Software Manual

Signal Generation Software

R&S® WinIQSIM2

1008.0858.42

ROHDE&SCHWARZ

Test and Measurement

Dear Customer,

throughout this manual, the Signal Generation Software R&S® WinIQSIM2 is abbreviated as R&S WinIQSIM2.

The Signal Generation Software includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/).

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG

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 thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, 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 prescipciones 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.

Certified Quality System

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

DQS REG. NO 001954 QM UM

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DIN EN ISO 9001:2000
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ROHDE & SCHWARZ

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	From outside USA	+1 410 910 7800 (opt 2)
	Fax	+1 410 910 7801
	E-mail	CustomerSupport@rohde-schwarz.com
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* 0.14 €/Min within the German fixed-line telephone network, varying prices for the mobile telephone network and in different countries.

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Content- Signal Generation Software

Signal Generation Software R&S WinIQSIM2

R&S WinIQSIM2 permits calculation of I and Q baseband signals on a Windows PC system. It combines the advantages and functionalities of the well known previous version of R&S WinIQSIM with the firmware of the R&S SMU/SMATE vector signal generator family.

Among R&S WinIQSIM2' functions are single-carrier modulation, the generation of multicarrier, W-CDMA and other 3rd Generation signals. Future digital standards will be supported as well.

The look-and-feel of R&S WinIQSIM2, especially the block diagram, is based on the R&S SMU firmware. So users of R&S SMU vector signal generators can easily get used to the handling and behavior of this software. Other users will find an easy approach as well, since the software offers a high grade of self-explanation by means of a logically structured signal flow diagram and menus.

The whole process of signal configuration can be controlled via the block diagram. The current status of signal configuration and active interfering components can be seen at a glance.

Comprehensive graphic display modes in the time and frequency domain, e.g., i(t) and q(t), vector diagram or spectrum, allow simulation and analysis of characteristics as early as in the design phase of new digital communications systems.

All in all, R&S WinIQSIM2 is an indispensable application for anyone engaged in state-of-the-art digital modulation.

Signal Generation with R&S WinIQSIM2

The system comprising R&S AFQ as a source for baseband signals and R&S WinIQSIM2 for configuring signal data enables a convenient generation of all kinds of complex, digitally modulated communication signals.

With R&S WinIQSIM2, computed signals can be loaded onto the R&S AFQ hard disk via the IEC/IEEE bus or TCP/IP by cable or via USB memory stick.

In addition, all R&S AFQ functions can be set under R&S WinIQSIM2 via Remote Desktop.

For generation of radio frequency (RF) signals, the R&S SMU or some other device of this family suits best to work with the above combination. R&S SMU also has the capability to be remote controlled via R&S WinIQSIM2.

Installation of R&S WinIQSIM2 Software

R&S WinIQSIM2 is delivered in the latest version available on the R&S WinIQIM2 CD-ROM. Software 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 home page. This home page always offers the latest information on your R&S WinIQSIM2 as well as the signal generator software, e.g., also on **changes of the software update procedure**.

To uninstall and to install R&S WinIQSIM2, the following hardware and software requirements have to be met.

Software Requirements

Windows XP or **Windows Vista**	Operating System. R&S WinIQSIM2 has to be installed on Windows XP. *Note:* *Any other Windows version is not supported.*
National Instruments (NI) VISA version 3.4.1 or higher (optional) or **Agilent VISA version 14 or higher (optional)**	VISA driver is usually bundled with a GPIB (IEC/IEEE)-bus card from National Instruments (NI) or Agilent. If none of these cards is used, there is the option to perform data transmission via TCP/IP connection over LAN. Drivers can be obtained from R&S or NI directly.

Hardware Requirements

CPU	At least Pentium or compatible, as from 1 GHz (recommended).
RAM	At least 512 Mbytes
VGA color display resolution	At least 800*600 pixels
GPIB (IEC/IEEE)-bus card (optional)	From National Instruments or Agilent

WinIQSIM2 Software

The R&S WinIQSIM2 software consists of the file `WinIQSIM2_<V.VV.VVV.VV>.exe`. The version numbers in the file names vary with each update.

The following files are required:

Uninstalling R&S WinIQSIM2: (required for update only)	`RsSigGenUninstaller_<VV>.cmd`
Installing R&S WinIQSIM2:	`WinIQSIM2_<V.VV.VVV.VV>.exe`

Installing R&S WinIQSIM2

Uninstall an old software version (skip, if this is a first-time installation)

◆ To uninstall a previous version of WinIQSIM2 run **RsSigGenUninstaller** from the menu Start – WinIQSIM2 or execute **RsSigGenUninstaller_VV.cmd** (VV stands for a version number) which came with the distribution.

◆ To uninstall this version go to Start - Settings - Control Panel - Add/Remove Programs and select the entry `WinIQSIM2_V.VV.VVV.VV`.

The script file identifies and removes all currently installed R&S signal generator software items.

Install a new software version

◆ In Windows Explorer double-click **WinIQSIM2_V.VV.VVV.VV.exe** and follow the instructions.

Getting started

The following section gives a brief introduction to R&S WinIQSIM2. Only main functions are described.

For more information see section *Graphical User Interface*, page 22.

After an overview of the operating concept, menus, and the associated toolbar, the main steps required for generating a modulated single-carrier signal are described. The description starts with the selection of the data source and ends with signal transmission to R&S AFQ. The steps for generating a certain signal, e.g., 3GPP FDD, CDMA2000, multi carrier, etc., are described in the corresponding sections.

Operating Menu and Toolbar

In the following, an overview of the operating menu and of the toolbar in the Main window of R&S WinIQSIM2 is given.

Operating Menu

File Menu	Loading and storing configurations, saving and deleting temporary files, setup, quitting R&S WinIQSIM2.

Opens the following menu:

New

Open

Save

Save as

Setup	**Software Options** **Temporary Files**

Exit

Transmission Menu	Choosing Instruments, transmitting a file.

Opens the following menu:

Instrument

Transmit

Graphics Menu	Activating graphics.

Opens the following menu:

Graphic 1	**Graphic 1 (Preview Only)** **Graphic 1 (Complete)**
Graphic 2	**Graphic 2 (Preview Only)** **Graphic 2 (Complete)**
Graphic 3	**Graphic 3 (Preview Only)** **Graphic 3 (Complete)**

Help Menu   Opening help functions

Opens the following menu:

Contents

Index

Toolbar

Creates a new file

Opens an existing file

Saves a file

Transmits a file

Activates a graphic

Info Button   Displays information on errors and warnings.

System Block Diagram

This section gives an overview of control elements, connectors, and signal configuration in the Main window. It shows the block diagrams, i.e., the whole system including connected devices at a glance. The graphical elements can be accessed for operation. Required menus and graphs are displayed in the block diagram, which contains the internal signal flow from baseband on the left position to the Signal Generator Blocks at the right. Each element/connector is briefly described.

