREQ:MODE CW` or `SWE`).

The files are stored with the fixed file extensions ***.lsw** in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:CAT?`, in which case all list mode files in the specified directory are deleted.

*RST does not affect data lists.

Example: `"MMEM:CDIR 'var/smbv/Lists/Listmode'"`
'selects the directory for the list mode files.

`"FREQ:MODE SWE"`
'deactivates the List mode for RF output and activates the Sweep mode.

`"SOUR2:FREQ:MODE SWE"`
'deactivates the List mode for RF output and activates Sweep mode.

`"LIST:DEL:ALL"`
'deletes all list mode files available in the set directory.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DEXChange:AFILe:CATalog?

The command requests a list of available ASCII files for export/import of list mode data. The individual files are separated by commas.

The ASCII files are stored with the fixed file extensions ***.txt** or ***.csv** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`.

The command is a query command and therefore has no *RST value.

Example: `MMEM:CDIR 'var/smbv/lists/listmode/import'`
'selects the directory for the ASCII files with frequency and level value pairs.

`LIST:DEXC:AFIL:EXT TXT`
'selects that ASCII files with extension *.txt are listed.

`LIST:DEXC:AFIL:CAT?`
'queries the available files with extension *.txt.

Response: `'list1,list2'`
'the ASCII files `list1`.txt and `list2`.txt are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DEXChange:AFILe:EXTension TXT | CSV

The command selects the file extension of the ASCII file to be imported or exported. Selection TXT (text file) or CSV (Excel file) is available.

Example: `MMEM:CDIR 'var/smbv/lists/listmode/import'`
'selects the directory for the ASCII files with frequency and level value pairs.

`LIST:DEXC:AFIL:EXT TXT`
'selects that ASCII files with extension *.txt are listed.

`LIST:DEXC:AFIL:CAT?`
'queries the available files with extension *.txt.

Response: `'list1,list2'`
'the ASCII files `list1`.txt and `list2`.txt are available.

*RST value	Resolution	SCPI
TXT	-	Device-specific

[SOURce:]LIST:DEXChange:AFILe:SELect <ascii_file_name>

The command selects the ASCII file to be imported or exported.

The ASCII files are stored with the fixed file extensions ***.txt** or ***.csv** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:DEXC:AFIL:SEL`, in which case the files are stored or loaded in the specified directory.

Example: `LIST:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.

`LIST:DEXC:AFIL:SEL 'var/smbv/user/listmode/import/list.csv'`
'selects that ASCII file list.csv is imported.

`LIST:DEXC:SEL 'var/smbv/user/listmode/import/list_imp'`
'selects that the ASCII file list.csv is imported into list mode list list_imp.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DEXChange:AFILe:SEParator:COLumn TABulator | SEMicolon | COMMa | SPACe

The command selects the separator between the frequency and level column of the ASCII table.

Example:

`LIST:DEXC:MODE EXP`
'selects that the list mode list is exported into an ASCII file.

`LIST:DEXC:AFIL:SEL 'var/smbv/user/listmode/import/list.csv'`
'selects ASCII file list.csv as destination for the list mode list data.

`LIST:DEXC:AFIL:SEP:COL TAB`
'the pairs of frequency and level values are separated by a tabulator.

`LIST:DEXC:AFIL:SEP:DEC DOT`
'selects the decimal separator dot.

`LIST:DEXC:SEL 'var/smbv/user/listmode/import/list_imp'`
'selects that the list mode list list_imp is imported into ASCII file list.csv.

*RST value	Resolution	SCPI
SEMicolon	-	Device-specific

[SOURce:]LIST:DEXChange:AFILe:SEParator:DECimal DOT | COMMa

The command the decimal separator used in the ASCII data between '.' (decimal point) and ',' (comma) with floating-point numerals.

Example:

`LIST:DEXC:MODE EXP`
'selects that the list mode list is exported into an ASCII file.

`LIST:DEXC:AFIL:SEL 'var/smbv/user/listmode/import/list.csv'`
'selects ASCII file list.csv as destination for the list mode list data.

`LIST:DEXC:AFIL:SEP:COL TAB`
'the pairs of frequency and level values are separated by a tabulator.

`LIST:DEXC:AFIL:SEP:DEC DOT`
'selects the decimal separator dot.

`LIST:DEXC:SEL 'var/smbv/user/listmode/import/list_imp'`
'selects that the list mode list list_imp is imported into ASCII file list.csv.

*RST value	Resolution	SCPI
DOT	-	Device-specific

[SOURce:]LIST:DEXChange:EXECute

The command starts the export or import of the selected file. When import is selected, the ASCII file is imported as list mode list. When export is selected, the list mode list is exported into the selected ASCII file.

The command triggers an event and therefore has no *RST value.

Example: `LIST:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.

`LIST:DEXC:AFIL:SEL 'var/smbv/user/listmode/import/list.csv'`
'selects that ASCII file list.csv is imported.

`LIST:DEXC:SEL 'var/smbv/user/listmode/import/list_imp'`
'selects that the ASCII file list.csv is imported into list mode list list_imp.

`LIST:DEXC:EXEC`
'starts the import of the ASCII file data into the list mode file.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DEXChange:MODE IMPort | EXPort

The command selects if list mode lists should be imported or exported. Depending on the selection her, the file select command define either the source or the destination for list mode lists and ASCII files.

Example: `LIST:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.

`LIST:DEXC:AFIL:SEL 'var/smbv/user/listmode/import/list.csv'`
'selects that ASCII file list.csv is imported.

`LIST:DEXC:SEL 'var/smbv/user/listmode/import/list_imp'`
'selects that the ASCII file list.csv is imported into list mode list list_imp.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DEXChange:SELect <list_name>

The command selects the list mode list to be imported or exported.

The list mode files are stored with the fixed file extensions ***.lsw** in a directory of the user's choice. The directory applicable to the commands is defined with the command `MMEMory:CDIR`. A path can also be specified in command `SOUR:LIST:DEXC:SEL`, in which case the files are stored or loaded in the specified directory.

Example: `LIST:DEXC:MODE IMP`
'selects that ASCII files with frequency and level value pairs are imported and transferred into list mode lists.

`LIST:DEXC:AFIL:SEL ‘var/smbv/user/listmode/import/list.csv'`
'selects that ASCII file list.csv is imported.

`LIST:DEXC:SEL ‘var/smbv/user/listmode/import/list_imp'`
'selects that the ASCII file list.csv is imported into list mode list list_imp.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:DWELl 1 ms ... 1 s

The command sets the time for which the instrument retains a setting.

Example: `"LIST:DWEL 15"`
'each setting in the list is retained for 15 ms.

*RST value	Resolution	SCPI
10 ms	-	Compliant

[SOURce:]LIST:FREQuency 300 kHz...RF_{max} {, 300 kHz...RF_{max}} | block data (RF_{max} depending on model)

The command fills the FREQuency part of the selected list with data. The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see the command `FORMat:DATA`).

*RST does not affect data lists.

Example: `"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects `list3` for editing. `List3` is created if it does not yet exist.

`"SOUR:LIST:FREQ 1.4GHz, 1.3GHz, 1.2GHz,..."`
'specifies the frequency values in `list3`. If the list already contains data, it is overwritten.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]LIST:FREQuency:POINts?

The command queries the length (in points) of the FREQuency component of the selected list.

The command is a query command and therefore has no *RST value.

Example: `"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects `list3` for editing. `List3` is created if it does not yet exist.

`"LIST:FREQ:POIN?"`
'queries the number of frequency values in `list3`.

Response: `"327"`
'list3 has 327 frequency entries.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]LIST:INDex:STARt 0 ... list length

The command sets the start index of the index range which defines a subgroup of frequency/level value pairs in the current list. Only the values in the set index range (`:LIST:INDex:STARt` ... `:LIST:INDex:STOP`) are processed in List mode.

Example: `"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects list3 for use in List mode.

`"LIST:IND:STAR 25"`
'sets 25 as start index of the index range.

`"LIST:IND:STOP 49"`
'sets 49 as stop index of the index range.

`"FREQ:MODE LIST"`
'activates List mode. The frequency/level value pairs from index 25 to index 49 in list3 are processed. All other entries of the list are ignored.

*RST value	Resolution	SCPI
0	-	Device-specific

[SOURce:]LIST:INDex:STOP 0 ... list length

The command sets the stop index of the index range which defines a subgroup of frequency/level value pairs in the current list. Only the values in the set index range (`:LIST:INDex:STARt` ... `:LIST:INDex:STOP`) are processed in List mode.

Example: `"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects list3 for use in List mode.

`"LIST:IND:STAR 25"`
'sets 25 as start index of the index range.

`"LIST:IND:STOP 49"`
'sets 49 as stop index of the index range.

`"FREQ:MODE LIST"`
'activates List mode. The frequency/level value pairs from index 25 to index 49 in list3 are processed. All other entries of the list are ignored.

*RST value	Resolution	SCPI
0	-	Device-specific

[SOURce:]LIST:LEARn

The command learns the selected list, i.e. it determines the hardware setting for the entire list. The data determined in this way is stored together with the list. When the list is activated for the first time, these settings are calculated automatically.

The command triggers an event and therefore has no *RST value.

Example: `LIST:SEL 'var/smbv/Lists/Listmode/list3'`
'selects `list3`. `List3` is created if it does not yet exist.

`LIST:LEAR`
'starts learning of the hardware setting for `list3` and stores the setting.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:MODE AUTO | STEP

The command specifies how the list is to be processed (similar to `SOURce:SWEep:MODE`).

Parameters: **AUTO**
Each trigger event triggers a complete list cycle. Possible trigger settings for `:LIST:TRIGger:SOURce` are `AUTO`, `SINGle` and `EXT`.

STEP
Each trigger event triggers only one step in the list processing cycle. Possible trigger settings for `:LIST:TRIGger:SOURce` are `SINGle` and `EXT`

Example: `"LIST:MODE STEP"`
'selects step-by-step processing of the list.

*RST value	Resolution	SCPI
AUTO	-	Compliant

[SOURce:]LIST:POWer -145 ...30 dBm {, -145 ...30 dBm} | block data

The command fills the Level part of the selected list with data. The data can be given either as a list of numbers (list can be of any length and list entries must be separated by commas) or as binary block data. When block data is transferred, 8 (4) bytes are always interpreted as a floating-point number with double accuracy (see the command `FORMat:DATA`).

*RST does not affect data lists.

Example: `"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects `list3` for editing. `List3` is created if it does not yet exist.

`"LIST:POW 0dBm, 2dBm, 2dBm, 3dBm,.."`
'specifies the level values in `list3`. The number of level values must correspond to the number of frequency values. The previous data is overwritten.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]LIST:POWer:POINts?

The command queries the length (in points) of the LEVel part of the selected list.

The command is a query command and therefore has no *RST value.

Example: `"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects `list3` for editing. `List3` is created if it does not yet exist.

`"LIST:POW:POIN?"`
'queries the number of levels in `list3.`

Response: `"327"`
'`LIST2` has 327 level entries.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]LIST:RESet

The command resets the list to the starting point.

The command triggers an event and therefore has no reset value.

Example: `"LIST:RES"`
'resets the list to the starting point.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:SELect '<list name>'

The command selects the specified list. If a new list is to be created, the name can be entered here. The list is created if it does not yet exist. The list selected here is available for the further processing steps (editing) and is used in the instrument when the List mode is activated.

The files are stored with the fixed file extensions ***.lsw** in a directory of the user's choice. The directory applicable to the command is defined with the command `MMEMory:CDIR`. A path can also be specified in command `:SOUR:LIST:SEL` in which case the list mode file in the specified directory is selected.

*RST does not affect data lists.

Example:

`"LIST:SEL 'var/smbv/Lists/Listmode/list3'"`
'selects `list3` for editing. `List3` is created if it does not yet exist.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:TRIGger:EXECute

The command immediately starts the processing of a list in list mode. It corresponds to the manual-control command **Execute Single**.

The command triggers an event and therefore has no reset value.

Example: `"SOUR:LIST:TRIG:EXEC"`
'triggers the processing of the selected list.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]LIST:TRIGger:SOURce AUTO | IMMediate | SINGle | EXTernal | BUS | EXTernal

The command sets the trigger source for the LIST mode.

The names of the parameters correspond to those under sweep mode. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	MODE AUTO
SINGle	BUS	MODE SINGLE or STEP
EXTernal	EXTernal	MODE EXT TRIG SINGLE or EXT TRIG STEP

Parameters:

AUTO
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. The selected list in List mode is restarted as soon as it is finished.

SINGle
The list is triggered by the IEC/IEEE-bus commands `SOURce:LIST:TRIGger:EXECute`. The list is executed once.

Example: `"TRIG:LIST:SOUR  EXT"`
'selects triggering by means of the external trigger. The trigger is input via the INST TRIG connector.

*RST value	Resolution	SCPI
SINGle	-	Device-specific

SOURce:MODulation Subsystem

This subsystem contains the command for switching on/off all modulations.

Command	Parameters	Default unit	Remark
[SOURce:]MODulation[:ALL]:STATe	ON | OFF		

[SOURce:]MODulation[:ALL]:STATe ON | OFF

The command switches the modulations on and off. The command `:SOUR:MOD:ALL:STAT OFF` switches all modulations off. A subsequent command `:SOUR:MOD:ALL:STAT ON` restores the status that was active before the last switch-off. **MOD OFF** is displayed in the info line of the header next to the **Level** field.

The keyword SOURce is optional.

Example: `"MOD:STAT OFF"`
'switches off all modulations.

*RST value	Resolution	SCPI
IN	-	Device-specific

SOURce:PHASe Subsystem

This subsystem contains the commands for adjusting the phase of the RF output signal relative to a reference signal of the same frequency.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]PHASe	-359.9 deg ... +359.9 deg	RAD	
[SOURce:]PHASe:REFerence			No query

[SOURce:]PHASe -359.9 deg ... +359.9 deg

The command specifies the phase variation relative to the current phase. The variation can be specified in RADians.

Example: `"PHAS 2DEG"`
'changes the phase by 2 degrees relative to the current phase.

`"PHAS:REF"`
'adopts the set phase as the current phase.

*RST value	Resolution	SCPI
0.0 deg	0.1 deg	Compliant

[SOURce:]PHASe:REFerence

The command adopts the phase set with `SOURce:PHASe:ADJust` as the current phase.

The command triggers an event and therefore has no *RST value and no query form.

Example: `"PHAS 0.1RAD"`
'changes the phase by 0.1 rad relative to the current phase.

`"PHAS:REF"`
'adopts the set phase as the current phase.

*RST value	Resolution	SCPI
-	-	Compliant

SOURce:PM Subsystem

The PM subsystem contains the commands for checking the phase modulation. The settings for the internal modulation source (LF generator) are made in the SOURce:LFOutput subsystem.

Command	Parameters	Default unit	Remark
[SOURce:]PM[:DEViation]	0 ...20 RAD	RAD	
[SOURce:]PM:EXTernal:COUPling	AC | DC		
[SOURce:]PM:MODE	HBANdwidth | HDEViation | LNOise		
[SOURce:]PM:SENSitivity?			Query only
[SOURce:]PM:SOURce	EXT | INT | INT, EXT		
[SOURce:]PM:STATe	ON | OFF		

[SOURce:]PM[:DEViation] 0 ... 20 RAD

The command sets the modulation deviation of the phase modulation in RAD. The maximal deviation depends on the RF frequency set and the selected modulation mode (see data sheet).

Example: `"PM 5"`
'sets the PM modulation deviation to 5 RAD.

*RST value	Resolution	SCPI
1 RAD	See data sheet	Compliant

[SOURce:]PM:EXTernal:COUPling AC | DC

The command selects the coupling mode for the external modulation input (EXT MOD) in the case of phase modulation.

Note:
Coupling for external feed via input EXT MOD can be set independently for modulations AM, PM and PhiM.

Parameters: **AC**
The DC voltage component is disconnected from the modulation signal.

DC
The modulation signal is not changed.

Example: `"PM:EXT:COUP AC"`
'selects the coupling mode AC for external phase modulation.

*RST value	Resolution	SCPI
AC	-	Compliant

[SOURce:]PM:MODE HBANdwidth | HDEViation | LNOise

The command selects the mode for the phase modulation.

Parameters: **HBANdwidth**

The maximum range for modulation bandwidth is available. However, phase noise is increased for low frequencies. The range for PhiM deviation is limited. This mode is recommended for high modulation frequencies.

HDEViation

The maximum range for PhiM deviation is available. Phase noise is improved for low frequencies. The range for modulation frequency is limited (see data sheet). This mode is recommended for low modulation frequencies and/or high PhiM deviation.

LNOise

Phase modulation with phase noise and spurious characteristics close to CW mode. The range for modulation bandwidth and PM deviation is limited (see data sheet)

Example: `"PM:MODE LNO"`

'selects Low Noise mode for external phase modulation.

*RST value	Resolution	SCPI
HBANdwidth	-	Compliant

[SOURce:]PM:SENSitivity?

The command queries the input sensitivity of the EXT MOD input in RAD/V. The command is only effective if the external modulation source is selected (`SOUR:PM:SOUR EXT`). The returned value depends on the modulation deviation setting (`SOUR:PM:DEViation`). This value is assigned to the voltage value for full modulation of the input.

The command is a query command and therefore has no *RST value.

Example: `"PM:DEV 1"`

'sets a modulation deviation of 1RAD.

`"PM:SENS?"`

'queries the input sensitivity at the EXT MOD input.

Response: `"1"`

'since the voltage value for full modulation is 1V, the resulting sensitivity is precisely 1RAD/V.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]PM:SOURce EXT | INT | INT,EXT

The command selects the modulation source for phase modulation. INT is the LF generator. The frequency of the internal modulation signal can be set in the SOURce:LFOutput subsystem. The external signal is input at the EXT MOD connector. Internal and external modulation source can be selected at the same time.

Example: `"PM:SOUR INT"`

'selects the internal modulation source.

*RST value	Resolution	SCPI
INTernal	-	Compliant

[SOURce:]PM:STATe ON | OFF

The command activates/deactivates phase modulation.

Activation of phase modulation deactivates phase modulation.

Example: `"PM:STAT ON"`
'activates PM modulation.

*RST value	Resolution	Correlation	SCPI
OFF	-	`PM:STATe ON` deactivates phase modulation.	Compliant

SOURce:POWer Subsystem

This subsystem contains the commands for setting the output level, level control and level correction of the RF signal. Other units can also be used instead of dBm:

by entering the unit directly after the numerical value (example `:POW 0.5V`),

by changing the DEFault unit in the UNIT system (see the command `UNIT:POWER`).

For one-path instruments, the keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]POWer:ALC:OMODe	SHOLd | TABLe		
[SOURce:]POWer:ALC:SONCe			No query
[SOURce:]POWer:ALC[:STATe]	ON | OFF | AUTO		
[SOURce:]POWer:[LEVEL][:IMMediate][:AMPLitude]	<numeric_value>	dBm	Depending on model
[SOURce:]POWer:[LEVEL][:IMMediate]:OFFSet	-100 ...+100 dB	dB	Depending on model
[SOURce:]POWer:[LEVEL][:IMMediate]:RCL	INCLlude | EXCLude		
[SOURce:]POWer:LIMit[:AMPLitude]	<numeric_value>	dBm	Depending on model
[SOURce:]POWer:MANual	<numeric_value>	dBm	Depending on model
[SOURce:]POWer:MODE	FIXed|CW | SWEep | LIST		
[SOURce:]POWer:PEP?		dBm	Query only
[SOURce:]POWer:STARt	<numeric_value>	dBm	Depending on model
[SOURce:]POWer:STEP[:INCRement]	0 ...100 dB	dB	
[SOURce:]POWer:STEP:MODE	USER | DECimal		
[SOURce:]POWer:STOP	<numeric_value>	dBm	Depending on model

[SOURce:]POWer:ALC:OMODe SHOLd | TABLe

The command sets the level control mode which becomes active when automatic level control is deactivated **(ALC Off)**.

Parameter: **SHOLd**
Level control is activated briefly if the level or frequency changes (**ALC Off Sample & Hold**).

SHOLd
Internal level control is performed according to the ALC table.

Example: `"POW:ALC OFF"`
'deactivates automatic level control for RF output A.

`"POW:ALC:OMOD SHOL"`
'level control is briefly activated if the frequency or level changes.

*RST value	Resolution	SCPI
SHOLd		Device-specific

[SOURce:]POWer:ALC:SONCe

The command briefly activates level control for correction purposes.

The command triggers an event and therefore has no *RST value and no query form.

Example: `"POW:ALC OFF"`
'deactivates automatic level control for RF output A.

`"POW:ALC:SONC"`
'level control is performed once only.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]POWer:ALC[:STATe] ON | OFF | AUTO

The command activates/deactivates automatic level control.

Parameters:

ON
Internal level control is permanently activated.

OFF
Internal level control is deactivated.

AUTO
Internal level control is activated/deactivated automatically depending on the operating state.

Example: `"POW:ALC ON"`
'activates automatic level control for RF output A.

*RST value	Resolution	SCPI
AUTO	-	Compliant

[SOURce:]POWer[:LEVel][:IMMediate][:AMPLitude] Minimum level ... Maximal level

The command sets the RF output level in CW mode. In addition to numerical values, it is also possible to specify `UP` and `DOWN`. The level is then increased or decreased by the value specified under `[SOURce<[1]|2>:]POWer:STEP`.

As with the **Level** value entered in the header, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFSet` values can be calculated using the following formula:

Minimum level + `OFFSet` ...Maximum level + `OFFSet`

The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown in the example.

Parameters:

Example: `"SOUR:POW:LEV:IMM:AMPL 15"` or `":POW 15"`
'sets the RF level at output A to 15 dBm.

*RST value	Resolution	SCPI
-30 dBm	0.01 dB	Compliant

[SOURce:]POWer[:LEVel][:IMMediate]:OFFSet -100 dB ... +100 dB

Caution:
The level offset is also effective for level sweeps!

The command specifies the constant level offset of a downstream attenuator/amplifier. If a level offset is entered, the level entered with `:POWer` no longer corresponds to the RF output level. The following correlation applies:

`:POWer` = RF output level + `POWer:OFFSet`.

Entering a level offset does not change the RF output level, but rather the query value of `:POWer`.

Only dB is permitted as the unit here. The linear units (V, W, etc.) are not permitted.

The keywords of this command are largely optional. Therefore, both the long and short form of the command are shown in the example.

Example: "`SOURce:POWer:LEVel:IMMediate:OFFSet -10`"
or
"`POW:OFFS 10`"
'sets the RF level offset to 10 dB.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Compliant

[SOURce:]POWer[:LEVel][:IMMediate]:RCL INCLude **|** EXCLude

The command determines whether the current level is retained or whether the stored level setting is adopted when an instrument configuration is loaded.

*RST does not affect this setting. The setting is valid for both paths. If a suffix is specified, it is ignored.

Parameters:

INCLude
The stored level is also loaded when a stored instrument configuration is loaded.

EXCLude
The RF level is not loaded when a stored instrument configuration is loaded. The current level is retained.

Example: "`POW:RCL INCL`"
'the stored level is set if the Recall command is called.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]POWer:LIMit[:AMPLitude] Minimum level .... Maximum level

The command limits the maximum RF output level in CW and SWEEP mode. It does not influence the LEVEL display or the response to the `POW?` query command.

Example: "`SOURce:POWer:LIMit:AMPLitude 10`" or "`:POW:LIM 10`"
'limits the RF level to maximum +10 dBm.

*RST value	Resolution	SCPI
+30 dBm	0.01 dB	Compliant

[SOURce:]POWer:MANual Minimum level ... Maximum level

In Sweep mode (`:SOUR:POW:MODE SWE`) the command sets the level for the next sweep step in the **Step** sweep mode (`:SOUR:SWE:POW:MODE MAN`). Here only level values between the settings `[:SOUR]:POW:STAR` and `...:STOP` are permitted. Each sweep step is triggered by a separate `:SOUR:POW:MAN` command.

As with the **Level** value entered in the **RF Level** menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ... Maximum level + `OFFSet`

Example: `"POW:SWE:MODE MAN"`
'sets the **Step** sweep mode for RF output A.

`"POW:MAN -5 dBm"`
'sets an RF level of -5 dBm for the next setting in the **Step** sweep mode for RF output A.

`"POW:MODE SWE"`
'sets the Level Sweep mode for RF output A.

`"POW:MAN -5.5 dBm"`
'triggers the next sweep step with a level of -5.5 dBm.

*RST value	Resolution	SCPI
-30 dBm	0.01 dBm	Compliant

[SOURce:]POWer:MODE CW|FIXed | SWEep | LIST

The command sets the instrument operating mode and therefore also the commands used to set the output level.

Parameters: **SWEep**
The level is set using the commands `SOURce:POWer:STARt; STOP; MANual`.

LIST
The instrument processes a list of frequency and level settings. The List mode settings are made in the SOURce:LIST subsystem. The setting `SOURce:POWer:MODE LIST` also sets the command `SOURce:FREQuency:MODE` automatically to `LIST`.

Example: `"POW:MODE SWEep"`
'sets the SWEep mode. The settings under `SOURce:POW:STARt; STOP; MANual` become effective.

*RST value	Resolution	Correlation	SCPI
CW	-	`POW:MODE LIST` sets `FREQ:MODE LIST`	Compliant

[SOURce:]POWer:PEP?

With digital modulation and all digital standards, the command returns the peak envelope power (**PEP**) in dBm (the value which is shown under the **Level** specification in the PEP lines in the display header).

The command is a query and therefore has no *RST value.

Example: `"POW:PEP?"`
'queries the PEP value for RF output A in the case of digital modulation.

Response: `"4"`
'the PEP value for RF output A is 4 dBm.

*RST value	Resolution	SCPI
--	-	Compliant

[SOURce:]POWer:STARt Minimum level ... Maximum level

The command sets the RF start level in Sweep mode.

As with the **Level** value entered in the **RF Level** menu, the `OFFSet` value is also taken into consideration with this command.

The specified value range is therefore only effective if `:SOURce:POWer:OFFSet` is set to 0. The value range for other `OFFset` values can be calculated using the following formula:

Minimum level + `OFFSet` ...Maximum level + `OFFSet`

Parameters:

Example: `"POW:STAR -20 dBm"`
'sets the start level for the level sweep to -15 dBm for RF output A.

*RST value	Resolution	SCPI
-30 dBm	0.01 dB	Compliant

[SOURce:]POWer:STEP[:INCRement] 0 dB ... 100dB

The command sets the step width for the level setting if `UP` and `DOWN` are used as the level values and variation mode `:SOUR:POW:STEP:MODE USER` is selected. The command is linked to setting **Variation Step** for manual control, i.e. the command also sets the step width of the rotary knob for **Variation Active on**.

Example: `"SOURce:POWer:STEP:INCRement 2"` or `"POW:STEP 2"`
'sets the step width for entering the RF level to 2 dB.

*RST value	Resolution	SCPI
1 dB	0.01 dB	Device-specific

[SOURce:]POWer:STEP:MODE USER | DECimal

This command activates (USER) or deactivates (DECimal) the user-defined step width used when varying the level value with the level values UP/DOWN. The command is linked to setting **Variation Active** for manual control, i.e. the command also activates/deactivates the user-defined step width used when varying the level value with the rotary knob.

Example: "POW:STEP 2"
'sets the step width for the level setting to 2 dB.

"POW:STEP:MODE USER"
'actives this step width for level variation with the rotary knob (manual control) and with level values UP/DOWN (remote control).

*RST value	Resolution	SCPI
DECimal	-	Device-specific

[SOURce:]POWer:STOP Minimum level ... Maximum level

The command sets the stop level in Sweep mode.

As with the **Level** value entered in the **RF Level** menu, the OFFSet value is also taken into consideration with this command.

The specified value range is therefore only effective if :SOURce:POWer:OFFSet is set to 0. The value range for other OFFset values can be calculated using the following formula:

Minimum level + OFFSet ...Maximum level + OFFSet

Parameters:

Example: "POW:STOP 3"
'sets the stop level for the level sweep to 3 dBm for RF output A.

*RST value	Resolution	SCPI
-10 dBm	0.01 dB	Compliant

SOURce:PULM Subsystem

This subsystem contains the commands for setting the pulse modulation.

The LF generator is used as the internal modulation source. The pulse frequency of the internal rectangular signal is therefore set in the SOURce:LFOutput subsystem.

The external signal is input at the **PULSE EXT** connector. The connector can be used as trigger input for internal pulse modulation. The polarity and input impedance of the connector can be selected.

The PGEN Subsystem contains the command for activating/deactivating the output of the video/sync signal at the **PULSE VIDEO** connector.

The keyword SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]PGEN:STATe	ON | OFF		
[SOURce:]PULM:DELay	20ns .. 1s	s	
[SOURce:]PULM:DOUBle:DELay	20ns .. 1s	s	
[SOURce:]PULM:DOUBle:STATe	ON | OFF		
[SOURce:]PULM:DOUBle:WIDTh	20ns .. 1s		
[SOURce:]PULM:MODE	SINGle | DOUBle		
[SOURce:]PULM:PERiod	5µs .. 85.s | 100ns .. 85 s		
[SOURce:]PULM:POLarity	NORMal | INVerted		
[SOURce:]PULM:SOURce	INT | EXT		
[SOURce:]PULM:STATe	ON | OFF		
[SOURce:]PULM:TRIGger:EXTernal:IMPedance	G10K | G50		
[SOURce:]PULM:TRIGger:EXTernal:SLOPe	POSitive | NEGative		
[SOURce:]PULM:TRIGger:EXTernal:GATE:POLarity	NORMal | INVerted		
[SOURce:]PULM:TRIGger:MODE	AUTO | EXTernal | EGATe		
[SOURce:]PULM:WIDTh	20ns .. 1s	s	

[SOURce:]PGEN:STATe ON | OFF

The command switches on/off the output of the video/sync signal at the PULSE VIDEO connector at the rear of the instrument.

Example: `PGEN:STAT OFF`
'deactivates output of video/sync signal

*RST value	Resolution	Options	SCPI
OFF	-	Option R&S SMBV-K23	Compliant

[SOURce:]PULM:DELay 20ns .. 1s

The command sets the pulse delay. The pulse delay determines the time that elapses after a trigger event before pulse modulation starts. The pulse delay is not effective for double pulse generation.

Example: `PULM:DEL 13 us`
'13 us elapse after a trigger before the first pulse is generated.

*RST value	Resolution	Options	SCPI
20 ns	20 ns	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:DOUBle:DELay 20ns .. 1s

The command sets the delay from the start of the first pulse to the start of the second pulse.

Example: `PULM:DOUB:DEL 22 us`
'22 us elapse between the beginning of the first pulse and the beginning of the second pulse in double-pulse mode.

*RST value	Resolution	Options	SCPI
1 ms	20 ns	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:DOUBle:STATe ON | OFF

The command enables/disables double pulse generation. The two pulses are generated in one pulse period.

Example: `PULM:DOUB:STAT ON`
'double-pulse mode is enabled.

*RST value	Resolution	Options	SCPI
OFF		Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:DOUBle:WIDTh 20ns .. 1s

The command sets the width of the second pulse in case of double pulse generation.

Example: `PULM:DOUB:WIDT 33 us`
'sets a width of 33 us for the second pulse.

*RST value	Resolution	Options	SCPI
1ms	20 ns	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:MODE SINGle | DOUBle

Sets the mode of the pulse generator.

Parameters: SINGle
Enables single pulse generation.

DOUBle
Enables double pulse generation. The two pulses are generated in one pulse period.

Example: `PULM:MODE DOUB`
'enables double pulse generation.

*RST value	Resolution	Options	SCPI
SINGle	-	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:PERiod 5µs .. 85.s | 100ns .. 85 s

The command sets the period of the generated pulse. The period determines the repetition frequency of the internal signal.

Example: `PULM:PER 220 us`
'the pulse period is 220 us.