The signal flow between the Signal Generator Blocks and the employed inputs and outputs are also represented.
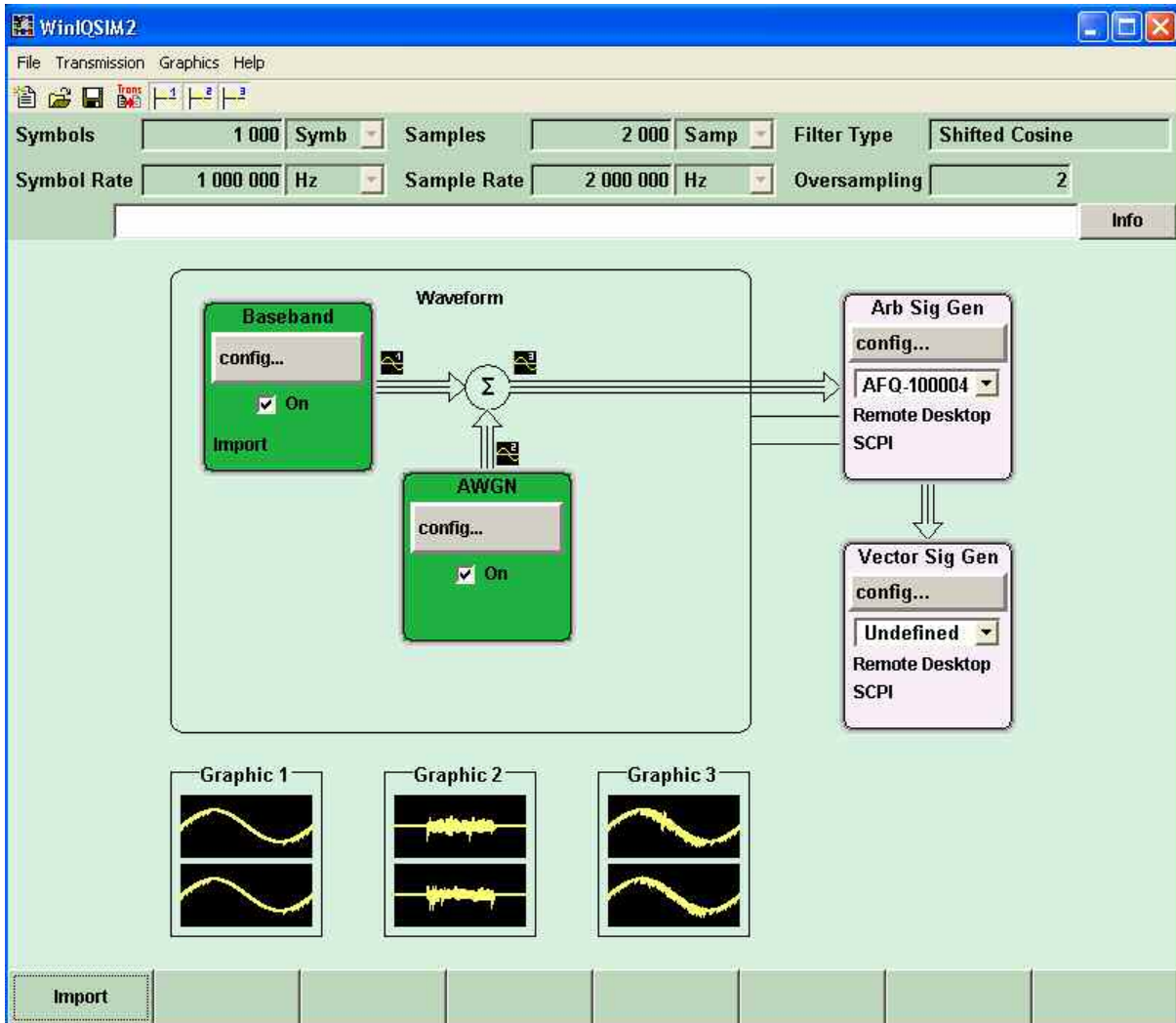
The Win bar at the bottom of the block diagram gives an overview of open dialogs and simplifies their access.

Labelled buttons represent open dialogs, the label indicates the dialogs. If several dialogs are open, the button of the currently active dialog is displayed in a lighter color. Up to eight dialogs may be open simultaneously. When the ninth dialog is opened, the dialog that was opened first is automatically closed.

For more information see section *Main Window - Signal Flow Diagram*, page *38.*

Control and Operation of R&S WinIQSIM2 via Block Diagram

Each of the blocks in the Main window contributes to the signal flow. Here, R&S WinIQSIM2 is controlled, the operational tasks can be performed, and the signal flow is visualized.

Selecting a digital standard

1. In the *Baseband* block diagram, below the *config* button, the state check box is located. Here, the states On or Off of the component block are controlled. By activating the block, its color switches to green and indicates that the block contributes to the signal flow.

2. Click the *config* button.
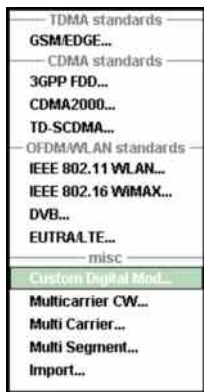
    A menu with a list of optional standards opens.

3. By selecting one of the offered options, a dialog opens. Parameter entries for the selected digital standard can be made.
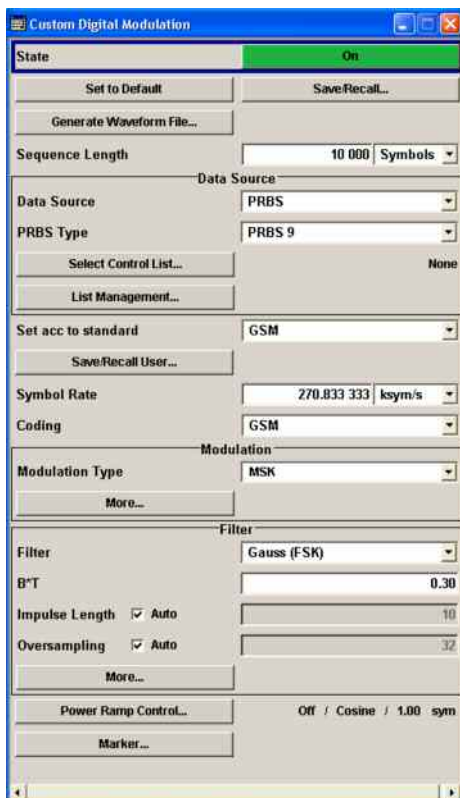
Example - Signal Configuration

This section describes the configuration procedure for a single-carrier signal with AWGN by way of an example.

To generate an I/Q signal with AWGN, the following steps are required:

– Configuring an instrument
– Selecting an instrument
– Generating the waveform
– Displaying and configuring the graphical representation of the waveform signal
– Adding Noise (AWGN) to the signal and displaying the signal flow
– Transmitting the signal to R&S AFQ

Example - Configuring an Instrument

There are two options:

◆ No instrument has been created yet. It is necessary to create and select an instrument before signal generation is possible. A dummy instrument might be created.

◆ An instrument has already been created and selected. Continue in section *Example - Generating the Waveform*, page 16.

1. Connect the instrument (in this example an R&S AFQ with option B10) via LAN interface (TCP/IP) and switch it on.

2. Open the Configure Instruments dialog by selecting Transmission → Instruments.

    The **Configure Instruments** dialog opens:
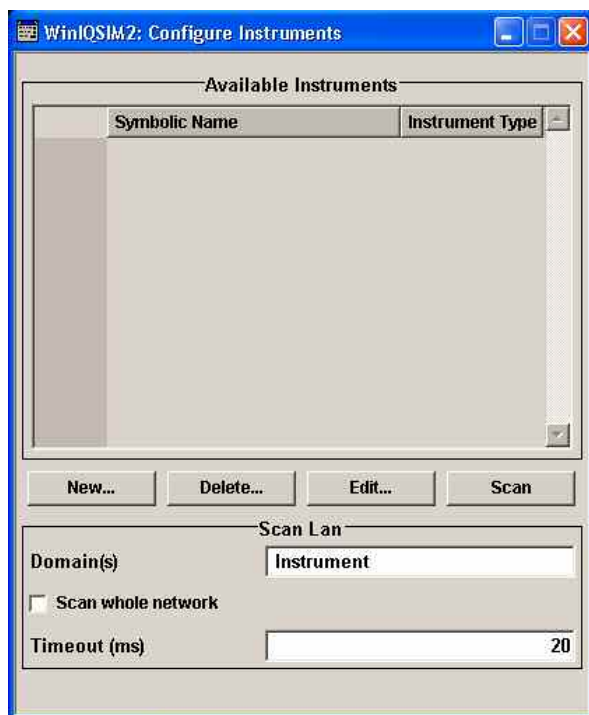
    In this dialog, you create the instrument or create a dummy instrument and configure the connection to the selected instrument.

WinIQSIM2 allows you to scan the LAN (TCP/IP), GPIB, or USB interfaces for connected instruments. Instruments found during the scan are listed in the list **Available Instruments** and can be selected for configuration.

By default, only the network domain *Instrument* is scanned for instruments connected via the TCP/IP interface (LAN). *Instrument* is the factory default setting for all R&S Generators. You can expand the scope for scanning by entering the desired domain(s) in the **Domain(s)** field, separated by commas or blanks, for example *Instrument,MyDomain*.

To scan the complete company network, activate **Scan whole network**. Keep in mind, that, depending on the size of the company network, this might take a lot of time.

If an NI Visa is used, the maximum time WinIQSIM2 waits for an instrument to respond during the scan can be set in the **Timeout (ms)** field.

The support of the scan feature depends on the VISA software installed on your system:

VISA version	Scan Functionality
NI-VISA	Timeout set in dialog.
Agilent Libraries Suite ≥ V14	Timeout has to be set within Agilent (Agilent IO Control —> Agilent Connection Expert —> LAN (TCP/IP) —> Change Properties button —> Connect Timeout field). Refer to the Agilent documentation for details.
Agilent Libraries Suite < V14	Only GPIB and USB are scanned. Network scan is not supported.

3. Click the **Scan** button to scan the desired domain(s) for the instrument.

All instruments found in the desired network domain as well as instruments connected via the GPIB or USB interfaces are displayed in the **Available Instruments** list. WinIQSIM2 obtains all information for connecting to the instrument, so further configuration is not necessary but can be performed via the **Edit** button, if desired.

Note:
 *WinIQSIM2 does not clear the list **Available Instruments** before a scan. Any instruments found during a scan will be added to the list.*
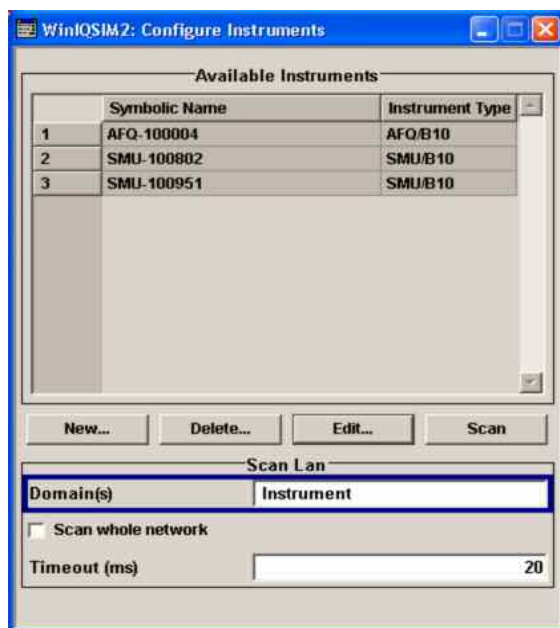
4. If the instrument of your choice is in the **Available Instruments** list, close the dialog.
    Now the R&S AFQ is available for selection in the **Arb Sig Gen** block.

    If the instrument of your choice is not displayed in the **Available Instruments** list, check if the

    following prerequisites are fulfilled, and scan for the instrument again:

− Is the instrument in the domain you have scanned?

− Is the instrument switched on?

− Is the instrument accessible via TCP/IP (LAN), GPIB, or USB?

− Is the firewall of the instrument's operating system deactivated?

For more information, see the following sections:

Example - Selecting an Instrument

Waveform calculation depends on the instrument settings, so before you can create the waveform, the instruments has to be selected first. For signal calculation, it is not necessary that an instrument is connected. The signal calculation can be performed for a dummy instrument (offline), but even this dummy instrument has to be selected before waveform calculation.

Note:
   The instrument has to be configured before it can be selected. For configuring the instrument, see
   Example - Configuring an Instrument*, page 13.*

− In the Main window, in the **Arb Sig Gen** block, select the AFQ from the combo box.

   The AFQ is selected. The prerequisites for waveform calculation are fulfilled.

Example - Generating the Waveform

The example task is to create a 16-QAM encoded waveform. The data consists of a sequence length of 511 samples of a pseudo random binary sequence (shift register length: 9 Bits). The symbol rate is set at 1 ksym/s. A cosine filter is used.

1. In the baseband block at the left position, click *config → Custom Digital Mod.*

    The following dialog opens:
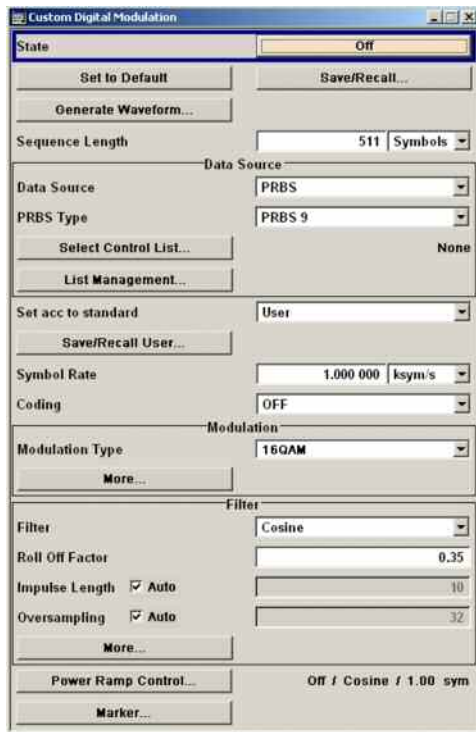
2. Make the following entries:

Sequence Length	`511 Symbols`
Symbol Rate	`1.000 000 ksym/s`
Modulation Type	`16QAM`
Filter	`Cosine`

3. Click the *State* button to change the state to *On*.

    A bar appears indicating the calculation progress. The waveform is generated. It can be checked by means of a graphic tool.

Example - Displaying and Configuring the Graphical Representation of the Waveform Signal

1. In the Main window, select **Graphics,** point to **Graphic 1**, and click **Graphic 1 (Preview Only)**.

    A small graphics display labelled **Graphic 1** opens at the bottom of the block diagram. A small icon shows up in the signal flow path indicating the position from where the graphics obtains its data.

2. Double-click the small graphics display to open the graphics dialog.
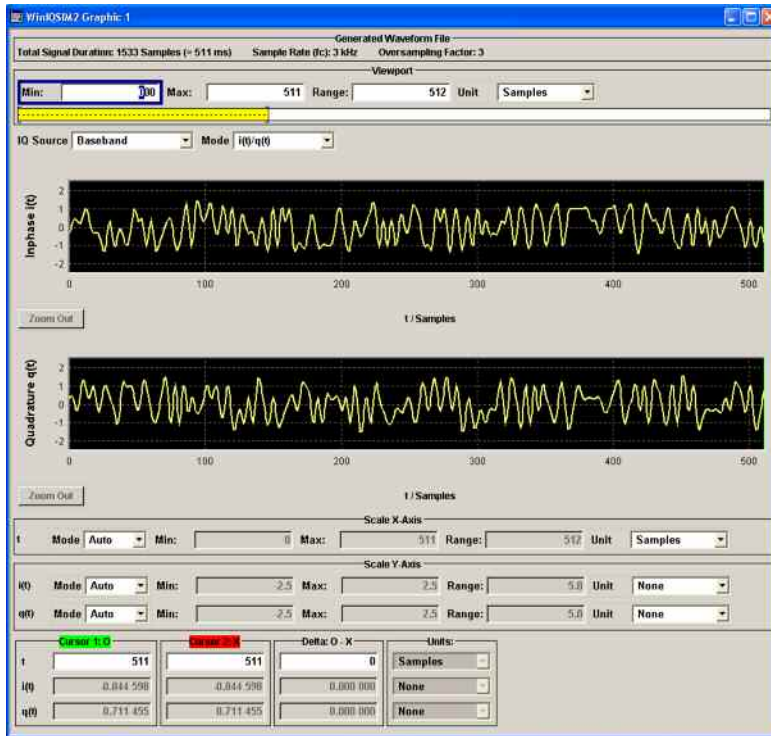
In the **Mode** combo box, the graphical representation mode can be selected, e.g., I/Q waveform format, vector diagram, spectrum, and many more.

The **graphics** panel is an important tool for viewing and checking the signal configuration. In this panel, the generated I/Q signal or representations derived thereof like the vector diagram or the signal spectrum can be displayed.

For more information, see

section *Graphic 1-3*, page 33.

section *Viewport*, page 34.

section *Graphical Representation of Waveforms*, page 36.