*RST value	Resolution	Options	SCPI
1 ms	1us | 20 ns	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:POLarity NORMal | INVerted

The command sets the polarity between modulating and modulated signal. This command is only effective for an external modulation signal.

Parameters:

NORMal
The RF signal is suppressed during the pulse pause.

INVerted
The RF signal is suppressed during the pulse.

Example: `"PULM:SOUR EXT"`
'selects the external modulation source.

`"PULM:POL INV"`
'selects inverted polarity.

*RST value	Resolution	SCPI
NORMal	-	Device-specific

[SOURce:]PULM:SOURce INTernal | EXTernal | CODer

The command selects the source for pulse modulation.

Parameters:

INTernal
The internally generated rectangular signal is used for the pulse modulation. The frequency of the internal signal can be set in the SOURce:LFOutput subsystem.

EXTernal
The signal applied externally via the EXT MOD connector is used for the pulse modulation.

Example: `"PULM:SOUR INT"`
'selects the internal modulation source.

`"PULM:STAT ON"`
'activates the pulse modulation.

*RST value	Resolution	SCPI
INTernal	-	Compliant

[SOURce:]PULM:STATe ON | OFF

The command activates/deactivates the pulse modulation.

Example: `"PULM:STAT ON"`

'activates pulse modulation with the modulation source selected under `SOURce:PULM:SOURce`.

*RST value	Resolution	SCPI
OFF	-	Compliant

[SOURce:]PULM:TRIGger:EXTernal:IMPedance G50 | G10K

The command selects the impedance for external pulse trigger. The trigger is fed via the PULSE EXT input

Example: `SOUR:PULM:TRIG:EXT:IMP G50`

'selects 50 OHM as the trigger impedance for the external pulse trigger.

*RST value	Resolution	Options	SCPI
G10K	-	Option R&S SMBV-K22	Compliant

[SOURce:]PULM:TRIGger:EXTernal:SLOPe POSitive | NEGative

The command sets the polarity of the active slope of an applied trigger at the PULSE EXT connector.

Example: `PULM:TRIG:EXT:SLOP NEG`

'the pulse generator is triggered on the negative slope of the external trigger signal.

*RST value	Resolution	Options	SCPI
POSitive	-	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:TRIGger:EXTernal:GATe:POLarity NORMal | INVerted

Selects the polarity of the Gate signal. The signal is supplied via the PULSE EXT connector.

Example: `PULM:TRIG:EXT:GAT:POL NORM`

'The pulse signal is generated while the gate signal is high.

*RST value	Resolution	Options	SCPI
NORMal	-	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

[SOURce:]PULM:TRIGger:MODE AUTO | EXTernal | EGATe

The command selects the trigger mode for pulse modulation.

Parameters: **AUTO**
The pulse modulation is generated continuously.

EXTernal
The pulse modulation is triggered by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

EGATe
The pulse modulation is gated by an external gate signal. The signal is supplied via the PULSE EXT connector.

Example: `PULM:TRIG:MODE EXT`
'selects triggering by an external trigger event. The trigger signal is supplied via the PULSE EXT connector.

*RST value	Resolution	Options	SCPI
AUTO	-	Option R&S SMBV-K22 and R&S SMVB-K23	Compliant

[SOURce:]PULM:WIDTh 20ns .. 1s

The command sets the width of the generated pulse. The width determines the pulse length. The pulse width must be at least 20 ns less than the set pulse period.

Example: `PULM:WIDT 33 us`
'sets a width of 33 us for the pulse.

*RST value	Resolution	Options	SCPI
1ms	20 ns	Option R&S SMBV-K22 and R&S SMBV-K23	Device-specific

SOURce:ROSCillator Subsystem

This subsystem contains the commands for setting the external and internal reference frequency.

Note:

*The commands of the SOURce:ROSCillator Subsystem are not affected by an instrument reset (*RST)*

Command	Parameters	Default unit	Remark
[SOURce:]ROSCillator:EXTernal:FREQuency	5 MHz | 10 MHz | 13 MHz	Hz	
[SOURce:]ROSCillator:EXTernal:RFOFf:STATe	ON | OFF		
[SOURce:]ROSCillator[:INTernal]:ADJust[:STATe]	ON | OFF		
[SOURce:]ROSCillator[:INTernal]:ADJust:VALue	0 ... 4095		
[SOURce:]ROSCillator:SOURce	INTernal | EXTernal		

[SOURce:]ROSCillator:EXTernal:FREQuency 5 MHz | 10 MHz | 13 MHz

The command informs the instrument of the frequency of the external reference.

Example: `"ROSC:SOUR EXT"`

'selects the external source. The reference must be input at the REF IN input.

`"ROSC:EXT:FREQ 5 MHz"`

'informs the instrument that the external reference frequency is 5 MHz.

*RST value	Resolution	SCPI
-	-	Compliant

[SOURce:]ROSCillator:EXTernal:RFOFf:STATe ON | OFF

The command determines if the RF output is switched off in case of a missing external reference signal for selectionexternal source.

If enabled, this setting ensures that no improper RF signal due to the missing external reference signal is output and used for measurements.

In addition to the error message "Ext Ref missing", message "RF output deactivated' is generated.

Example: `ROSC:SOUR EXT`

'selects the external source. The reference must be input at the REF IN input.

`ROSC:EXT:RFOF:STAT ON`

'in case of a missing external signal, no RF signal is output.

*RST value	Resolution	SCPI
-	-	

[SOURce:]ROSCillator[:INTernal]:ADJust:VALue 0 ... 4095

The command specifies the frequency correction value (adjustment value).

Example: `"ROSC:ADJ:VAL 1400"`
'sets the adjustment value to 1400.

*RST value	Resolution	SCPI
-	1	Device-specific

[SOURce:]ROSCillator[:INTernal]:ADJust[:STATe] ON | OFF

The command determines whether the calibrated (OFF) or a user-defined (ON) adjustment value is used for fine adjustment of the frequency. With STATe ON, the instrument is no longer in the calibrated state. However, the calibration value is not changed and the instrument resumes the calibrated state after switching the Adjustment State to Off.

Example: `"ROSC:SOUR INT"`
'selects the internal source.

`"ROSC:ADJ ON"`
'activates use of a user-defined adjustment value.

`"ROSC:ADJ:VAL 1400"`
'sets the adjustment value to 1400.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]ROSCillator:SOURce INTernal | EXTernal

The command selects between internal and external reference frequency.

Parameters:

INTernal
The internal reference oscillator is used.

EXTernal
An external reference signal is used. It must be input at the REF IN connector at the rear of the instrument. The instrument is informed of the frequency of the external reference signal by means of the command `SOURce:ROSCillator:EXTernal:FREQuency`.

Example: `"ROSC:SOUR EXT"`
'selects the external source.

`"ROSC:EXT:FREQ 5 MHz"`
'informs the instrument that the external reference has a frequency of 5 MHz.

*RST value	Resolution	SCPI
-	-	Device-specific

SOURce:SWEep Subsystem

This subsystem contains the commands for checking the RF sweeps, i.e. the sweeps of the RF generators. Sweeps are always triggered, except for the `MANual` sweep mode. The frequency sweep is activated by the command `SOURce:FREQuency:MODE SWEep`, and the level sweep by the command `SOURce:POWer:MODE SWEep`. All sweeps, including the LF sweep, can be set independently of each other.

For one-path instruments, the keyword SOURce is optional and can be omitted.

A sweep is set in several steps which are shown below taking a frequency sweep as an example:

1. Set the sweep range.
   `[SOURce:]FREQuency:CENTer 200 MHz`
   `[SOURce:]FREQuency:SPAN 300 MHz`

2. Select linear or logarithmic spacing.
   `[SOURce:]SWEep[:FREQuency]:SPACing LIN`

3. Set the step width and dwell time.
   `[SOURce:]SWEep[:FREQuency]:STEP:LINear 20 MHz`
   `[SOURce:]SWEep[:FREQuency]:DWELl 12 ms`

4. Select the trigger mode.
   `TRIGger:FSWeep:SOURce SINGle`

5. Select the sweep mode and activate the sweep.
   `[SOURce:]SWEep[:FREQuency]:MODE AUTO`
   `[SOURce:]FREQuency:MODE  SWEep`

6. Trigger the sweep.
   `[SOURce:]SWEep[:FREQuency]:EXECute`

Command	Parameters	Default unit	Remark
[SOURce:]SWEep[:FREQuency]:DWELl	2 ms ... 10 s	s	
[SOURce:]SWEep[:FREQuency]:EXECute	-		
[SOURce:]SWEep[:FREQuency]:MODE	AUTO | MANual | STEP		
[SOURce:]SWEep[:FREQuency]:POINts	<numeric_value>		
[SOURce:]SWEep[:FREQuency]:SHAPe	SAWTooth |TRIangle		
[SOURce:]SWEep[:FREQuency]:SPACing	LINear | LOGarithmic		
[SOURce:]SWEep[:FREQuency]:STEP[:LINear]	0 ... (STOP - STARt)	Hz	
[SOURce:]SWEep[:FREQuency]:STEP:LOGarithmic	0.01 ... 9999 PCT		
[SOURce:]SWEep:POWer:AMODe	NORMal | HPOWer		
[SOURce:]SWEep:POWer:DWELl	2 ms...10 s	s	
[SOURce:]SWEep:POWer:EXECute	-		
[SOURce:]SWEep:POWer:MODE	AUTO | MANual | STEP		
[SOURce:]SWEep:POWer:POINts	<numeric_value>		
[SOURce:]SWEep:POWer:SHAPe	SAWTooth |TRIangle		
[SOURce:]SWEep:POWer:SPACing:MODE			Query only
[SOURce:]SWEep:POWer:STEP:[:LOGarithmic]	0.1 ...20 dB		
[SOURce:]SWEep:RESet[:ALL]			No query

[SOURce:]SWEep[:FREQuency]:DWELl 3 ms...10 s

The command sets the time taken for each frequency step of the sweep.

The keyword `[:FREQuency]` can be omitted (see example). The command is then SCPI-compliant.

Example: `"SWE:DWEL 12 ms"`
'sets a dwell time of 12 ms for a frequency sweep at the RF output.

*RST value	Resolution	SCPI
10 ms	0.1 ms	Device-specific

[SOURce:]SWEep[:FREQuency]:EXECute

The command triggers a sweep.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"SWE:FREQ:EXEC"`
'triggers a frequency sweep at the RF output.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]SWEep[:FREQuency]:MODE AUTO | MANual | STEP

The command sets the sweep mode.

The keyword `[:FREQuency]` can be omitted (see example). The command is then SCPI-compliant.

Parameters:

AUTO
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each frequency step of the sweep is triggered individually, either by varying the **Current Frequency** value using the rotary knob under manual control or by means of a `FREQ:MAN` command under remote control. With manual control, the frequency increases or decreases (depending on the direction of the rotary encoder) by the value specified under `FREQ:STEP:INCRement`. With remote control, the frequency is set directly with the command `:FREQ:MAN`.

STEP
Each tcrigger triggers one sweep step only (**Mode Single Step**). The frequency increases by the value entered under `SOUR:SWE:FREQ:STEP:LIN` (linear spacing) or `...:STEP:LOG` (logarithmic spacing).

Example: `"SWE:MODE AUTO"`
'selects **Mode Auto** for a frequency sweep at the RF output.

*RST value	Resolution	SCPI
AUTO	-	Device-specific

[SOURce:]SWEep[:FREQuency]:POINts <numeric_value>

The command sets the number of steps in an RF sweep. The command is linked to the command `:SWEep[:FREQuency]:STEP` as follows:

The following applies for linear sweeps: `POINts = (SPAN / STEP:LIN) + 1`

The following applies for logarithmic sweeps and `STARt < STOP`:
`POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Two separate POINts values are used for linear or logarithmic sweep spacing (`:SWEep[:FREQuency]:SPACing LIN | LOG`). The command is always effective for the currently set sweep spacing.

Example: `"FREQ:STAR"`
'sets the start frequency to 100 MHz.

`"FREQ:STOP"`
'sets the stop frequency to 500 MHz.

`"SWE:SPAC LIN"`
'sets linear sweep spacing.

`"SWE:POIN 401"`
'sets 401 sweep steps for linear sweep spacing. The sweep step width (`STEP`) is automatically set to 1 MHz.

*RST value	Resolution	Correlation	SCPI
	-	The value of `:SWE:STEP` is adjusted automatically.	Device-specific (adapted to instrument properties)

[SOURce:]SWEep[:FREQuency]:SHAPe SAWTooth | TRIangle

The command sets the cycle mode for a sweep sequence (shape).

Parameters: **SAWTooth**
One sweep runs from start to stop frequency. Each subsequent sweep starts at the start frequency, i.e. the shape of the sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop frequency and back, i.e. the shape of the sweep resembles a triangle. Each subsequent sweep starts at the start frequency.

Example: `SOUR:SWE:SHAP TRI`
'selects the sweep cycle with alternating ascending and descending sweep directions.

*RST value	Resolution	Options	SCPI
SAWTooth	-		Device-specific

[SOURce:]SWEep[:FREQuency]:SPACing LINear | LOGarithmic

The command selects linear or logarithmic sweep spacing.

The keyword `[:FREQuency]` can be omitted (see example). The command is then SCPI-compliant.

Example: `"SWE:SPAC LIN"`
'selects linear sweep spacing for a frequency sweep at the RF output.

*RST value	Resolution	SCPI
LIN	-	Device-specific

[SOURce:]SWEep[:FREQuency]:STEP[:LINear] 0 ... (STOP - STARt)

The command sets the step width for linear sweeps.

This command is linked to the command `:SWEep[:FREQuency]:POINts` as follows:

`POINts = (SPAN / STEP:LIN) + 1`

If `STEP:LIN` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

The keywords `[:FREQuency]` and `[:LINear]` can be omitted (see example). The command is then SCPI-compliant.

Example: `"FREQ:STAR"`
'sets the start frequency to 100 MHz.

`"FREQ:STOP"`
'sets the stop frequency to 500 MHz.

`"SWE:SPAC LIN"`
'sets linear sweep spacing.

`"SWE:STEP 2 MHz"`
'sets the step width for linear sweep spacing to 2 MHz (RF sweep at the RF output. The number of sweep steps for linear sweep spacing (`POINts`) is automatically set to 201.

*RST value	Resolution	Correlation	SCPI
1 MHz	0.1 Hz.	The value of `:SWE:POINts` is adjusted automatically.	Device-specific

[SOURce:]SWEep[:FREQuency]:STEP:LOGarithmic 0.01 ... 9999 PCT

The command specifies the step width factor for logarithmic sweeps. The next frequency value of a sweep is calculated (for `STARt` < `STOP`) using the following formula:

New frequency = Old frequency + `STEP:LOG` x Old frequency

`STEP:LOG` therefore gives the fraction of the old frequency. The frequency is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in percent, whereby the suffix `PCT` must always be used.

The command is linked to the command `:SWEep[:FREQuency]:POINts` for `STARt` < `STOP` as follows:

`POINts = ((log STOP - log STARt) / log STEP:LOG) + 1`

If `STEP:LOG` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

Example: "FREQ:STAR"
'sets the start frequency to 100 MHz.

"FREQ:STOP"
'sets the stop frequency to 500 MHz.

"SWE:SPAC LOG"
'sets logarithmic sweep spacing.

"SWE:STEP:LOG 10PCT"
'sets the step width for logarithmic sweep spacing to 10% of the previous frequency in each instance (for a frequency sweep at the RF output.

*RST value	Resolution	Correlation	SCPI
1 PCT	0.01 PCT	The value of `:SWE:POIN` is adjusted automatically.	Device-specific

[SOURce:]SWEep:POWer:DWELl 2 ms...10 s

The command sets the time taken for each level step of the sweep.

Example: "SWE:POW:DWEL 12 ms"
'sets a dwell time of 12 ms for a level sweep at the RF output.

*RST value	Resolution	SCPI
10 ms	0.1 ms	Device-specific

[SOURce:]SWEep:POWer:EXECute

The command triggers a sweep.

The command triggers an event and therefore has no query form and no *RST value.

Example: "SWE:POW:EXEC"
'triggers a level sweep at the RF output.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]SWEep:POWer:MODE AUTO | MANual | STEP

The command sets the cycle mode of the level sweep.

Parameters: **AUTO**
Each trigger triggers exactly one complete sweep.

MANual
The trigger system is not active. Each level step of the sweep is triggered individually, either by varying the **Current Level** value using the rotary knob under manual control or by means of a `POW:MAN` command under remote control. With manual control, the level increases or decreases (depending on the direction of the rotary encoder) by the value specified under `POW:STEP:INCRement`. With remote control, the level is set directly with the command `POW:MAN`.

STEP
Each trigger triggers one sweep step only. The level increases by the value entered under `:SWEep:POWer:STEP:LOGarithmic`.

Example: `"SWE:POW:MODE AUTO"`
'selects **Mode Auto** for a level sweep at RF output.

*RST value	Resolution	SCPI
AUTO	-	Device-specific

[SOURce:]SWEep:POWer:POINts <numeric_value>

The command sets the number of steps in a level sweep. The command is linked to the command `:SWEep:POWer:STEP` as follows:

`POINts = ((STOP - STARt) / STEP:LOG) + 1`

If `POINTs` changes, the value of `STEP` is adjusted. The `STARt` and `STOP` value is retained.

Example: `"POW:STAR - 30 dBm"`
'sets the start frequency to -30 dBm.

`"POW:STOP - 10 dBm"`
'sets the stop frequency to -10 dBm.

`"SWE:POW:POIN 20"`
'sets 20 sweep steps. The sweep step width (`STEP`) is automatically set to 1 dB.

*RST value	Resolution	Correlation	SCPI
20 dB	-	The value of `:SWE:POW:STEP` is adjusted automatically.	Device-specific (adapted to instrument properties)

[SOURce:]SWEep:POWer:SHAPe SAWTooth | TRIangle

The command sets the cycle mode for a sweep sequence (shape).

Parameters: **SAWTooth**
One sweep runs from the start level to the stop level. The subsequent sweep starts at the start level again, i.e. the shape of sweep sequence resembles a sawtooth.

TRIangle
One sweep runs from start to stop level and back, i.e. the shape of the sweep resembles a triangle.Each subsequent sweep starts at the start level again.

Example: `SOUR:SWE:POW:SHAP TRI`
'selects the sweep cycle with alternating ascending and descending sweep directions.

*RST value	Resolution	Options	SCPI
SAWTooth	-		Device-specific

[SOURce:]SWEep:POWer:SPACing:MODE?

The command queries the sweep spacing. The sweep spacing for level sweeps is always linear.

This command is a query command and has no *RST value.

Example: `"SWE:POW:SPAC:MODE?"`
'queries the sweep spacing for a level sweep at RF output.

Result: `"LIN"`
'linear spacing.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]SWEep:POWer:STEP[:LOGarithmic] 0.01 ... 165 dB

The command sets the step width factor for logarithmic sweeps. The next level value of a sweep is calculated (for `STARt` < `STOP`) using the following formula:

New level = Old level + `STEP:LOG` x Old level

`STEP:LOG` therefore gives the fraction of the old level. The level is increased by this fraction for the next sweep step. Usually `STEP:LOG` is given in decibels, whereby the suffix dB must always be used.

The command is linked to the command `:SWEep:POWer:POINts` for `STARt` < `STOP` as follows:

`POINts = ((STOP - STARt) / STEP:LOG) + 1`

If `STEP:LOG` changes, the value of `POINTs` is adjusted. The `STARt` and `STOP` value is retained.

Example: `"SWE:POW:STEP 10dB"`
'sets the step width for logarithmic sweep spacing to 10 dB of the previous level in each instance (for a level sweep at RF output).

*RST value	Resolution	SCPI
1 dB	0.01 dB	Device-specific

[SOURce:]SWEep:RESet[:ALL]

The command resets all active sweeps to the starting point.

The command triggers an event and therefore has no reset value.

Example: `"SWE:RES"`
'resets all active sweeps to the starting point.

*RST value	Resolution	SCPI
-	-	Device-specific

SOURce:INPut Subsystem

The SOURce:INPut subsystem contains the commands for configuring the inputs for trigger, data and control signals.

A common trigger threshold and input impedance is effective for all trigger and control signal inputs. The settings influence the digital modulations, the generation of waveforms or multicarrier signals, and all digital standards. Irrespective of this, a common threshold and input impedance is effective for the serial and parallel data input. These data sources are available for digital modulation (**Custom Digital Modulation**).

The instrument trigger setting influences all sweeps and is effective in the List mode (Instrument Trigger).

Command	Parameters	Default unit	Remark
[SOURce:]INPut:CLOCk:IMPedance	G50 | G1K		
[SOURce:]INPut:TRIGger:BBANd:SLOPe	POSitive | NEGative		
[SOURce:]INPut:TRIGger:IMPedance	G50 | G1K		
[SOURce:]INPut:TRIGger:LEVel	0 ... 2 V		
[SOURce:]INPut:TRIGger:SLOPe	POSitive | NEGative		

[SOURce:]INPut:CLOCk:IMPedance G1K | G50

Selects the input impedance for the clock inputs. 1kOhm/GND should be selected for high clock rates.

The setting affects the CLOCK IN BNC connector at the rear of the instrument.

Parameters: **G1K**
1 kOhm to ground

G50
50 Ohm to ground

Example: `"INP:CLOC:IMP G1K"`
'sets the clock inputs to 1 kOhm to ground. This setting is recommended in the case of high clock rates.

*RST value	Resolution	SCPI
G1K	-	Device-specific

[SOURce:]INPut:TRIGger:BBANd:SLOPe POSitive | NEGative

The command sets the active slope of an externally applied trigger signal at the **TRIGGER** 1 | 2 connectors. The setting is effective for both connectors at the same time.

Example: `"INP:TRIG:BBAN:SLOP NEG"`
'the active slope of the external trigger signal at the TRIGGER 1 and 2 connector is the falling slope.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

[SOURce:]INPut:TRIGger:IMPedance G1K | G50

The command sets the impedance of the trigger and control signal inputs.

The setting affects the TRIGGER 1 and CLOCK inputs (BNC connectors at the rear of the instrument.

Parameters: **G1K**
1 kOhm to ground

G50
50 Ohm to ground

Example: `"INP:TRIG:IMP G50"`
'all trigger and control signal inputs are set to 50 ohm to ground. This setting is recommended in the case of high clock rates.

*RST value	Resolution	SCPI
G1K	-	Device-specific

[SOURce:]INPut:TRIGger:LEVel 0...2 V

The command sets the high/low threshold of the trigger and control signal inputs in the baseband section. In the case of positive polarity, this threshold determines the point as of which a signal is high (active) or low (inactive).

The setting affects the TRIGGER 1 and CLOCK inputs (BNC connectors at the front of the instrument.

Example: `"INP:TRIG:LEV 1 V"`
'a high/low threshold of 1 volt is set at all trigger and control signal inputs of the baseband section. In the case of positive polarity, the signal is high (active) for a signal voltage of 1 volt and higher.

*RST value	Resolution	SCPI
1 V	-	Device-specific

[SOURce:]INPut:TRIGger:SLOPe POSitive | NEGative

Sets the polarity of the active slope of an applied instrument trigger.

This setting affects the INST TRIG input (BNC connector at the rear of the instrument).

Example: `"INP:TRIG:SLOP NEG"`
'the active slope of the external trigger signal at the INST TRIG input is the falling slope.

*RST value	Resolution	SCPI
POSitive	-	Device-specific

SOURce-IQ Subsystem - I/Q Modulation

This subsystem contains the commands for checking the I/Q modulation.

Command	Parameters	Default unit	Remark
[SOURce:]IQ:CREStfactor	0...30 dB	dB	
[SOURce:]IQ:GAIN	DBM3 | DB0 | DB3 | DB6		
[SOURce:]IQ:IMPairment:IQRatio[:MAGNitude]	-12.0...12.0 PCT	PCT	
[SOURce:]IQ:IMPairment:LEAKage:I	0 ... 50.0 PCT	PCT	
[SOURce:]IQ:IMPairment:LEAKage:Q	0 ... 50.0 PCT	PCT	
[SOURce:]IQ:IMPairment:QUADrature[:ANGLe]	-10.0...10.0 DEG	DEG	
[SOURce:]IQ:IMPairment[:STATe]	ON | OFF		
[SOURce:]IQ:SOURce	ANALog | BASeband		
[SOURce:]IQ:STATe	ON | OFF		
[SOURce:]IQ:SWAP[:STATe]	ON | OFF		
[SOURce:]IQ:WBSTate	ON | OFF		

[SOURce:]IQ:CREStfactor 0...30 dB

This command specifies the crest factor of the external analog signal.

Example: `"IQ:CRES 10"`
'specifies a crest factor of 10 dB for the external analog signal.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce:]IQ:GAIN DBM3 | DB0 | DB3 | DB6

This command specifies the baseband gain for the external analog wideband I/Q signal. Thus, the modulation of the I/Q modulator can be optimized for any measurement requirement. The gain settings for an internal or external baseband signal are performed with command `:SOURce:BB:IQGain`.

Parameters: **DB0**
Activates 0 dB gain (standard settings).

Example: `"IQ:SOUR ANAL"`
'selects an external analog signal as the input signal for the I/Q modulator. The signal must be applied at the inputs **I** and **Q**.

`"IQ:GAIN DB0"`
'sets gain 0 dB (standard).

*RST value	Resolution	SCPI
External Wideband: 3 dB	0.01 dB	Device-specific

[SOURce:]IQ:IMPairement:IQRatio[:MAGNitude] -12 ... +12 PCT

This command sets the ratio of I modulation to Q modulation (amplification “imbalance”).

Example: `"IQ:IMP:IQR 3 PCT"`
'sets the imbalance to 3 percent.

*RST value	Resolution	SCPI
0 PCT	0.05 PCT	Device-specific

[SOURce:]IQ:IMPairment:LEAKage:I 0 ... 50 PCT

This command sets the carrier offset for the I-channel of the I/Q modulation.

Example: `"IQ:IMP:LEAK:I 3 PCT"`
'sets the leakage for the I-channel to 3 percent.

*RST value	Resolution	SCPI
0 PCT	0.05 PCT	Device-specific

[SOURce:]IQ:IMPairment:LEAKage:Q 0 ... 50 PCT

This command sets the carrier leakage amplitude for the Q-channel of the I/Q modulation.

Example: `"IQ:IMP:LEAK:Q 3 PCT"`
'sets the leakage for the Q-channel to 3 percent.

*RST value	Resolution	SCPI
0 PCT	0.05 PCT	Device-specific

[SOURce:]IQ:IMPairment:QUADrature[:ANGLe] -10.0 ... 10.0 DEG

This command sets the quadrature offset for the I/Q modulation.

Example: `"IQ:IMP:QUAD:ANGL -5DEG"`
'sets the quadrature offset to -5 degrees.

*RST value	Resolution	SCPI
0 DEG	0.02 DEG	Device-specific

[SOURce:]IQ:IMPairment[:STATe] ON | OFF

The command activates (ON) and deactivates (OFF) the three impairment or correction values LEAKage, QUADrature and IQRatio for the analog signal in the I/Q modulator.

Example: `"IQ:IMP OFF"`
'deactivates I/Q impairment.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce:]IQ:SOURce ANALog | BASeband

This command selects the input signal for the I/Q modulator.

Example: "IQ:SOUR ANAL"
'selects an external analog signal as the input signal. The signal must be applied at the inputs **I** and **Q**.

*RST value	Resolution	Dependencies	SCPI
BASeband		Selecting ANALog (Wideband I/Q In) switches off: SOURce:AM:STATe OFF SOURce:BBAM:STATe OFF SOURce:BB:DM:STATe OFF SOURce:BB:<standard>:STATe OFF	Device-specific

[SOURce:]IQ:STATe ON | OFF

This command activates and deactivates I/Q modulation.

Example: "IQ:STAT ON"
'activates I/Q modulation.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce:]IQ:SWAP[:STATe] ON | OFF

When set to ON, this command swaps the I and Q channel.

Example: "IQ:SWAP ON"
'swaps the I and Q channel.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce:]IQ:WBSTate ON | OFF

This command selects optimized setting for wideband modulation signals (>5 MHz) (State ON).

Example: "IQ:WBST ON"
'activates optimized setting for wideband signals.

*RST value	Resolution	SCPI
OFF	-	Device-specific

SOURce-IQ-OUTPut Subsystem

This subsystem contains the commands for configuring the differential output.

For one-path instruments, the key word SOURce is optional and can be omitted.

Command	Parameters	Default unit	Remark
[SOURce:]IQ:OUTPut:BIAS:OPTimization[:RF]:STATe	ON | OFF		
[SOURce:]IQ:OUTPut:BIAS:Q	-2.50 .. 2.50V	V	
[SOURce:]IQ:OUTPut:LEVel	<numeric value>	V	Query only
[SOURce:]IQ:OUTPut:MODE	FIXed | VARiable		
[SOURce:]IQ:OUTPut:TYPE	SINGle | DIFFerential		
[SOURce:]IQ:OUTPut[:ANALog]:POWer:PEP:RESult	<numeric value>	V	Query only

[SOURce:]IQ:OUTPut:BIAS:OPTimization[:RF]:STATe ON | OFF

This command activates/deactivates optimization of level accuracy and imbalance for RF Output. Level accuracy and imbalance can be either optimized for RF output (active) or for differential outputs (not active).

Example: `"IQ:OUTP:BIAS:OPT:STAT ON"`
'activates optimization for RF output.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce:]IQ:OUTPut:LEVel <numeric value>

This command sets the off-load voltage.

The value range differs for the two output types.

Differential output: Value range: ± 3,0 Volt.

Single Ended: Value range: ± 1,5 Volt.

Example: `"IQ:OUTP:LEV 2 V"`
'sets a off-load level of 2 V.

*RST value	Resolution	SCPI
1 V	0.001 V	Device-specific

[SOURce:]IQ:OUTPut:LEVel:RESult <numeric value>

Displays the resulting output off-load voltage of both signal components at the rear panel.

Example: `"IQ:OUTP:LEV:RES?"`
'queries the resulting off-load power.

*RST value	Resolution	SCPI
0.000	0.001 V	Device-specific

[SOURce:]IQ:OUTPut:MODE FIXed | VARiable

This command selects the mode for setting the outputs.

Parameter: **FIXed**
The settings are fixed and cannot be changed.
(`IQ:OUTPut:BIAS:I|Q` = 0V, `IQ:OUTPut:OFFSet:I|Q` = 0V and `IQ:OUTPut:LEVel` = 2V (`TYPE DIFFerential`) or 1V (`TYPE SINGle`).

VARiable
The settings can be changed.

Example: `"IQ:OUTP:MODE FIX"`
'the predefined settings are used.

*RST value	Resolution	Dependencies	SCPI
FIXed	-	Selection FIXed locks all `IQ:OUTPut`-commands except for `IQ:OUTPut:TYPE` and sets them to predefined values (see above).	Device-specific

[SOURce:]IQ:OUTPut:TYPE SINGle | DIFFerential

This command selects the output type.

Parameter: **DIFFerential**
The I/Q-signal components are output differential. A bias can be defined.

Single Ended
The I/Q-signal components are output single-ended.

Example: `"IQ:OUTP:TYPE DIFF"`
'the I/Q-signal components are output differential.

*RST value	Resolution	SCPI
SINGle		Device-specific

STATus Subsystem

This system contains the commands for the status reporting system. *RST has no effect on the status registers.

Queries return the current value of the respective register, which permits a check of the device status. A decimal value between 0 and 32767 (=2^{15}-1) is returned.

The configuration commands set the respective register thus determining which status changes of the R&S Vector Signal Generator causes the status registers to be changed. A decimal value between 0 and 32767 (= 2^15-1) is set.