Example - Adding Noise (AWGN) to the Signal and Displaying the Signal Flow

1. In the Main window, in the AWGN block diagram, click **config**, and then click **AWGN**.

    The **AWGN Settings** dialog opens.
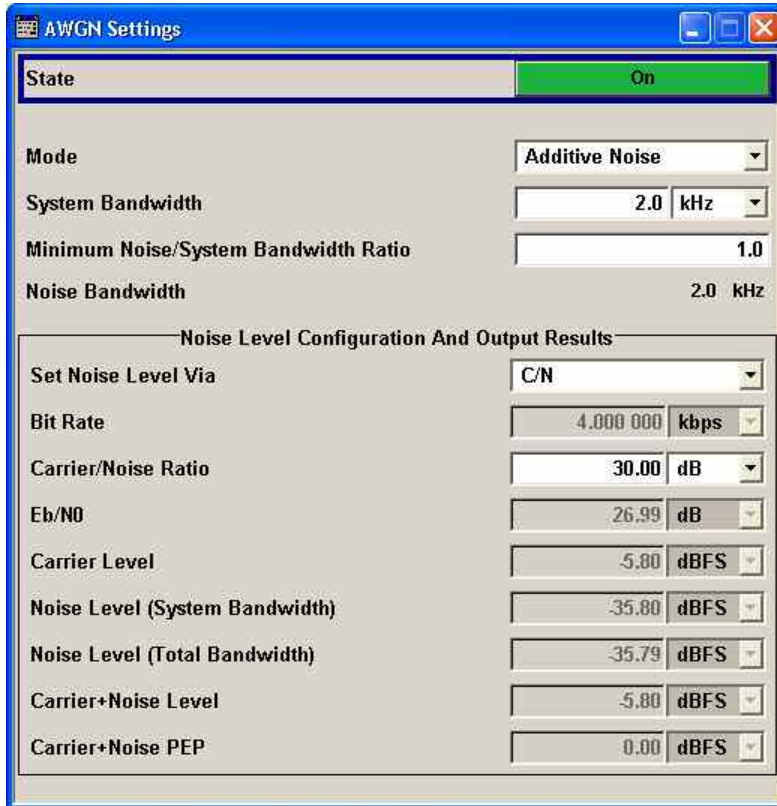
2. Make the following entries:

System Bandwidth	`2 kHz`
Carrier/Noise Ratio	`30 dB`

3. Click the ***State*** button to change the state to ***On***.

    A bar appears indicating the calculation progress. The AWGN is generated. It can be checked by means of a graphic tool.

4. To display the AWGN signal, in the Main window, select **Graphics,** point to **Graphic 2**, and click **Graphic 2 (Preview Only)**.

    A small graphics display labelled **Graphic 2** opens at the bottom of the block diagram. A small icon shows up in the signal flow path indicating the position from where the graphics obtain information.

5. Double-click the small graphics display to open the graphics dialog.

6.   Make the following entries:

  IQ Source   `AWGN`
  Mode   `FFT Magnitude`

7.   To display the graphics dialog for the baseband signal, in the Main window, select **Graphics**, point
  to **Graphic 1**, and click **Graphic 1 (Complete)**.
  The Graphics dialog for the baseband signal opens.

8.   Make the following entries:

  IQ Source   `Baseband`
  Mode   `FFT Magnitude`

9.   To display the baseband and AWGN signals, in the Main window, select **Graphics**, point to
  Graphic 3, and click **Graphic 3 (Complete)**.
  The Graphics dialog opens.

10. Make the following entries:

  IQ Source   `Baseband+AWGN`
  Mode   `FFT Magnitude`

11. Close all graphics dialogs.
  You can now see the graphical representation before summation with AWGN, with AWGN only, and
  after the summation point (noise afflicted baseband signal).
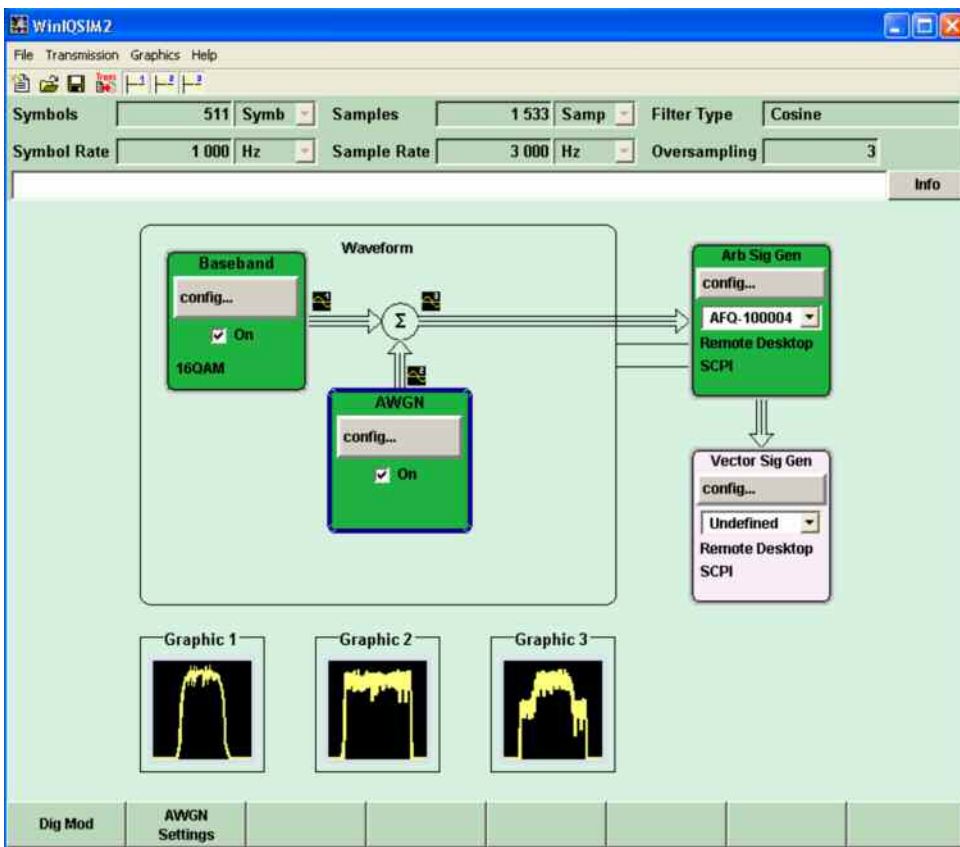
Example - Transmitting the Signal to the R&S AFQ

Before you can transmit the waveform to the R&S AFQ, you have to ensure that the connection to the R&S AFQ is enabled. This is indicated by two thin lines leading from the R&S WinIQSIM2 block to the **Arb Sig Gen** block.

In case of crossed lines, the connection has to be established before the waveform can be transmitted to the instrument.

The prerequisites for a successful connection to the instrument are:

– Instrument is switched on
– Instrument accessible either via TCP/IP (LAN), GPIB, or USB
– Remote Desktop is enabled in the instrument's operating system
– Firewall is off in the instrument's operating system

By default, the firewall is on and Remote Desktop is disabled, so you have to change the settings.

There are two ways to change the settings:

– When starting up the AFQ
– Via Control Panel of the instrument's operating system

To change the settings when starting up the AFQ:
1.   Switch off the AFQ, and switch it on again.
2.   When during startup the status LEDs on the AFQ's front panel start to flash counterclockwise, push the Trigger button of the AFQ.

  This disables the firewall and enables Remote Desktop of the AFQ's operating system.

  When you connect to the instrument via Remote Desktop, you are asked if you want to either permanently disable the firewall and enable the Remote Desktop or for the current session only.

  Now the R&S AFQ is ready to play and the waveform can be created.

To disable the firewall of the AFQ via Control Panel:
1.   Click **Start**, click Control Panel, and double-click **Windows Firewall**.

  The **Windows Firewall** dialog opens.
2.   On the General tab, activate Off (not recommended).
3.   Click **OK**.

  The Windows Firewall is disabled.

To enable Remote Desktop of the AFQ via Control Panel:
1.   Click **Start**, click Control Panel, and double-click **System**.

  The **System Properties** dialog opens.
2.   Click the Remote tab, and activate Allow users to connect remotely to this computer.
3.   Click **OK**.

  Remote Desktop is enabled.

To transmit the signal to the AFQ, perform as follows:

1. In the Main window, in the tool bar, click the *Transmit* button .

    The **Waveform Transmission To Arbitrary Signal Generator** dialog opens.

WinIQSIM2: Waveform Transmission To Arbitrary Waveform Generator "Undefined"

User Comment for File/Waveform

Source

Internal (WinIQSIM2) | File...

Destination

Instrument | File...