Command	Parameters	Default unit	Remark
STATus:OPERation:CONDition?			Query only
STATus:OPERation:ENABle	0...32767		
STATus:OPERation[:EVENt]?			Query only
STATus:OPERation:NTRansition	0...32767		
STATus:OPERation:PTRansition	0...32767		
STATus:PRESet			No query
STATus:QUEStionable:CONDition?			Query only
STATus:QUEStionable:ENABle	0...32767		
STATus:QUEStionable[:EVENt]?			Query only
STATus:QUEStionable:NTRansition	0...32767		
STATus:QUEStionable:PTRansition	0...32767		
STATus:QUEue[:NEXT]?			Query only

STATus:OPERation:CONDition?

The command queries the content of the CONDition part of the STATus:OPERation register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Example: `"STAT:OPER:COND?"`
'queries the Status:Operation:Condition register.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:OPERation:ENABle

The command sets the bits of the ENABle part of the STATus:OPERation register. This setting determines which events of the Status-Event part are forwarded to the sum bit in the status byte. These events can be used for a service request.

Example: `"STAT:OPER:ENAB 32767"`
'all events are forwarded to the sum bit of the status byte.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:OPERation:EVENt?

The command queries the content of the EVENt part of the STATus:OPERation register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Example: `"STAT:OPER:EVEN?"`
'queries the STATus:OPERation:EVENt register.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:OPERation:PTRansition

The command sets the bits of the PTRansition part of the STATus:OPERation register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENt part of the register. A new event in the hardware is thus registered, e.g. the start of an adjustment.

Example: `"STAT:OPER:PTR 32767"`
'all transitions from 0 to 1 in the condition part of the Status:Operation register cause an entry to be made in the EVENt part.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:OPERation:NTRansition

The command sets the bits of the NTRansition part of the STATus:OPERation register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register. The disappearance of an event in the hardware is thus registered, e.g. the end of an adjustment.

Example: `"STAT:OPER:NTR 0"`
'a transition from 1 to 0 in the condition part of the Status:Operation register does not cause an entry to be made in the EVENt part.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:PRESet

The command resets the status registers. All PTRansition parts are set to FFFFh (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 in a CONDition bit is not detected. The ENABle parts of STATus:OPERation and STATus:QUEStionable are set to 0, i.e. all events in these registers are not passed on.

The command triggers an event and therefore has no query form and no *RST value.

Example: `"STAT:PRES"`
'resets the status registers.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:QUEStionable:EVENt?

The command queries the content of the EVENt part of the STATus:QUEStionable register. This part contains information on the actions performed in the instrument since the last readout. The content of the EVENt part is deleted after being read out.

Example: `"STAT:OPER:EVEN?"`
'queries the Status:Questionable:Event register.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:QUEStionable:CONDition?

The command queries the content of the CONDition part of the STATus:QUEStionable register. This part contains information on the action currently being performed in the instrument. The content is not deleted after being read out since it indicates the current hardware status.

Example: `"STAT:OPER:COND?"`
'queries the Status:Questionable:Condition register.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:QUEStionable:PTRansition

The command sets the bits of the PTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 0 to 1 in the condition part causes an entry to be made in the EVENt part of the register.

Example: `"STAT:OPER:PTR 32767"`
'all transitions from 0 to 1 in the condition part of the Status:Questionable register cause an entry to be made in the EVENt part.

*RST value	Resolution	Options	SCPI
-	-		Compliant

STATus:QUEStionable:NTRansition

The command sets the bits of the NTRansition part of the STATus:QUEStionable register. If a bit is set, a transition from 1 to 0 in the condition part causes an entry to be made in the EVENt part of the register.

Example: `"STAT:OPER:NTR 0"`
'a transition from 1 to 0 in the condition part of the Status:Questionable register does not cause an entry to be made in the EVENt part.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:QUEStionable:ENABle

The command sets the bits of the ENABle part of the STATus:QUEStionable register. This setting determines which events of the Status-Event part are enabled for the sum bit in the status byte. These events can be used for a service request.

Example: `"STAT:OPER:ENAB 1"`
'problems when performing an adjustment cause an entry to be made in the sum bit.

*RST value	Resolution	SCPI
-	-	Compliant

STATus:QUEue[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI(see Chapter 9). If the error queue is empty, 0 ("No error") is returned. The command is identical to `SYSTem:ERRor?`.

Example: `"STAT:QUE?"`
'queries the oldest entry in the error queue.

Response: "0, 'no error'"
'no errors have occurred since the error queue was last read out.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem Subsystem

The SYSTem subsystem contains a series of commands for general functions which do not directly affect signal generation.

Command	**Parameters**	**Default unit**	**Remark**
SYSTem:BEEPer:STATe	ON | OFF		
SYSTem:COMMunicate:GPIB:LTERminator	EOI | STANdard		
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0...30		
SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname	‘string’		
SYSTem:COMMunicate:NETWork:COMMon:SET			No query
SYSTem:COMMunicate:NETWork:DNS:ALTernate	0.0.0.0 .. ff.ff.ff.ff		
SYSTem:COMMunicate:NETWork:DNS:MODE	STATic | AUTO		
SYSTem:COMMunicate:NETWork:DNS:PREFerred	0.0.0.0 .. ff.ff.ff.ff		
SYSTem:COMMunicate:NETWork:DNS:SET			No query
SYSTem:COMMunicate:NETWork:GET			No query
SYSTem:COMMunicate:NETWork:IPADdress	0.0.0.0 .. ff.ff.ff.ff		
SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway	‘string’		
SYSTem:COMMunicate:NETWork:IPADdress:MODE	STATic | P2P | AUTO		
SYSTem:COMMunicate:NETWork:IPADdress:SET			No query
SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK	0.0.0.0 .. ff.ff.ff.ff		
SYSTem:COMMunicate:NETWork:MACaddress			Query only
SYSTem:COMMunicate:NETWork:RESource	‘string’		
SYSTem:COMMunicate:USB:RESource			Query only
SYSTem:DATE	<year>,<month>,<day>		
SYSTem:DISPlay:UPDate	ON | OFF		
SYSTem:ERRor:ALL			Query only
SYSTem:ERRor:CODE:ALL			Query only
SYSTem:ERRor:CODE[:NEXT]?			Query only
SYSTem:ERRor:COUNt?			Query only
SYSTem:ERRor[:NEXT]?			Query only
SYSTem:IDENtification	USER |RSSML |ORIGinal		
SYSTem:IRESponse	<string>		
SYSTem:FPReset	See 'Preset Commands'		No query
SYSTem:KLOCk	ON | OFF		
SYSTem:LANGuage			Query only
SYSTem:PRESet			No query
SYSTem:PROTect<n>[:STATe]	ON | OFF , password		
SYSTem:SECurity[:STATe]	ON | OFF		
SYSTem:SERRor?			Query only
SYSTem:STARtup:COMPlete			Query only
SYSTem:TIME	<hour>,<minute>,<second>		
SYSTem:VERSion?			Query only

SYSTem:BEEPer:STATe ON | OFF

The command switches the key beep on or off.

Example: `"SYST:BEEP:STAT OFF"`
'no acoustic signal is output when a key on the front panel is pressed.

*RST value	Resolution	SCPI
OFF	-	Compliant

SYSTem:COMMunicate:GPIB:LTERminator EOI | STANdard

The command sets the terminator recognition for remote control via the IEC/IEEE bus.

Parameters: **EOI**
The terminator must be sent together with the line message EOI (End of Line). This setting is recommended for binary block transmissions where a character could coincidentally have the value LF (Line Feed) but is not intended as the terminator. This setting must be selected for block data with undefined length.

STANdard
An LF (Line Feed) is recognized as the terminator regardless of whether it is sent with or without EOI.

Example: `"SYST:COMM:GPIB:LTER EOI"`
'only a character which is sent simultaneously with the line message EOI is accepted as the terminator.

*RST value	Resolution	SCPI
STANdard	-	Compliant

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 1 ... 30

The command sets the IEC/IEEE-bus address.

Example: `"SYST:COMM:GPIB:ADDR 14"`
'sets IEC/IEEE-bus address 14.

*RST value	Resolution	SCPI
28	-	Compliant

SYSTem:COMMunicate:NETWork[:COMMon]:HOSTname ‘string’

The command enters the individual computer name of the R&S Signal generator. The entry is only activated after sending command `SYST:COMM:NETW:COMM:SET`.

Note:
The hostname can only be changed after deactivating protection level 1 (command `SYSTem:PROTect<n>:STATe OFF`*, password)*

Example: `SYST:COMM:NETW:HOST ‘SMBV’`
'enters the individual computer name of the R&S Signal Generator

`SYST:COMM:NETW:COMM:SET ON`
'activates the change of the hostname.

*RST value	Resolution	Options	SCPI
	-		Device-specific

SYSTem:COMMunicate:NETWork:COMMon:SET

The command activates the hostname setting (Command `SYST:COMM:NETW:COMM:HOST`).

The command triggers an event and therefore has no *RST value and no query form.

Example: `SYST:COMM:NETW:COMM:SET`
'activates a change of the hostname.

*RST value	Resolution	Options	SCPI
-	-		Device-specific

SYSTem:COMMunicate:NETWork:DNS:ALTernate 0.0.0.0 .. ff.ff.ff.ff

The command sets the alternate DNS server address manually.

Example: `SYST:COMM:NETW:DNS:MODE STAT`
' the DNS server address is assigned manually.

`SYST:COMM:NETW:DNS:ALT 7.8.9.10`
'sets the IP address of the alternate DNS server

`SYST:COMM:NETW:COMM:SET ON`
'activates the above settings.

*RST value	Resolution	Options	SCPI
-	-		Device-specific

SYSTem:COMMunicate:NETWork:DNS:MODE STATic | AUTO

The command selects if the DNS server address is assigned automatically or manually. The entry is only activated after sending command `SYST:COMM:NETW:DNS:SET`.

Parameters: **AUTO**
The DNS server address is assigned automatically. The network used must support automatic assignment of address (DHCP) in order to use this function.

STATic
The DNS server address is assigned manually.

Example: `SYST:COMM:NETW:DNS:MODE AUTO`
' the DNS server address is assigned automatically (DHCP).

`SYST:COMM:NETW:COMM:SET ON`
'activates DHCP.

*RST value	Resolution	Options	SCPI
AUTO	-		Device-specific

SYSTem:COMMunicate:NETWork:DNS:PREFerred 0.0.0.0 .. ff.ff.ff.ff

The command sets the preferred DNS server address manually. The entry is only activated after sending command `SYST:COMM:NETW:DNS:SET`.

Example: `SYST:COMM:NETW:DNS:MODE STAT`
' the DNS server address is assigned manually.

`SYST:COMM:NETW:DNS:PREF 7.8.9.10`
'sets the IP address of the preferred DNS server.

`SYST:COMM:NETW:COMM:SET ON`
'activates the above settings.

*RST value	Resolution	Options	SCPI
-	-		Device-specific

SYSTem:COMMunicate:NETWork:DNS:SET

The command activates the DNS setting (Commands `SYST:COMM:NETW:DNS:..`).

The command triggers an event and therefore has no *RST value and no query form.

Example: `SYST:COMM:NETW:DNS:SET`
'activates all changes of the DNS settings.

*RST value	Resolution	Options	SCPI
-	-		Device-specific

SYSTem:COMMunicate:NETWork:GET

The command retrieves the current network settings. They can be queried with the corresponding commands.

The command triggers an event and therefore has no *RST value and no query form.

Example: `SYST:COMM:NETW:GET`
' retrieves the current network settings.

*RST value	Resolution	Options	SCPI
-	-		Device-specific

SYSTem:COMMunicate:NETWork:IPADdress 0.0.0.0 .. ff.ff.ff.ff

The command enters the IP address . The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Example: `SYST:COMM:NETW:IPAD  7.8.9.10`
'enters the IP address of the R&S Signal Generator.

`SYST:COMM:NETW:IPAD:SET`
'activates all changes of the IP address settings.

*RST value	Resolution	Options	SCPI
	-		Device-specific

SYSTem:COMMunicate:NETWork[:IPADdress]:GATeway 0.0.0.0 .. ff.ff.ff.ff

The command enters the IP address of the default gateway. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Example: `SYST:COMM:NETW:GAT 1.2.3.4`
'enters the IP address of the default gateway.

`SYST:COMM:NETW:IPAD:SET`
'activates all changes of the IP address settings.

*RST value	Resolution	Options	SCPI
28	-		Device-specific

SYSTem:COMMunicate:NETWork:IPADdress:MODE STATic | AUTO

The command selects if the IP address is assigned automatically or manually. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Parameters: **AUTO**
The IP address is assigned automatically. The network used must support automatic assignment of address (DHCP) in order to use this function.

STATic
The IP address is assigned manually.

P2P
A Peer to Peer connection is used.

Example: `SYST:COMM:NETW:IPAD:MODE AUTO`
' the IP address is assigned automatically (DHCP).

`SYST:COMM:NETW:IPAD:SET ON`
'activates DHCP.

*RST value	Resolution	Options	SCPI
AUTO	-		Device-specific

SYSTem:COMMunicate:NETWork:IPADdress:SET

The command activates the IP settings (Commands `SYST:COMM:NETW:IPAD:..`).

The command triggers an event and therefore has no *RST value and no query form.

Example: `SYST:COMM:NETW:IPAD:SET`
'activates all changes of the IP adress settings.

*RST value	Resolution	Options	SCPI
-	-		Device-specific

SYSTem:COMMunicate:NETWork[:IPADdress]:SUBNet:MASK 0.0.0.0 .. ff.ff.ff.ff

The command enters the Subnet mask. The entry is only activated after sending command `SYST:COMM:NETW:IPAD:SET`.

Example: `SYST:COMM:NETW:SUBN:MASK 255.255.255.0`
'enters the Subnet mask.

`SYST:COMM:NETW:IPAD:SET`
'activates all changes of the IP address settings.

*RST value	Resolution	Options	SCPI
	-		Device-specific

SYSTem:COMMunicate:MACaddress?

The command queries the MAC address of the network adapter.

The command is a query command and therefore has no *RST value.

Example: `SYST:COMM:NETW:MAC?`
'queries the MAC address.

*RST value	Resolution	Options	SCPI
	-		Device-specific

SYSTem:COMMunicate:NETWork:RESource?

The command queries the visa resource string. This string is used for remote control of the instrument.

The command is a query command and therefore has no *RST value.

Example: `SYST:COMM:NETW:RES?`
'queries the VISA resource string.

Response:
`TCPIP::192.1.2.3::INSTR`

*RST value	Resolution	SCPI
	-	Device-specific

SYSTem:COMMunicate:USB:RESource?

The command queries the visa resource string for remote control via the USB interface. .

The command is a query command and therefore has no *RST value.

Example: `SYST:COMM:USB:RES?`
'queries the VISA resource string for remote control via the USB interface.

Response:
`USB::72::000000::INSTR`

*RST value	Resolution	Options	SCPI
	-		Device-specific

SYSTem:DATE <year>,<month>,<day>

The command sets the date for the instrument-internal calendar.

Example: `"SYST:DATE 2003,05,01"`
'sets May 1, 2003.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:DISPlay:UPDate ON | OFF

The command switches the update of the display on/off. A switchover from remote control to manual control always sets the status of the update of the display to ON.

Example: `"SYST:DISP:UPD OFF"`
'switches update of displayed parameter values off.

*RST value	Resolution	SCPI
-	-	Device-specific

SYSTem:ERRor:ALL?

The command queries all entries in the error queue and then deletes them. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI. If the error queue is empty, 0 ("No error") is returned.

The command is a query command and therefore has no *RST value.

Example: `"SYST:ERR:ALL?"`
'queries all entries in the error queue.

Response: "0, 'no error'"
'no errors have occurred since the error queue was last read out.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:ERRor:CODE:ALL?

The command queries all entries in the error queue and then deletes them. Only the error numbers are returned and not the entire error text. Positive error numbers denote device-specific errors, and 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 is a query command and therefore has no *RST value.

Example: `"SYST:ERR:CODE:ALL?"`
'queries all entries in the error queue.

Response: "0"
'no errors have occurred since the error queue was last read out.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:ERRor:CODE[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Only the error number is returned and not the entire error text. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI (see chapter 9, section "*Error Messages*"). If the error queue is empty, 0 is returned.

The command is a query command and therefore has no *RST value.

Example: `"SYST:ERR:CODE?"`
'queries the oldest entry in the error queue.

Response: "0"
'no errors have occurred since the error queue was last read out.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:ERRor:COUNt?

The command queries the number of entries in the error queue. If the error queue is empty, '0' is returned.

The command is a query command and therefore has no *RST value.

Example: `"SYST:ERR:COUN?"`
'queries the number of entries in the error queue.

Response: "1"
'one error has occurred since the error queue was last read out.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:ERRor[:NEXT]?

The command queries the oldest entry in the error queue and then deletes it. Positive error numbers denote device-specific errors, and negative error numbers denote error messages defined by SCPI (see Chapter 9). If the error queue is empty, 0 ("No error") is returned. The command is identical to the command `STATus:QUEue:NEXT?`.

The command is a query command and therefore has no *RST value.

Example: `"SYST:ERR?"`
'queries the oldest entry in the error queue.

Response: "0, 'no error'"
'no errors have occurred since the error queue was last read out.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:IDENtification USER | RSSML | ORIGinall

The command selects if the instruments identifies itself as R&S SMx or as R&S SML generator when queried with common command *IDN?. A user defined identification string can be defined in addition.

Example: `SYST:IDEN RSSML`
'selects the identification string of the R&S SML

*RST value	Resolution	Options	SCPI
ORIGinal	-	-	-

SYSTem:IRESponse <string>

The command defines the identification string for selection used defined (`SYST:IDEN USER`).

Example: `SYST:IDEN USER`
'selects an user-defined the identification

`SYST:IRES "Test Device"`
'defines the identification string 'test device'

`*IDN?`

Response: 'test device'

*RST value	Resolution	Options	SCPI
''	-	-	-

SYSTem:KLOCk ON | OFF

The command (Keyboard LOCk) disables the front panel keyboard of the R&S Vector Signal Generator including the LOCAL key, or enables it again (OFF).

Example: `"SYST:KLOC ON"`
'activates the keyboard lock. The keyboard cannot be operated again until it has been enabled with `SYST:KLOC OFF`.

*RST value	Resolution	SCPI
OFF	-	Compliant

SYSTem:LANGuage?

The command queries the remote control command set.

The command is a query and therefore has no *RST value.

Example: `SYST:LANG?`

Response `"SCPI"`
'the SCPI command set is used

*RST value	Resolution	Options	SCPI
-	-		Device specific

SYSTem:PRESet

The command triggers an instrument reset. It has the same effect as the PRESET key on the front panel and the *RST command.

The command triggers an event and therefore has no *RST value and no query form.

Example: `"SYST:PRES"`
'all instrument settings (also those that are not currently active) are reset to their default values.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:PROTect<n>[:STATe] ON | OFF, password

The command activates and deactivates the specified protection level. There are several protection levels which disable specific service functions (authorized personnel of R&S Service Departments only). These levels are identified by the suffix under PROTect.

The respective functions are disabled when the protection level is activated. No password is required for activation. A password must be entered to deactivate the protection level. The password for the first level is 123456. This protection level can be used to lock-out internal adjustments.

The command triggers an event and therefore has no *RST value and no query form.

Example: `"SYST:PROT1 ON"`
'activates protection level 1. Internal adjustments are only possible after deactivating the lock-out.

`"SYST:PROT1 OFF, 123456"`
'deactivates protection level 1. Internal adjustments are enabled again.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:SERRor?

This command returns a list of all errors existing at the time when the query is started. This list corresponds to the display on the info page under manual control.

The command is a query command and therefore has no *RST value.

Example: `"SYST:SERR?"`
'queries all errors existing in the error queue.

Response: `"-221, 'Settings conflict', 153, 'Input voltage out of range'"`
'the two returned errors have occurred since the error queue was last queried.

*RST value	Resolution	SCPI
-	-	Device-specific

SYSTem:STARtup:COMPlete?

The command queries if the startup of the instrument is completed.

This command is a query and therefore has no *RST value.

Example: `SYST:STAR:COMP?`

`Response: 1`
'the startup of the instrument is completed.

*RST value	Resolution	Options	SCPI
	-		

SYSTem:TIME 0...23,0...59,0...59

The command sets the time for the instrument-internal clock.

Example: `"SYST:TIME 12,0,0"`
'sets the time to precisely 12 pm.

*RST value	Resolution	SCPI
-	-	Compliant

SYSTem:VERSion?

The command queries the SCPI version with which the instrument complies.

The command is a query command and therefore has no *RST value.

Example: `"SYST:VERS?"`
'queries the SCPI version.

Response: 1996
'the instrument complies with the version from 1996.

*RST value	Resolution	SCPI
-	-	Compliant

TEST Subsystem

The TEST system contains the commands for performing the routines as well as for direct manipulation of the hardware assemblies (`:TEST:DIRect`). The self tests return a "0" if the test is performed successfully, otherwise a value other than "0" is returned. None of the commands of this system have an *RST value.

NOTICE **Improper use could destroy the assembly!**

The respective hardware assembly responds directly to the `:TEST:DIRect` command; any safety mechanisms are bypassed. The command is used for servicing purposes and should not be applied by the user.

Command	Parameters	Default unit	Remark
TEST:ALL	0 if succeeded, 1 if failed		Query only
TEST:CONNector:BNC	-		Query only
TEST:DIRect	'SSYN' | 'IQOP3' | 'IQOP6' | 'SATT3' | 'SATT6' | 'DIRECTLAST', subaddress, hex data string		

TEST:ALL?

This command performs a selftest on all installed hardware options.

Example: `"TEST:ALL?"`

Response: "`0`" on success, "`1`" on fail

*RST value	Resolution	SCPI
-	-	Device-specific

TEST:CONNector:BNC?

The command triggers a test of the BNC connectors of the instrument (see Service Manual Instrument, chapter 1, "Performance Test"). This function is only available via remote control.

Example: "TEST:CONN:BNC?"

*RST value	Resolution	SCPI
-	-	Device-specific

TEST:DIRect "SSYN' | 'IQOP3' | 'IQOP6' | 'SATT3' | 'SATT6' | 'DIRECTLAST', subaddress, hex data string

The respective hardware assembly responds directly to the command; any safety mechanisms are bypassed. This function is only available via remote control.

Example: "TEST:DIR 'SSYN',0,#H12345678"

"TEST:DIR? 'SSYN',0"

Response:
'#H12345678

*RST value	Resolution	SCPI
-	-	Device-specific

TRIGger Subsystem

The TRIGger system contains the commands for selecting the trigger source for the RF and LF sweep.

The trigger input connectors are configured in the SOURce:INPut subsystem.

In addition, the LF output is activated with TRIGger0.
The trigger system of the R&S Vector Signal Generator is a simplified implementation of the SCPI trigger system. The TRIGger system differs from the SCPI system as follows:

– No INITiate command; the instrument behaves as if `INITiate:CONTinuous ON` were set.
– Under TRIGger several sweep subsystems exist.

Other commands associated with the trigger system of the R&S Vector Signal Generator can be found in the modulation and RF signal subsystems.

Command	Parameters	Default unit	Remark
TRIGger0[:SWEep]:SOURce	AUTO | IMMediate | SINGle | BUS | EXTernal		
TRIGger:FSWeep[:IMMediate]			No query
TRIGger:FSWeep:SOURce	AUTO | IMMediate | SINGle | BUS | EXTernal		
TRIGger:LIST[:IMMediate]			No query
TRIGger:PSWeep[:IMMediate]			No query
TRIGger:PSWeep:SOURce	AUTO | IMMediate | SINGle | BUS | EXTernal		
TRIGger[:SWEep][:IMMediate]			No query
TRIGger[:SWEep]:SOURce	AUTO | IMMediate | SINGle | BUS | EXTernal		

TRIGger0[:SWEep]:SOURce AUTO **|** IMMediate **|** SINGle **|** EXTernal|BUS

The command sets the trigger source for the LF sweep. The trigger is triggered by the command `:SOURce:LFOutput:SWEep[:FREQuency]EXECute`.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	**Auto** mode
SINGle	BUS	**Single** mode.
EXTernal	EXTernal	**Ext Single** and **Ext Step** mode. The command LFO:SWEep:MODE is used to select between the two sweep modes.

Parameters: **AUTO | IMMediate**
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle
One complete sweep cycle is triggered by the IEC/IEEE-bus commands `SOURce:LFOutput:SWEep:FREQuency:EXEC` or `*TRG`. The mode has to be set to `AUTO (:SOURce:LFOutput:SWEep:FREQuency:MODE AUTO)`.

EXTernal
The sweep is triggered externally via the INST TRIG connector.

Example: "TRIG0:SOUR EXT"
'selects triggering with an external trigger. The trigger is input via the INST TRIG connector.

*RST value	Resolution	SCPI
SINGle	-	Device-specific

TRIGger:FSWeep[:IMMediate]

The command immediately starts an RF frequency sweep. The sweep to be executed depends on the respective MODE setting (`SOURce:SWEep:FREQuency:MODE SING`). The command corresponds to the manual-control command **Execute Trigger**.

This command triggers an event and therefore has no *RST value.

Example: "SWE:FREQ:MODE SING"
'sets the Single trigger mode, i.e. a trigger starts a single sweep.
"TRIG:FSW"
'starts a single RF frequency sweep.

*RST value	Resolution	SCPI
-	-	Device-specific

TRIGger:FSWeep:SOURce AUTO|IMMediate | SINGle | EXTernal|BUS

The command sets the trigger source for the RF frequency sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	**Auto** mode
SINGle	BUS	**Single** mode.
EXTernal	EXTernal	**Ext Single** and **Ext Step** mode. The command :SWEep:FREQ:MODE is used to select between the two sweep modes.

Parameters:

AUTO | IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle
One complete sweep cycle is triggered by the IEC/IEEE-bus commands `SOURce:SWEep:FREQuency:EXEC` or `*TRG`. The mode has to be set to `AUTO (:SOURce:SWEep:FREQuency:MODE AUTO)`.

EXTernal

Example: "TRIG:FSW:SOUR EXT"
'selects triggering with an external trigger. The trigger is input via the TRIGGER 1 connector.

*RST value	Resolution	SCPI
SINGle	-	Device-specific

TRIGger:LIST[:IMMediate]

The command immediately starts the processing of a list in LIST mode. It corresponds to the manual-control command **Execute Trigger.**

This command triggers an event and therefore has no *RST value.

Example: `"SOUR:LIST "LIST1"`
'selects the list.

`"SOUR:LIST:DWEL 5 ms"`
'sets the dwell time to 5 ms.

`"TRIG:LIST"`
'starts processing of the selected list.

*RST value	Resolution	SCPI
-	-	Device-specific

TRIGger:PSWeep[:IMMediate]

The command immediately starts an RF level sweep. The sweep to be executed depends on the set sweep mode (`:SOURce:SWEep:POWer:MODE`). The command corresponds to the manual-control command **Execute Trigger**.

This command triggers an event and therefore has no *RST value.

Example: `"SWE:POW:MODE STEP"`
'sets the STEP trigger mode, i.e. a trigger starts the sweep initially, and then the sweep is generated continuously.

`"TRIG:PSW"`
'starts the continuous generation of the RF level sweep at output A.

*RST value	Resolution	SCPI
-	-	Device-specific

TRIGger:PSWeep:SOURce AUTO|IMMediate | SINGle | EXTernal|BUS

The command sets the trigger source for the RF level sweep.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration. An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	**Auto** mode
SINGle	BUS	**Single** mode.
EXTernal	EXTernal	**Ext Single** and **Ext Step** mode. The command :SWEep:POW:MODE is used to select between the two sweep modes.

Parameters: **AUTO | IMMediate**
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle
One complete sweep cycle is triggered by the IEC/IEEE-bus commands `SOURce:SWEep:LEVel:EXEC` or `*TRG`. The mode has to be set to `AUTO` (`:SOURce:SWEep:LEVel:MODE AUTO`).

EXTernal

Example: `"TRIG:PSW:SOUR EXT"`
'selects triggering with an external trigger. The trigger is input via the INST TRIG connector.

*RST value	Resolution	SCPI
SINGle	-	Device-specific

TRIGger[:SWEep][:IMMediate]

The command starts all sweeps which are activated for the respective path. The command starts all sweeps which are activated.

The sweep to be executed depends on the respective MODE setting (`:SOUR:SWEep:POW|FREQ:MODE` and `:SOUR:LFO:SWEep[:FREQ]:MODE`).

The command corresponds to the manual-control command **Execute Trigger**.

This command triggers an event and therefore has no *RST value.

Example: `"TRIG"`
'starts all active sweeps.

*RST value	Resolution	SCPI
-	-	Device-specific

TRIGger:SWEep:SOURce AUTO|IMMediate | SINGle | EXTernal|BUS

The command sets the trigger source for all sweeps.

The names of the parameters correspond directly to the various settings under manual control. SCPI uses other names for the parameters; these names are also accepted by the instrument. The SCPI names should be used if compatibility is an important consideration.

An overview of the various names is given in the following table:

R&S name	SCPI name	Command under manual control
AUTO	IMMediate	MODE AUTO
SINGle	BUS	MODE SINGLE
EXTernal	EXTernal	MODE EXT TRIG SINGLE or EXT TRIG STEP

Parameters:

AUTO | IMMediate
The trigger is free-running, i.e. the trigger condition is fulfilled continuously. As soon as one sweep is finished, the next sweep is started.

SINGle
One complete sweep cycle is triggered by the IEC/IEEE-bus commands `SOURce:SWEep:POWer|FREQuency:EXEC` or `*TRG`. The mode has to be set to `AUTO (:SOURce:SWEep:POWer|FREQuency:MODE AUTO)`.

EXTernal
The sweep is triggered externally via the TRIGGER connectors.

Example:

`"TRIG:SWE:SOUR EXT"`
'selects triggering with an external trigger. The trigger is input via the TRIGGER 1 connector.

*RST value	Resolution	SCPI
SINGle	-	Device-specific

UNIT Subsystem

The UNIT subsystem contains the commands specifying which units are valid if no unit is indicated in a command. These settings are valid for the entire instrument.

Command	Parameters	Default unit	Remark
UNIT:ANGLe	DEG | RAD		
UNIT:POWer	V | DBM		

UNIT:ANGle DEG | RAD

The command defines the default unit for angles. It is valid for all commands which determine angle values. It does not influence the manual control parameter unit and the display.

Example: `"UNIT:ANGL DEG"`
'sets default unit DEG for all commands which determine angle values.

*RST value	Resolution	SCPI
RAD	-	Compliant

UNIT:POWer V | DBM

The command defines the default unit for power. It is valid for all commands which determine power values. It does not influence the manual control parameter unit and the display.

Example: `"UNIT:POW V"`
'sets default unit V for all commands which determine power values.

*RST value	Resolution	Options	SCPI
DBM	-		Compliant

Contents Chapter 8 - Maintenance and Interfaces

8 Maintenance and Remote Control Interfaces

Introduction - Maintenance and Interfaces

The following chapter contains information on the maintenance of the signal generator and a description of the remote control interfaces.
Please follow the instructions in the service manual when exchanging modules or ordering spares. The order no. for spare parts can be found in the service manual.
The address of our support center and a list of all Rohde & Schwarz service centers can be found at the beginning of the printed manual.
The service manual includes further information particularly on troubleshooting, repair and exchange of modules.

Maintenance

The instrument does not need a periodic maintenance. What is necessary is essentially the cleaning of the instrument. However, it is recommended to check the rated data from time to time.

Cleaning the Outside and Storing

The outside of the instrument is suitably cleaned using a soft, line-free dust cloth. Make sure that vents are not obstructed.

NOTICE	**Instrument damage caused by cleaning agents!** Cleaning agents contain substances that may damage the instrument, e.g. solvent-containing cleaning agents may damage the front panel labeling or plastic parts. Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances. The outside of the instrument is suitably cleaned using a soft, line-free dust cloth.

The storage temperature range of the instrument is given in the data sheet. If the instrument is to be stored for a longer period of time, it must be protected against dust.
The original packing should be used, particularly the protective covers at the front and rear, when the instrument is to be transported or dispatched. If the original packing is no longer available, use a sturdy cardboard box of suitable size and carefully wrap the instrument to protect it against mechanical damage.