☐ Automatically Load And Start Waveform

Transmit Waveform

Transmit

---
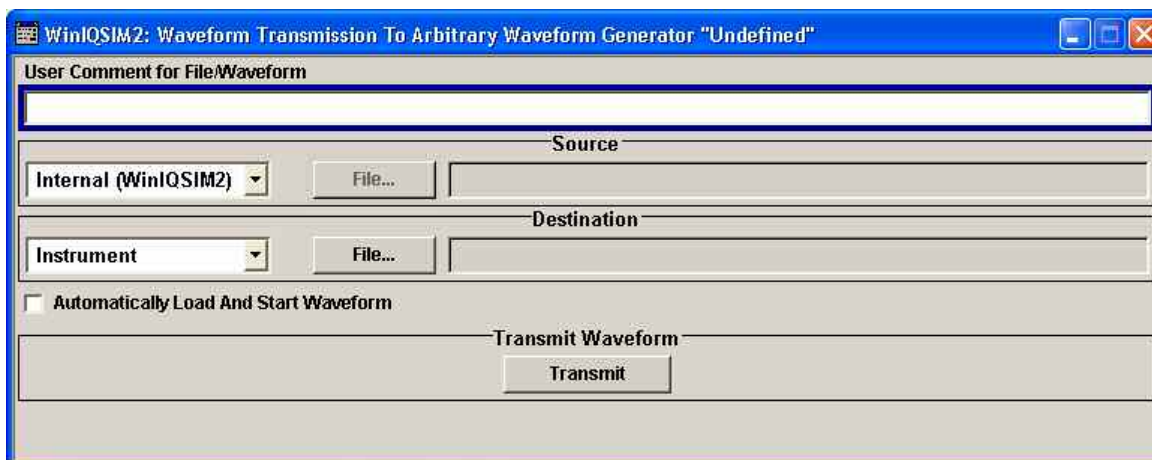
2. In the Source group box, select `Internal (WinIQSIM2)`. The file generated latest is chosen.

3. In the **Destination** group box, choose Instrument and click the **File** button.

    A file browser dialog of the destination device opens to prompt the destination file name. Type in a file name and click **OK**.

4. Enable the **Automatically Load and Start Waveform** check box. After the waveform has been successfully transmitted to the device, the signal will immediately be generated by the R&S AFQ.

5. Click the **Transmit** button to start the transmission.

    A progress bar indicates the status of the transmission process. If the transmission has been successful, the waveform will be loaded into the ARB and is available at the output connectors of the R&S AFQ.

Graphical User Interface

In the following, a detailed description of the R&S WinIQSIM2 user interface is given. The Main window with the block diagram is the operating and control interface for the whole program. From here, all program functions are accessible. This panel is displayed after the start of R&S WinIQSIM2. The program always loads the previously used settings so you can continue your work in the next session.

Operating Menu and Toolbar in the Main Window

At the top of the Main window of R&S WinIQSIM2, there are the menu bar, the tool bar, and the Info bar with its corresponding Info button.
To offer the user a familiar environment, operation is very similar to operation of MS Windows user interfaces. All menus and dialogs are built using known elements, e.g., selection lists, check boxes, and entry fields.
A blue frame indicates that the selected item is active. In the highlighted element, entries can be made.

Content of the menu

File	Transmission	Graphics	Help
New	Instruments	Graphic 1	Contents
Open	Transmit	Graphic 2	Index
Save		Graphic 3	
Save as			
Setup			
Exit			

The main menu functions are also accessible via the toolbar with its icons below the menu selection line.

Toolbar icons in R&S WinIQSIM2

	New	Resets the system to default.
	Open	Loads a previously stored configuration file containing all settings.
	Save as	Stores all settings made by R&S WinIQSIM2 in a configuration file.
	Transmit	Opens the Transmit dialog.
	Graphics	Activates the small graphics display at the bottom of the diagram.

Signal Information Bar in the Main Window

Below the toolbar, the **Signal Information bar** is located.

Symbols	0	Symb ▾	Samples	0	Samp ▾	Filter Type	Filter unknown
Symbol Rate	0	Hz ▾	Sample Rate	0	Hz ▾	Oversampling	0

In the **Signal Information bar**, the following fields and boxes are displayed:

Symbols	Number of symbols.
Symbol Rate	Rate (symbols/sec) at which the symbols are sent.
Samples	Number of samples, respectively the number of symbols times over sampling factor.
Sample Rate	Rate (samples/sec) at which the samples are sent, respectively the symbol rate times over sampling factor.
Filter Type	Type of the filter that is applied to the signal.
Oversampling	Factor by which the symbols have been upsampled to obtain the waveform samples.

Messages in the Info Bar

Messages indicate information, warnings, and errors. They are displayed in the info line in different colors depending on their importance and display duration. A few operating states and the current messages are displayed in the info line. For information on messages in greater detail and their management, an **Info** dialog can be opened.

The following messages are displayed:

◆   **Error**: An error, e.g., settings conflict, is displayed in red color. There are two options:

−   Critical: Prevents R&S WinIQSIM2 from working, e.g., a DLL file version does not match. Critical errors are displayed in red color.

−   System: Concerns the operating system, e.g., wrong file path. System errors are displayed in black color.

◆   **Information**: The information, e.g., file not found, is displayed in black color.

◆   **Warning**: A warning indicates a less significant error and is displayed in black color.

◆   **Brief message**: Brief messages report automatic settings in the program, e.g., switching off of incompatible types of modulation, or on illegal entries that are not accepted by the program, 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.

Brief messages usually do not demand user actions and disappear automatically after a short period of time. They are stored in the history, however.

◆   **Permanent messages**: Permanent messages are displayed if an error occurs that impairs further program operation. The error signaled by a permanent message must be eliminated before correct software 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.

Managing Messages in the Info Dialog

A few operating states and the current messages are displayed in the info line. For information on messages in greater detail and their management, an info dialog can be opened.

1. In the Main window, click the **Info** button.

    The **Info** dialog opens.
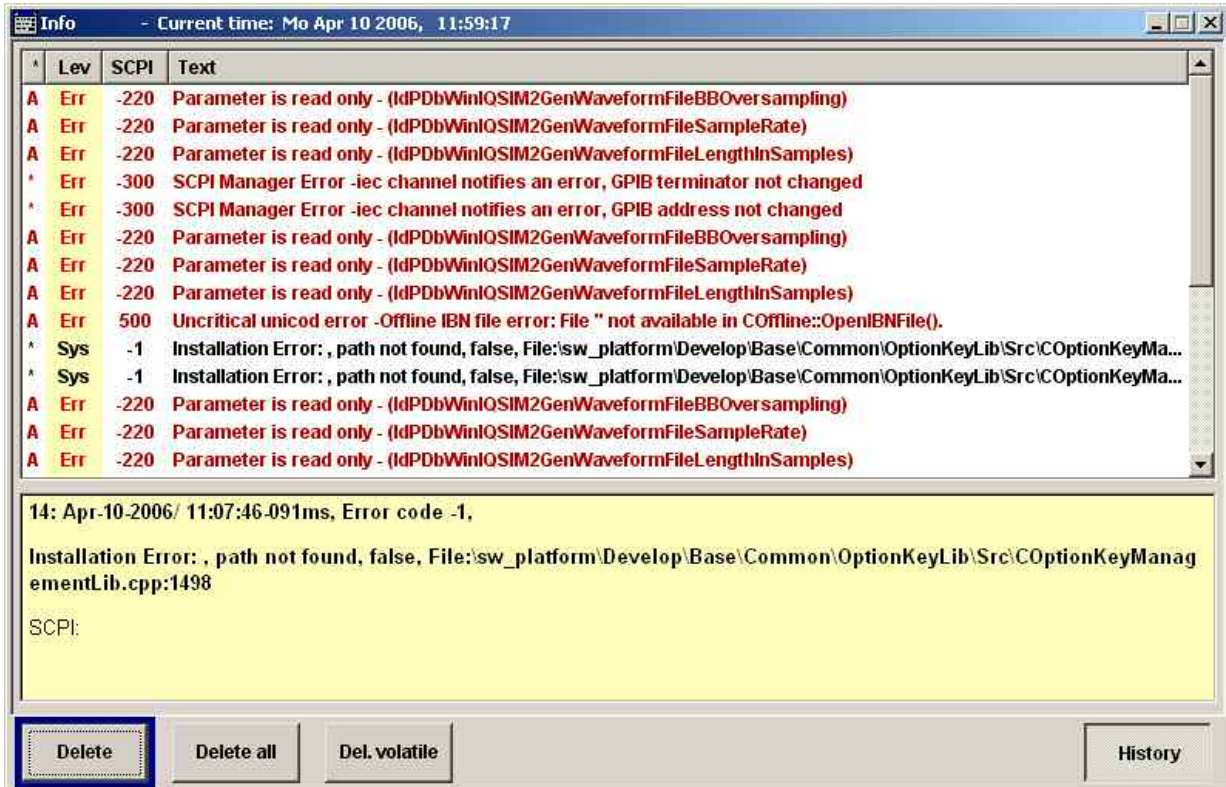
A list of currently active permanent messages and a detailed description of each message is shown. The messages are color-coded according to their level.