Hardware Interfaces

The following section describes the remote control interfaces of the signal generator and the pin assignment of the monitor connector. The AUX IO interface is described with the associated configuration menu in chapter 4, section "*User Marker - AUX-IO - Setup-Environment-Global...Settings*". All other interfaces are described in chapter 1, sections *"Legend for Front Panel View"* and *"Legend for Rear Panel View"*. For specifications refer to the data sheet.

IEC/IEEE Bus Interface

The standard instrument is equipped with an IEC/IEEE bus connector. An IEEE 488 interface connector is located on the rear panel. An external controller for remote control of the instrument can be connected via the IEEE 488 interface connector using a shielded cable.

Interface Characteristics

- 8-bit parallel data transfer
- bi-directional data transfer
- three-line handshake
- high data transfer rate
- up to 15 instruments can be connected
- maximal length of the interconnecting cables 15 m (single connection, 2 m)
- wired-OR connection if several instruments are connected in parallel.

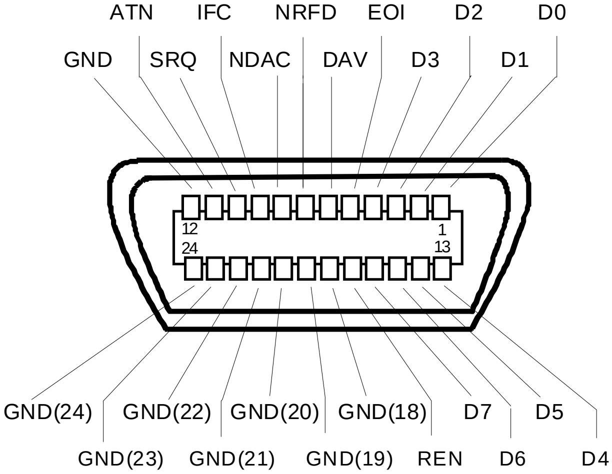


Figure 8-1 Pin assignment of IEC/IEEE-Bus interface

Bus Lines

1. Data bus with 8 lines D0 to D7.

The transmission is bit-parallel and byte-serial in the ASCII/ISO code. D0 is the least significant bit, D7 the most significant bit.

2. Control bus with 5 lines

IFC (Interface Clear)	active LOW resets the interfaces of the instruments connected to the default setting.
ATN (Attention)	active LOW signals the transmission of interface messages.
	inactive HIGH signals the transmission of device messages.
SRQ (Service Request)	active LOW enables the connected device to send a service request to the controller.
REN (Remote Enable)	active LOW permits switchover to remote control.
EOI (End or Identify)	has two functions in connection with ATN:
	ATN = HIGH active LOW marks the end of data transmission.
	ATN = LOW active LOW triggers a parallel poll.

3. Handshake bus with three lines

DAV (Data Valid)	active LOW signals a valid data byte on the data bus.
NRFD (Not Ready For Data)	active LOW signals that one of the connected devices is not ready for data transfer.
NDAC (Not Data Accepted)	active LOW signals that the instrument connected is accepting the data on the data bus.

IEC/IEEE-Bus Interface Functions

Instruments which can be remote controlled via the IEC/IEEE bus can be equipped with different interface functions. The following table lists the interface functions appropriate for the instrument.

Table 8-1 IEC/IEEE Bus Interface functions

Control character	Interface function
SH1	Handshake source function (source handshake), full capability
AH1	Handshake sink function (acceptor handshake), full capability
L4	Listener function, full capability, unaddress if MTA.
T6	Talker function, full capability, ability to respond to serial poll, unaddress if MLA
SR1	Service request function (Service Request), full capability
PP1	Parallel poll function, full capability
RL1	Remote/Local switch over function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability
C0	No controller function

IEC/IEEE Bus Messages

Interface messages are transferred on the data lines of the IEC/IEEE bus when the "ATN" control line is active (LOW). They are used for communication between controller and instruments and can only be sent by the controller which currently has control of the IEC/IEEE bus.

Universal Commands

The universal commands are encoded 10 - 1F hex. They affect all instruments connected to the bus without addressing.

Table 8-2 Universal Commands

Command	VISUAL BASIC command	Effect on the instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument settings..
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	Locks switchover from remote control to manual operation by means of the front panel keys
SPE (Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial poll.
SPD (Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial poll.
PPU (Parallel Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of the parallel-poll state.

Addressed Commands

The addressed commands are encoded 00 - 0F hex. They are only effective for instruments addressed as listeners.

Table 8-3 Addressed Commands

Command	VISUAL BASIC Command	Effect on the instrument
SDC (Selected Device Clear)	IBCLR (device%)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
GET (Group Execute Trigger)	IBTRG (device%)	Triggers a previously active device function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual operation).
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configures instrument for parallel poll. Additionally, the VISUAL BASIC command executes PPE/PPD.

LAN Connector

The unit is equipped with an LAN interface as standard. The LAN connector is at the rear of the instrument. Provided the appropriate rights have been assigned by the network administrator, files can be transmitted via the network, and network resources, e.g. a network folders, can be used. The instrument can also be remote controlled and manually operated in the network. It is connected by means of a commercial RJ45 cable.

The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

Connection of the R&S Signal Generator is described in Chapter 1, section "*Connection to the Network*", remote control via Ethernet in chapter 5, section "Remote Control via LAN Interface", page 5.5. The architecture of a LAN remote-control connection is described in detail in the following.

Remote control of an instrument via a network is based on standardized protocols which follow the OSI reference model (see Fig. 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

Fig. 8-2 Example for LAN remote control based on the OSI reference model

Based on TCP/UDP, messages between the controller and the instrument are exchanged via open network computing (ONC) - remote procedure calls (RPC). With XDR, legal RPC messages are known as VXI-11 standard. Based on this standard, messages are exchanged between the controller and the instrument. The messages are identical with SCPI commands. They can be organized in four groups: program messages (control command to the instrument), response messages (values returned by the instrument), service request (spontaneous queries of the instrument) and low-level control messages (interface messages).

A VXI-11 link between a controller and an instrument uses three channels: a core, abort and interrupt channel. Instrument control is mainly performed on the core channel (program, response and low-level control messages). The abort channel is used for immediate abort of the core channel; the interrupt channel transmits spontaneous service requests of the instrument. Link setup itself is very complex. For more details refer to the VXI-11 specification ("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").

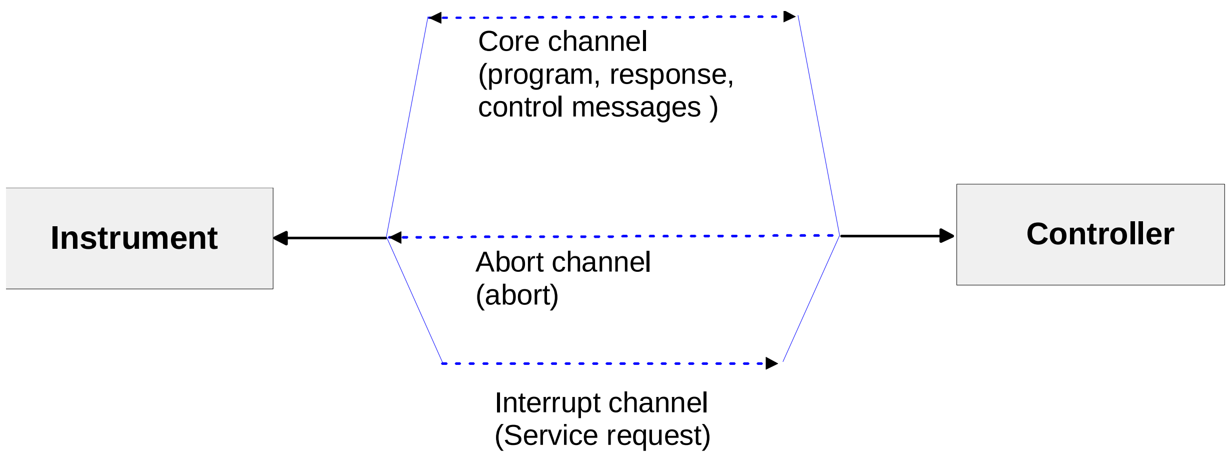


Fig. 8-3 VXI-11 channels between instrument and controller

The number of controllers that can address an instrument is practically unlimited in the network. In the instrument, the individual controllers are clearly distinguished. This distinction continues up to the application level in the controller, i.e. two applications on a PC are identified by the instrument as two different controllers.

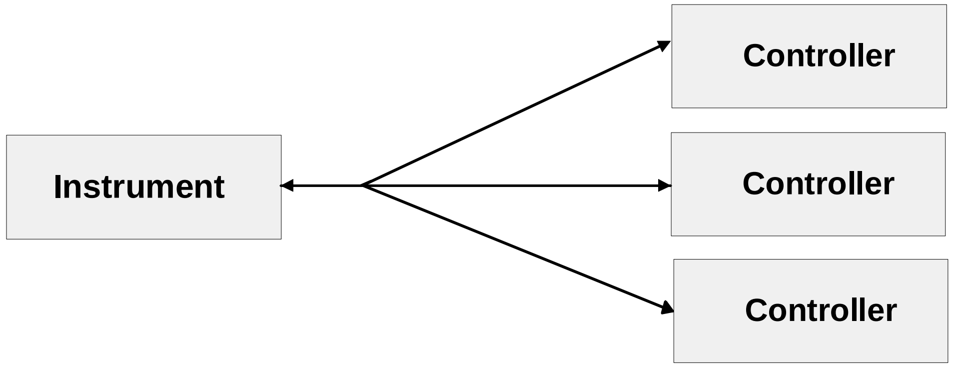
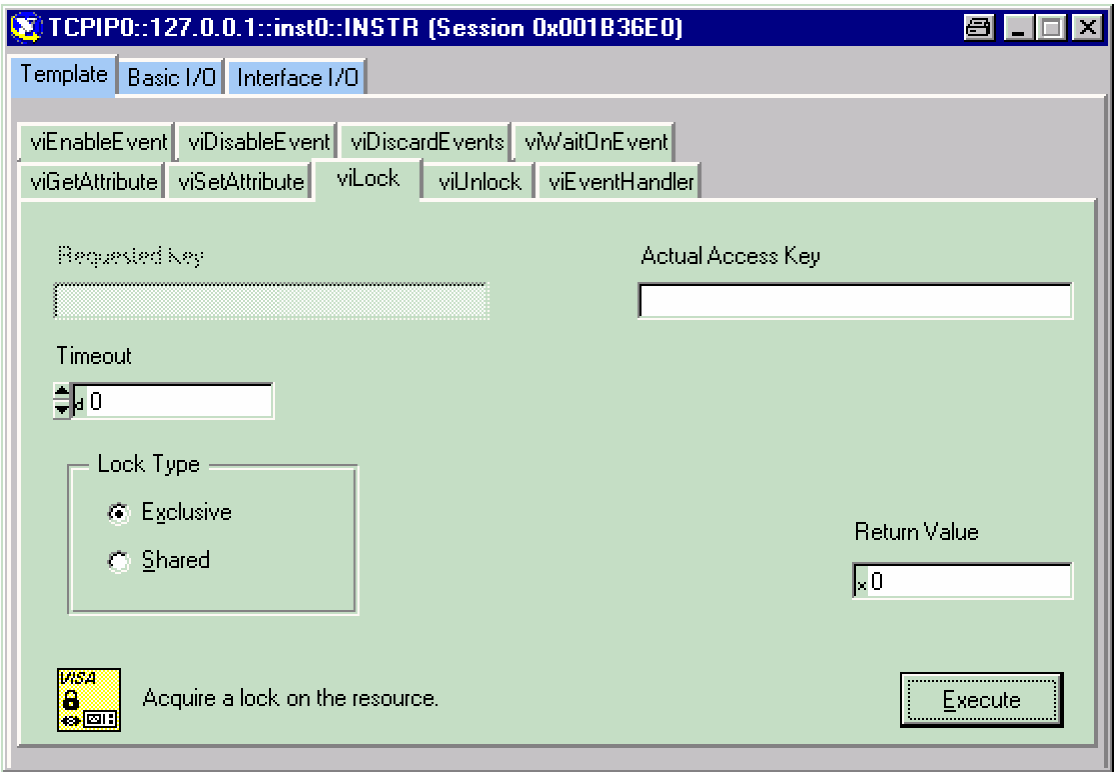


Fig. 8-4 Remote control via LAN from several controllers

The controllers can lock and unlock the instrument for exclusive access. This regulates access to the instrument of several controllers.
In the **'Measurement & Automation Control'** program, this setting is made on the **Template** tab.



VXI-11 Interface Messages

On the Ethernet link, the interface messages are called low-level control messages. These messages can be used to emulate interface messages of the IEC/IEEE bus.

Table 8-4 VXI-11 Interface Messages#

Command		**Effect on the instrument**
&ABO	(Abort)	Aborts the processing of the commands just received.
&DCL	(Device Clear)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
&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)	Triggers a previously active device function (e.g. a sweep). The effect of the command is the same as with that of a pulse at the external trigger signal input.
&LLO	(Local Lockout)	Disables switchover from remote control to manual operation by means of the front panel keys
&POL	(Serial Poll)	Starts a serial poll
&NREN	(Not Remote Enable)	Enables switchover from remote control to manual operation by means of the front panel keys

USB Connection (USB and USB IN)

The instrument is equipped as standard with several USB (universal serial bus) interfaces.

USB
Most of them are type A interfaces (host USB) which establish a connection to the controller. They can be used for connecting peripherals such as mouse and keyboard or a memory stick for data transmission. Two of the master USBs are at the instrument front, the others are at the rear.

USB IN
One USB interface is a type B interface (device USB) and located at the rear of the instrument. It can be used for remote control (see chapter "Remote Control - Basics"). The instrument is assigned as device, not as host.

Contents - Chapter 9 - "Error Messages"

9 Error Messages

Introduction - Status Information and Messages

This chapter describes the error messages of the R&S Signal Generator. The error messages are output in the **Info** line on the screen and entered in the error error/event queue of the status reporting system.

A great variety of different messages such as status messages, error messages, warnings or information are displayed in the header field of the screen. Some error messages require that the error must be eliminated before correct instrument operation can be ensured. The info window with a list of current messages and a detailed description of each message can be opened with the INFO key

In the remote control mode, error messages are entered in the error/event queue of the status reporting system and can be queried with the command `SYSTem:ERRor?`. If the error queue is empty, 0 ("No error") is returned.

Status Information

The status messages are displayed in the header section of the screen. The status information gives the user an overview of the main operating states and settings of the instrument. The states are indicated for information only and do not necessitate any action by the user. Status information is displayed between the frequency and level fields, at the left of the info line or in the info line itself. On two-path instruments, all states that can occur independently in the two paths are displayed separately for each path. The associated path is indicated in the info line.

Status information displayed between the frequency and level fields:

RF OFF The RF output is switched off

MOD OFF All modulations are switched off.

FREQ OFFSET A frequency offset is set.

The frequency entered and displayed in the frequency field takes any set frequency offset into consideration, e.g. an offset set for a downstream instrument. This means that with a frequency offset the frequency displayed in the header does not correspond to the frequency at the RF output, but rather to the frequency at the output of the downstream instrument.

This allows the desired frequency at the output of a downstream instrument to be entered in the frequency field. The signal generator changes the RF output frequency according to the entered offset.

However, the frequency entered and displayed in the Frequency/Phase menu of the RF/Ana Mod function block always corresponds to the RF output frequency. Any frequency offset is not taken into consideration.

The correlation is as follows:

Freq in header = RF output frequency
(= Freq in menu) + Freq offset (= Offset in menu)

OVERLOAD The power of the external signal applied to the RF output is too high. The overload protection is tripped and the connection between the RF output and attenuator is interrupted. The overload protection is reset by pressing the RF ON/OFF key. The RF input is activated when the overload protection is reset.

LEVEL OFFSET A level offset is set.

The level entered and displayed in the Level field takes the offset of any downstream attenuators/amplifiers into consideration by way of calculation. This means that with a level offset the level displayed in the header does not correspond to the level at the RF output, but rather to the level at the output of the downstream instrument.

This allows the desired level at the output of downstream instruments to be entered. The signal generator changes the RF output level according to the set offset.

However, the level entered and displayed in the **Level** menu of the **RF/Ana Mod** function block always corresponds to the RF output level. Any level offset is not taken into consideration.

The correlation is as follows:

Level in header = RF output level (= Level in menu) + Level offset

EXT REF An external reference is used.

The external signal with selectable frequency and defined level must be input at the REF IN connector. It is output at the REF OUT connector.

The reference frequency setting is effective for both paths.

I/Q Out OFF R&S AMU only:
The I/Q output is switched off.

BUSY A setting or calculation is executed.

Status information displayed to the left of the Info line:

REMOTE The instrument is remote controlled. The keys on the front panel are usable, but all parameters are in **read only** mode.

The LOCAL key switches the instrument from remote control to manual operation. The current command must be fully processed before the mode is switched, otherwise the instrument switches immediately back to remote control.

REM-LLO The instrument is remote (**REM**ote) controlled. The LOCAL key is disabled by remote control with the command LLO (**L**ocal**L**ock**O**ut). The keys on the front panel are usable, but all parameters are in **read only** mode.
The instrument can be switched from remote control to manual operation by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`).

LOC-LLO For operating directly the instrument is placed from remote control to manual operation (Local State). The LOCAL key was disabled by remote control with the command **L**ocal**L**ock**O**ut).

With the next activating of the remote control mode, the instrument cannot be switched to manual operation by the operator. The status information changes to REM LLO.

The instrument can be switched to manual operation by means of remote control only (e.g. with the Visual Basic command `CALL IBLOC (generator%)`).

SYS CTRL **SYS CTRL** indicates that the instrument is controlling another instrument.

Status information displayed in the Info line:

RFSweep
LevelSweep
LFSweep

The indicated sweep is enabled.

ALC On/Auto/S&H/Table The status of the automatic level control is indicated:

- ON = automatic level control permanently on
- Auto = automatic level control is automatically adapted to the operating states
- S&H = automatic level control off, recalibration of the level whenever the level or frequency is set (sample and hold mode).
- Table = automatic level control off, recalibration of the level according to the ALC table (R&S SMBV only).

ListMode List mode is active.

The values of the frequency/level pairs in the selected list are set for the chosen dwell time.

AttFixed Attenuator fixed mode is active.

The uninterrupted level settings are made in a fixed range without attenuator switching. The variation range is set automatically when this mode is activated. The range is displayed under **Attenuator Fixed Range** in the **Level** menu.

UCorr User Correction is active.

The level is corrected by the given values in the selected user correction list. Correction is performed by the user-defined list values being added to the output level for the respective RF frequency. With frequencies which are not contained in the list, the level correction is determined by interpolation of the closest correction values.

OvenCold The reference oscillator has not yet reached its nominal frequency.

When switching on from the STANDBY mode, the specified frequency accuracy is reached immediately. If the power switch was switched off, the reference oscillator needs some warm-up time to reach its nominal frequency. During this period of time, the output frequency does not yet reach its final value either.

Error Messages

Messages indicate errors in the instrument. They are displayed in the info line in different colors depending on their importance and display duration. Errors (e.g. no calibration data) are displayed in red, information (e.g. file not found) and warnings in black. Warnings indicate less significant errors (e.g. the instrument operates outside specified data).

Volatile messages

Volatile messages report automatic settings in the instrument (e.g. switching off of incompatible types of modulation) or on illegal entries that are not accepted by the instrument (e.g. range violations). They are displayed in the info line on a yellow background. They are displayed on top of status information or permanent messages.

Volatile messages do not normally demand user actions and disappear automatically after a brief period of time. They are stored in the history, however.

Remote-control command:
`SYST:ERR? or SYST:ERR:ALL?`

Permanent messages

Permanent messages are displayed if an error occurs that impairs further instrument operation, e.g. a hardware fault. The error signaled by a permanent message must be eliminated before correct instrument operation can be ensured.

The message is displayed until the error is eliminated. It covers the status display in the info line. After error elimination, the message automatically disappears and is also recorded in the history.

Remote-control command:
`SYST:SERR?`

Alphabetical List of SCPI-Error Messages

The following list contains all error messages defined in SCPI in alphabetical order. SCPI error messages are the same in all SCPI instruments. The errors are assigned negative numbers.

The error text being entered into the error/event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation as to the respective error.

Note:
The index provides a list of the error messages sorted according to their error codes.

Block data not allowed (-168)

The command contains legal block data which are not allowed at this point.

Example: The command `SOURce:BB:FOFFset` requires a numeric parameter – `BB:FOFF #13a`

SCPI: Command error - sets bit 5 in the ESR register

Character data not allowed (-148)

The character data is prohibited for this command or at this point of the command.

Example: Command `SOUR:BB:FOFF` requires a numeric parameter.

SCPI: Command error - sets bit 5 in the ESR register

Character data too long (-144)

The character data element contains more than 12 characters.

SCPI: Command error - sets bit 5 in the ESR register

Command error (-100)

Generic error message that cannot detect a more specific error.

SCPI: Command error - sets bit 5 in the ESR register

Data out of range (-222)

A value of the transmitted command was outside the legal range.

Example: Command `SOUR:BB:FOFF 50MHz` only permits entries in the range of min to max frequency.

SCPI: Execution error - sets bit 4 in the ESR register

Device-specific error (-300)

Device-specific error not defined in greater detail.

SCPI: Device-specific error - sets bit 3 in the ESR register

Exponent too large (-123)

The magnitude of the exponent is too large.

SCPI: Command error - sets bit 5 in the ESR register

Expression data not allowed (-178)

The command contains a mathematical expression at an impermissible position.

SCPI: Command error - sets bit 5 in the ESR register

GET not allowed (-105)

A Group Execute Trigger (GET) is within a command line.

Note: A Group Execute Trigger (`GET`) is only allowed at the end of a command line or in a separate command line.

SCPI: Command error - sets bit 5 in the ESR register

Hardware error (-240)

A legal program command or a query could not be executed because of a hardware problem in the device.

SCPI: Execution error - sets bit 4 in the ESR register

Hardware missing (-241)

A legal program command or a query could not be executed because of a missing device hardware.

Example: An option is not fitted.

SCPI: Execution error - sets bit 4 in the ESR register

Header suffix out of range (-114)

The command contains an illegal numeric suffix.

Example: `:SOURce22` is not defined for the instrument.

SCPI: Command error - sets bit 5 in the ESR register

Illegal parameter value (-224)

The parameter value is invalid.

Example: An invalid text parameter is indicated - `:SOUR:BB:GSM:TRIG:SOUR TASTe`

SCPI: Execution error - sets bit 4 in the ESR register

Invalid block data (-161)

The command contains illegal block data.

Example: An END message was received before the expected number of data had been received or no numeric data element is sent after the introductory #

SCPI: Command error - sets bit 5 in the ESR register

Invalid character (-101)

The command contains an invalid sign.

Example: A header contains an ampersand, "`SOURCE&`".

SCPI: Command error - sets bit 5 in the ESR register

Invalid character data (-141)

The command contains an invalid value indication.

Example: ON is indicated instead of a numeric value for frequency setting - `SOUR:BBIN:FOFF ON`

SCPI: Command error - sets bit 5 in the ESR register

Invalid separator (-103)

The command contains an impermissible sign instead of a separator.

Example: A semicolon is missing after the first command in a command line with several commands - "`SOURce:BBIN:FOFFset 2MHz CFACtor -2.5dB`".

SCPI: Command error - sets bit 5 in the ESR register

Invalid suffix (-131)

The suffix is not appropriate for this command.

Example: nHz is not defined.

SCPI: Command error - sets bit 5 in the ESR register

Missing parameter (-109)

The command does not contain the required parameters.

Example: Command `:SOUR:BBIN:FOFFset` requires the indication of a parameter - `"SOURce:BBIN:FOFFset; CFACtor -2.5dB"`

SCPI: Command error - sets bit 5 in the ESR register

No error (0)

This message is output if the error queue does not contain entries.

Numeric data not allowed (-128)

The command contains a numeric data element the device does not accept in this position.

Example: The command `:SOUR:BB:DM:COD` requires an alphanumeric parameter - `SOUR:BB:DM:COD GSM`.

SCPI: Command error - sets bit 5 in the ESR register

Out of memory (-225)

The storage space available in the instrument is exhausted.

SCPI: Execution error - sets bit 4 in the ESR register

Parameter not allowed (-108)

The command contains too many parameters.

Example: Command `SOURce:BBIN:FOFFset`permits only one frequency indication - `":BBIN:OFFSet 30 kHz, 40 kHz"`.

SCPI: Command error - sets bit 5 in the ESR register

Program mnemonic too long (-112)

The header contains more than 12 characters.

SCPI: Command error - sets bit 5 in the ESR register

Query interrupted (-410)

This query has been interrupted.

Example After a query, the instrument receives new data before the response has been sent completely.

SCPI: Query error - error in data request - sets bit 2 in the ESR register.

Query unterminated (-420)

This query is missing or incomplete.

Example The instrument is addressed as a talker and receives incomplete data.

SCPI: Query error - error in data request - sets bit 2 in the ESR register.

Query deadlocked (-430)

This query cannot be processed.

Example The input and output buffers are full, the instrument cannot be operated.

SCPI: Query error - error in data request - sets bit 2 in the ESR register.

Queue overflow (-350)

This error code is entered into the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been recorded in the queue. The original error message is lost.

Remedy: Reading out the error messages e.g. with command `SYSTem:ERRor:ALL?` clears the error queue.

SCPI: Device specific error- sets bit 3 in the ESR register

Self test failed ... (-330)

An error was detected in the selftest named after the semicolon. An error-free operation of the module concerned is no longer guaranteed.

SCPI: Device specific error- sets bit 3 in the ESR register

Settings conflict ... (-221)

There is a setting conflict between the two parameters indicated after the semicolon.

Example: The set FSK deviation is too large for the selected symbol rate.

Remedy One of the given values has to be corrected to obtain a valid output signal.

SCPI: Execution error - sets bit 4 in the ESR register

Example: **Center frequency vs. frequency tuning range with phase continuous frequnency setting (SMx instruments only)**

When changing the output frequency in the phase continuous frequency setting mode, only the frequency of the DDS syhthesizer is changed. Therefore the usable DDS frequnecy range limits the allowed output frequency tuning range. The maximum usable DDS frequency range depends on the set tuning mode (medium or wide).

Remedy Change to tuning mode wide or

Disable the phase continuous frequency setting mode, change the frequency and enable this mode again, if necessary

String data not allowed (-158)

The command contains a legal string data element which is not allowed at this point.

Example: A text parameter is set in quotation marks.
`SOURce:BBIN:MODE "ANAL".`

SCPI: Command error - sets bit 5 in the ESR register

Suffix not allowed (-138)

A suffix is not allowed for this command or at this point of the command.

Example: Command *RCL does not permit indicating a suffix.

SCPI: Command error - sets bit 5 in the ESR register

Suffix too long (-134)

The suffix contains more than 12 characters.

SCPI: Command error - sets bit 5 in the ESR register

Syntax error (-102)

The command is invalid.

Example: The command contains block data the instrument does not accept.

SCPI: Command error - sets bit 5 in the ESR register

System error (-310)

This error message suggests an error within the instrument. Please inform the R&S Service.

SCPI: Device specific error- sets bit 3 in the ESR register

Too many digits (-124)

The decimal numeric data element contains too many digits.

SCPI: Command error - sets bit 5 in the ESR register

Too much data (-223)

More data were sent by the host than the instrument can handle.

SCPI: Execution error - sets bit 4 in the ESR register

Undefined header (-113)

The sent command header has not been defined.

Example: Header ":*XYZ" or ":SOURCe&" is undefined for every instrument.

SCPI: Command error - sets bit 5 in the ESR register

Alphabetical List of Device-Specific Error Messages

The following list contains all error messages specific of the instrument in alphabetical order. The positive error codes mark the errors specific of the instrument.

The error text being entered into the error/event queue or being displayed is printed in bold face on the left together with the error code. Below the error text, there is an explanation as to the respective error.

Note:
The index provides a list of the error messages sorted according to their error codes.

Extern reference out of range or disconnected (50)

External reference is selected but no external signal is applied or the signal is out of range.

Remedy: Check the selected reference signal source (internal or external) in the Reference Oscillator menu (Setup). Change setting to 'internal' if no approriate external source is available.

SCPI: Device-specific error - sets bit 3 in the ESR register

Adjustment data invalid (183)

Adjustment data are invalid and must be restored.

Remedy: The adjustment data have to be generated again by an internal or external adjustment or to be loaded into the instrument.

SCPI: Device-specific error - sets bit 3 in the ESR register

Adjustment data missing (182)

Adjustment data are missing.

Remedy: The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the instrument.

SCPI: Device-specific error - sets bit 3 in the ESR register

Adjustment failed (180)

Adjustment could not be executed

Remedy: The adjustment data have to be generated first by an internal or external adjustment or to be loaded into the device (see section Adjustment).

SCPI: Device-specific error - sets bit 3 in the ESR register

Cannot access the EEPROM (202)

A error occurs when writing or reading a EEPROM.

Example: The EEPROM is defect.

SCPI: Device-specific error - sets bit 3 in the ESR register

Cannot access hardware (200)

The data transmission to a module was unsuccessful.

Example: The module is not installed, not properly installed or missing.

SCPI: Device-specific error - sets bit 3 in the ESR register

Cannot open file (460)

The selected file can not be opened.

Remedy: Check the path and file name.

SCPI: Device-specific error - sets bit 3 in the ESR register

Cannot read file (462)

The file can not be read.

Example: The file contents are not compatible with the file type.

SCPI: Device-specific error - sets bit 3 in the ESR register

Cannot write file (461)

The file can not be written.

Example: The file is read-only.

SCPI: Device-specific error - sets bit 3 in the ESR register

Driver initialization failed (204)

Initialization of a driver fails when booting the instrument firmware

Example: The driver is not compatible with the hardware or software configuration of the instrument.

SCPI: Device-specific error - sets bit 3 in the ESR register

File contains invalid data (465)

The selected file contains data that is not valid for the file type. The file extension determines the data that is valid for this file type. If the file extension is changed the lists are no longer recognized and the data are therefore invalid.

Example: The extension of a waveform file (= *.wv) was changed to *.txt.

SCPI: Device-specific error - sets bit 3 in the ESR register

Filename missing (463)

The desired operation cannot be executed because the file name is not specified.

Example: A file name has to be entered when creating a new list.

SCPI: Device-specific error - sets bit 3 in the ESR register

Hardware revision out of date (201)

A later version of certain parts of the instrument is necessary to execute the function selected.

Example: The driver does not support the installed version of a module.

SCPI: Device-specific error - sets bit 3 in the ESR register

Invalid EEPROM data (203)

Reading a EEPROM is possible, however the data are inconsistent.

SCPI: Device-specific error - sets bit 3 in the ESR register

Invalid filename extension (464)

The file extension is not valid for the desired operation.

Example: The file extension for waveform list files is *.wv. It is not possible to enter another file extension when storing a list.

SCPI: Device-specific error - sets bit 3 in the ESR register

No current list (241)

There is no list selected. To execute the desired operation a list has to be selected in the related menu. If no list is available, a new list must be created.

SCPI: Device-specific error - sets bit 3 in the ESR register

This modulation forces other modulations off (140)

A modulation has been switched on which cannot be used at the same time as an already active modulation. The previous modulation has been switched off.

Example: Enabling modulation GSM/EDGE switches any active digital modulation off.

SCPI: Device-specific error - sets bit 3 in the ESR register

Unknown list type specified (242)

The list type selected is not valid for the desired operation

Example: The file extension for waveform list files is *.wv. It is not possible to enter another file extension when selecting a list.

SCPI: Device-specific error - sets bit 3 in the ESR register

Waveform Protected (261)

The selected waveform file cannot be transferred to a controller. The waveform is produced with simulation software WinIQSIM and is protected.

SCPI: Device-specific error - sets bit 3 in the ESR register

Alphabetical List of Commands

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