In the **Info** dialog, in the upper section, the following columns are displayed:

*   Signal path

The following signal path might occur:

−   **A:** Path A

−   *** :** No path is assigned

LEV   Message level. Messages referring to a logical component of WinIQSIM2, e.g., Unicode, are marked in red color, info messages are marked in black color.

The following levels might occur:

−   **Err**: Error message

−   **Info**: Information message

−   **Sys**: System message

−   **Crit**: Critical message

For more information see section *Messages* in the Info Bar, page *23*.

SCPI	Indicates the SCPI error code.
Text	A list of all currently permanent messages in the order of their occurrence, i.e., the most recent message is displayed first.

With the following buttons, error messages can be cleared and a history of all messages can be displayed:

Delete	Clears the highlighted message. This button is available only if the history of the messages is displayed.
Delete All	Clears all messages. This button is available only if the history of the messages is displayed.
Del. volatile	Clears all brief messages. This button is available only if the history of the messages is displayed.
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.

Getting Additional Information on the Message

◆   In the **Info** dialog, click a message to select it.

In the lower section of the dialog, additional information on the highlighted message is displayed.

Displaying all Messages

◆   In the **Info** dialog, click the **History** button.

A history of all messages that have occurred since R&S WinIQSIM2 software was started is listed in the upper dialog pane. The most recent message is displayed first.

Deleting an Error Message

◆   In the **Info** dialog, select the highlighted message and click the ***Delete*** button.

The highlighted message is cleared.

This button is available only when the history of the messages is displayed.

Deleting all Error Messages

◆   In the **Info** dialog, click the ***Delete All*** button.

All messages are cleared.

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

Deleting all Brief Messages

− In the **Info** dialog, click the **Del. volatile** button.

  All brief messages are cleared.

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

Calling the History

1. In the **Info** dialog, click the **History** button.

    A list of all messages that have occurred since instrument switch-on is displayed. The most recent messages are displayed at the top of the list.
2. Click the **History** button once more.

    A list of current messages is displayed.

File Menu

In the following, the **File** menu of the R&S WinIQSIM2 Main window is described in detail. It incorporates the standard submenus and additionally a **Setup** submenu.

New

Resets R&S WinIQSIM2 to default.

Open

Opens the standard file open browser for loading a saved R&S WinIQSIM2 file (∗.savrcl). The WinIQSIM2 file contains the user specific settings of a WinIQSIM2 session, such as baseband settings, instrument settings, graphic display settings, etc. The complete settings of a WinIQSIM2 session can be saved and loaded.

Only files of this type are selectable.

Save

Standard quick save of the settings of the current WinIQSIM2 session if a file name previously has been applied. If not, the **Save as** dialog is opened.

For more information see section *Save as* below.

Save as

Opens the standard file save browser for saving the settings of the current R&S WinIQSIM2 session. R&S WinIQSIM2 files have the file extension .savrcl so the name typed in is equipped with this extension. The complete settings of a WinIQSIM2 session are saved.

Setup: Software/Options

1. From the *File* menu, select *Setup → Software/Options*.

    An info dialog opens, showing program information.
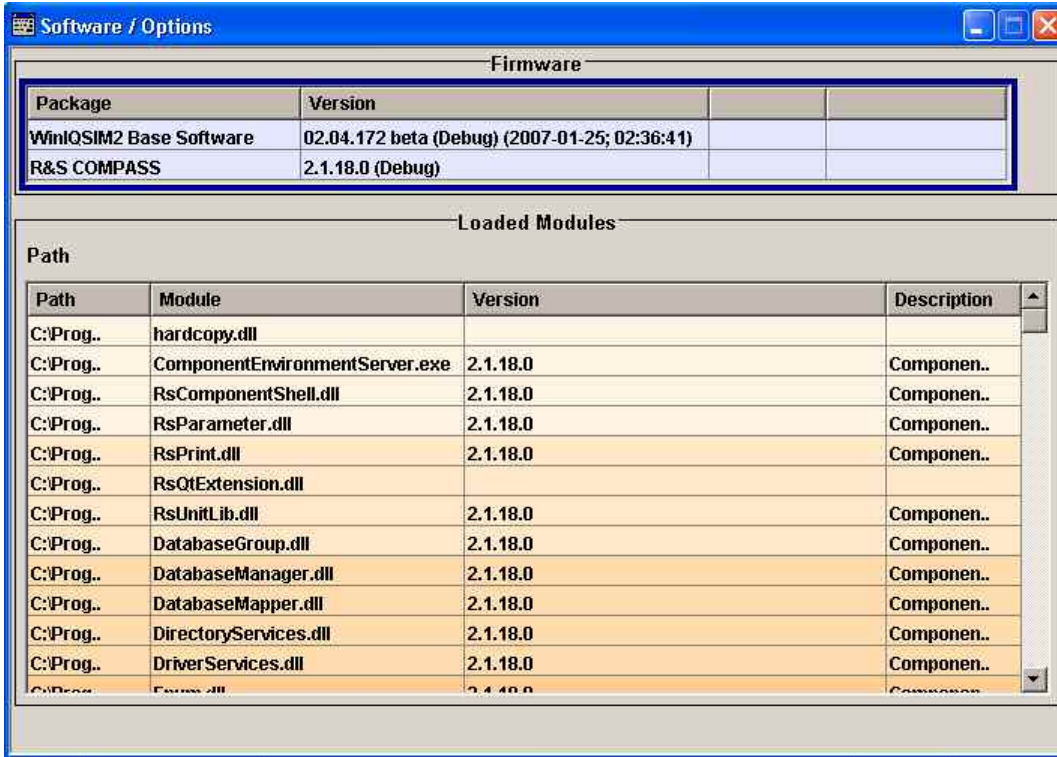
2. In the group box *Firmware*, the following columns are displayed:

Package	Installed software packages.
Version	Release of the software package.

    In the group box *Loaded Modules*, the following columns are displayed:

Path	Path to the file location.
Module	A module file.
Version	Version of a file.
Description	Description of the module file.

Note:
*In the **Description** column, double-click a cell to get detailed information. For your convenience, the rows have a colored background.*

Setup: Temporary Files

You can define a location where you want to save the temporary WinIQSIM2 files.
1.   From the *File* menu, select *Setup → Temporary Files*.

The *Temporary Files* dialog opens.
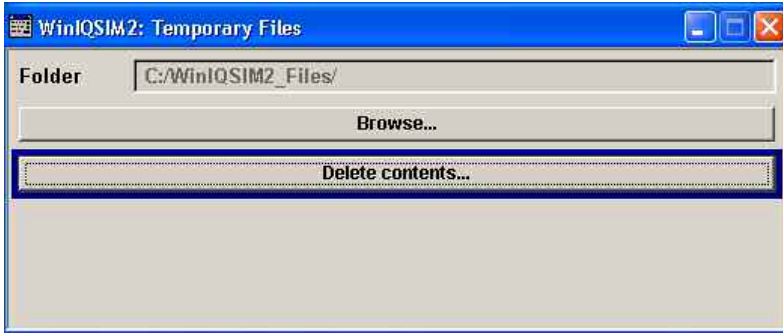
2.   In the *Folder* field, the currently selected location for temporary WinIQSIM2 files is displayed.

3.   To change the folder, click *Browse*.

The *Browse For Folder* dialog opens.

4.   Select the folder of your choice, and click *OK*.

The selected folder is displayed with the complete path in the **Folder** field.

5.   To delete the contents in the folder, click *Delete contents*.

A message box opens.

6.   Click **OK** to delete all the files in the folder.

Exit

Quits R&S WinIQSIM2. The current settings of the WinIQSIM2 session are saved and loaded by default when starting WinIQSIM2 again.

Transmission Menu

In the following, all settings that are responsible for transmission of the waveform file from R&S WinIQSIM2 to the instrument are described.

Creating New Instruments

Before a transmission can take place, the connected instruments must be selected and the connection must be configured. The general instrument settings affect various functions, e.g., the maximum size of the file the waveform is stored in. Therefore it is important, that the instrument is selected and configured **before** waveform generation take place.

1. In the Main window, select *Transmission → Instruments*.

   The **Configure Instruments** dialog opens.
2. Click the *New* button.

   The **Configure Instruments - New** dialog opens to register a new instrument. The number of the instrument is counted by R&S WinIQSIM2 by default.

3. In the *Symbolic Name* field, enter an alias name of your choice.

4.   In the **Instrument Type** field, select the device family to connect to.

   There are the following options:

	SMU/B9	SMJ/B9	SMATE/B9	AMU/B9
	(256 MSamples)	(256 MSamples)	(256 MSamples)	(256 MSamples)
AFQ/B10	SMU/B10	SMJ/B10	SMATE/B10	AMU/B10
(256 MSamples)	(64 MSamples)	(64 MSamples)	(64 MSamples)	(64 MSamples)
AFQ/B11	SMU/B11	SMJ/B11	SMATE/B11	AMU/B11
(500 MSamples)	(16 MSamples)	(16 MSamples)	(16 MSamples)	(16 MSamples)
		− SMJ/B50		
		(64 MSamples)		
		SMJ/B51		
		(16 MSamples)		

Note:
   The option selected determines the maximum number of samples that can be generated.

5.   In the **Instruments Limits** group box, important limits of the selected instrument are displayed.
6.   If Remote Desktop is used or the remote control connection via LAN interface is chosen, fill in the IP Address or instrument name (see below) for the connected instrument in the **Instrument Name/IP Address** field of the **Remote Desktop** group box.
7.   In the **Hardware Channel** field of the **Remote Control** group box, select the VISA connection. For each of the channels, unique address information is required, the user interface changes accordingly.

Channel	Address name
USB	Serial Number, e.g., 100012 The number can be found on the rear panel of the instrument, above the barcode.
TCP/IP	Instrument name of the Remote Desktop. The instrument name consists of the following parts: RS+<*instrument name*>+<*serial number*> You find the 6-digit serial number on the rear panel of the instrument. Example: RSAFQ100A100010
GPIB	Address, e.g., 19

8.   Click **OK** to confirm the settings and to close the dialog.
9.   Click the **Apply** button to confirm the settings.
10. Click **Cancel** button to discard settings and to close the dialog.

Editing Instruments

1.   In the *Available Instruments* group box, the instruments are listed.
2.   Select the instrument to be edited and click the *Edit* button.

     The *Configure Instruments - Edit* dialog opens.
3.   Change the settings and click *OK*.

     The settings are edited.

Scanning for Available Instruments

1.   Open the **Configure Instruments** dialog by selecting **Transmission → Instruments**.

     The **Configure Instruments** dialog opens:
2.   Click the **Scan** button to scan the desired domain for the instrument.

     All instruments in the desired domain which are connected to the LAN or via GPIB or USB and being switched on are displayed in the **Available Instruments** list. WinIQSIM2 obtains all information for connecting to the instrument, so further configuration is not necessary.

     For further details regarding the prerequisites using the scan feature, refer to *Example - Configuring an Instrument*, page 13.

Deleting Instruments

1.   In the Main window, select *Transmission → Instruments*.

     The **Configure Instruments** dialog opens.
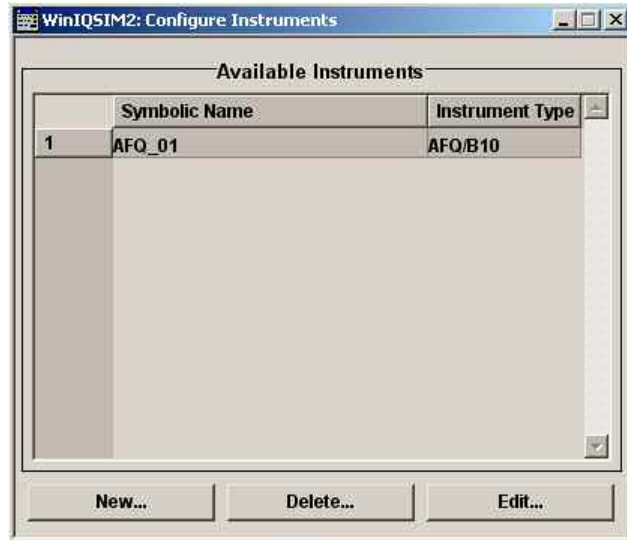
2.   Select the instrument to be deleted and click the *Delete* button.

     The selected instrument is deleted.

Transmitting the Signals

1. In the Main window, select *Transmission → Transmit*.

    The **Waveform Transmission To Arbitrary Signal Generator** dialog opens.
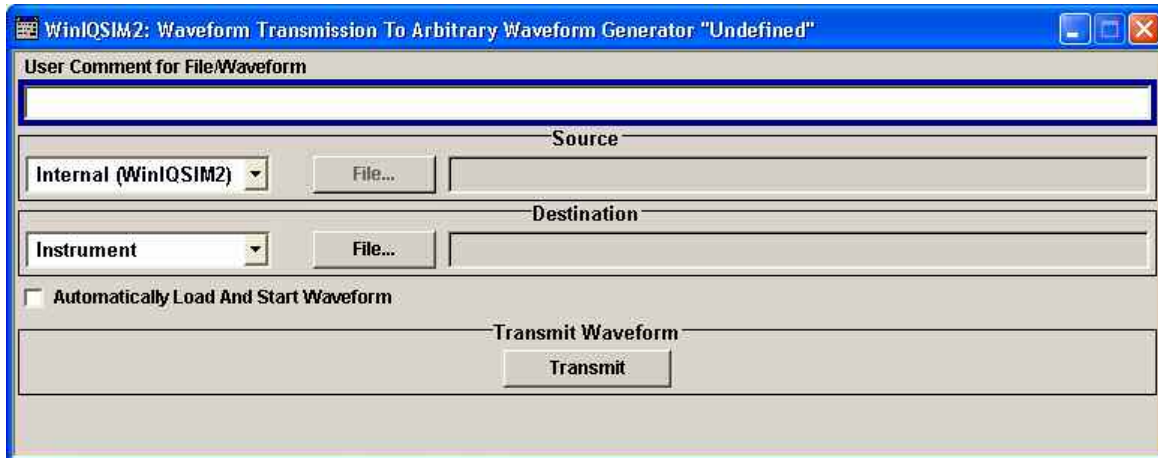
2. In the *User Comment for File/Waveform* field, additional information can be given, e.g., for identifying a file. The comment is written into the file and is shown in the **<Instrument> file open** dialog.

Note:
  Filling out this field is optional.

3. In the *Source* group box, there are two options:
−   **Internal**
    The internal waveform file produced by the last signal generation is used as the transmission source.
    Because it is an internal file name, the file name of this file shown in the text field cannot be modified.
−   **File**
    A file on the PC is used as the transmission source. You are prompted to choose an existing waveform file by the file browser. Select the file you want to transmit.
4. In the **Destination** group box, there are two options:
−   **Instrument**
    Transmits the waveform to the instrument. Select Instrument and click the File button. You are prompted to select or to type in a file name from the instrument.

Note:
  In the instrument, the typed in name will be used and not the original name of the file.

−   **File**
    Copies the waveform file to another file on the PC. Choose File, and click the File button.
    By clicking the File button, you are prompted to select or type in a file name on your hard disk. If you select a file as source and a file as destination, the transmission will be a simple copy operation.
    If the Automatically Load And Start Waveforms check box is activated, the waveform file is copied to the hard disk of the instrument, loaded into the ARB, and started. The signal is immediately available at the I/Q output connectors.
    If the checkbox is disabled, the waveform is copied from PC's hard disk to the instrument's hard disk.
5. In the *Generate and Transmit Waveform* group box, click the *Transmit* button.

    The waveform is transmitted and saved according to the settings.

Graphics Menu

In the following, all settings concerning graphics are described. The output signal can be graphically displayed in a number of diagrams. This allows a fast check of signal characteristics. Zoom functions permits in-depth evaluation.

1.   In the Main window, select Graphics → Graphic 1 → Graphic 1 (Preview Only).

Below the block diagrams, a small representation of the graphics dialog appears. A graphics icon ![icon] in the signal flow indicates the signal source (either **Baseband**, **AWGN**, or **Baseband + AWGN**).

2.   Double-click the graphic.

The **Graphic 1** dialog opens.

Graphic 1-3

The graphical display of the waveform enables the user to rapidly check signal characteristics. Zoom functions allow in-depth evaluation.
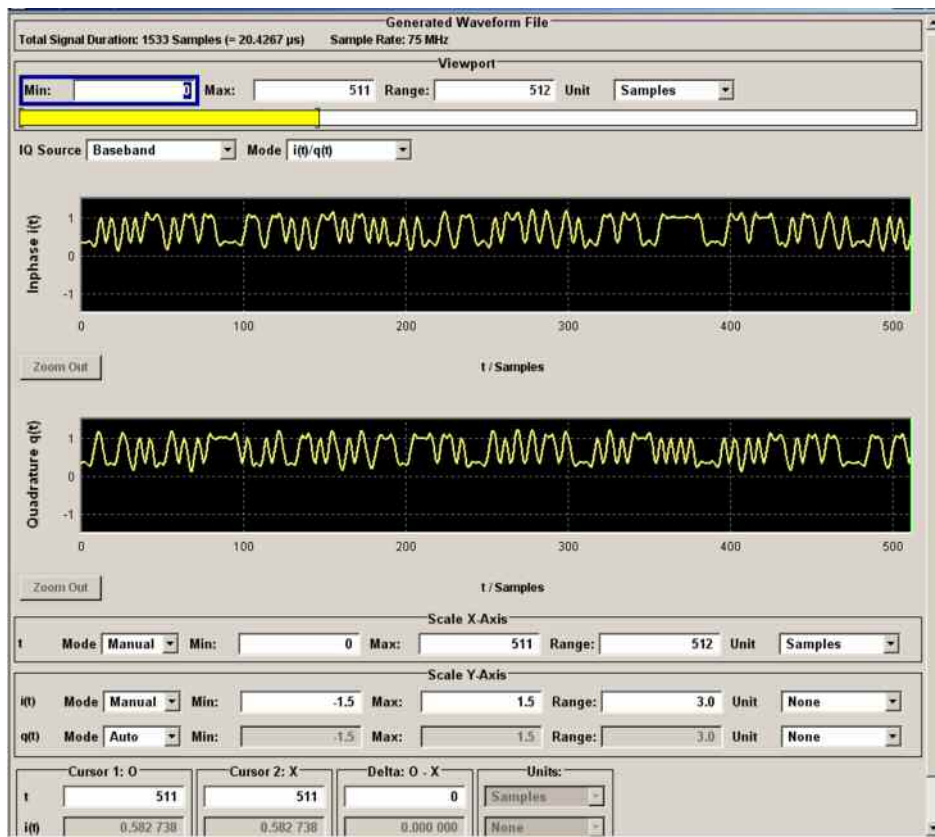
The *Graphic* dialog consists of three main parts:

− Generated waveform file

− Viewport selection

− Graphics area with scaling option and cursor settings

Since the behavior of these parts mostly depends on each other, the functions are explained without a strict separation into these parts.

Generated Waveform File

In the group box *Generated Waveform File*, information on signal duration and sample rate is displayed.

Total Signal Duration	Displays the signal duration in seconds of the available samples within the generated waveform file. Remote-control command: `GEN:WAV:DUR?`

Sample Rate (fc)	Dispalys the Sample Rate in [Hz], that is calculated as follow:
	The Sampling Rate = Number of Symbols * Oversampling Factor.
	Remote-control command:
	`GEN:WAV:SAMP?`
	`GEN:WAV:SRAT?`

Oversampling Factor	Displays the baseband oversampling factor. This parameter is determined by the content of the generated waveform file. To adjust the oversampling rate, set the corresponding parameters defined within the standards. Remote-control command: `GEN:WAV:OSAM?`

Viewport

In the following, the selection of the displayed area of the waveform takes place. Information about the total duration of the signal and the sample rate is given.

Note:
There is no limitation to the length of the waveforms. Long waveform streams are divided in packets of an displayable size and are then displayed packet-wise.

In the *Viewport* group box, the following fields are displayed:

Min	Begin of scope.
Max	End of scope.
Range	Delta between values in the *Min* and in the *Max* fields.
Unit	Units of the *Min*, *Max*, and *Range* values. If the unit is changed, the values contained in the *Min*, *Max,* and *Range* fields will be converted. Subsequently, the values in the new unit can be changed.

Note:
*It also possible to set the *Min* value and the *Range* value, the *Max* value will be adjusted automatically.*

The Viewport bar indicates the following information depending on the selected mode of representation:

Mode	Viewport ▭	Yellow Bar	White Bar
i(t)/q(t) **r(t)/q(t)**	Scope, within the scaling of the X-axis can be shifted against the display.	Scope which is viewed	Total signal
FTT	Maximum observed scope	Actually used scope for FTT	Total signal
Vector **Constellation** **Eye** **CCDF**	Observed scope	Irrelevant	Total signal

1. In the **IQ Source** field, select whether the signal is displayed before summation with AWGN, with AWGN only, or after the summation point (noise afflicted baseband signal).
2. To control the mode of representation, select it in the **Mode** combo box.

    The following modes are implemented:

`i(t)/q(t)`	Displays the actual waveform over time in two windows: the top one for inphase, the bottom one for quadrature samples.
`r(t)/phi(t)`	Displays the actual waveform over time in two windows: the top one for amplitude, the bottom one for phase values.
`Vector`	The samples are depicted in the complex plane, transitions displayed as vectors.
`CCDF`	Complementary Cumulative Density Function
`FFT Magnitude`	Spectrum (magnitude over frequency) derived from a Fast Fourier Transform of the signal.
`Constellation`	All sample points displayed in the complex plane.
`Eye(i/q)`	Eye diagram of I and Q samples. Superposition in time of symbol transitions sampled at symbol rate.

    Depending on the selected mode, the graphical representation is adapted.

For more information see section *Graphical Representation of Waveforms* below.

Graphical Representation of Waveforms

After the mode of representation is set, the actual graphical representation of the waveform is displayed. The waveforms can be analyzed and checked.

There are two ways of zooming into a representation for measurement:
– By mouse
– By value entry

Zooming into a representation by mouse

◆ To zoom into a displayed part of a waveform, position the mouse cursor in the top left-hand corner of the graph area to be zoomed. Click the left mouse key and hold it down.
The mouse cursor will change its shape to a cross-hair. Move the mouse cursor to the bottom right-hand corner of the section to be zoomed. While you move the cursor, a dotted rectangular frame will be drawn between the start point and the current cursor position. The frame marks the area to be zoomed. When the mouse has arrived at the end of the area to be zoomed, i.e. when the whole area is within the red frame, release the left mouse key. The selected area is shown expanded.

Zooming into a representation by value entry

Directly beneath the graphics area, the scaling section with *Scale X-Axis* group box and *Scale Y-Axis* group box is located. The behavior for X- and Y-axis is identical. For that reason, the function is explained only once.

◆ In the *Scale X-Axis* group box, in the *Mode* combo box, there are two options for scaling of modes:
– Auto
– Manual
If *Auto* is selected, the scaling works automatically and all entry fields are inactive. Only the unit of the values which will adapt in the gray entry fields can be selected. The automatic scaling for the X-axis takes the values of the Viewport; the Y-axis scaling is calculated from the maximum and minimum value of the samples displayed.
If *Manual* is selected, the scaling is fully adjustable by the user. The area that is to be zoomed is set by the *Min* and *Max* values. The **Range** value is then adapted. As in Viewport, you can as well set the *Min* and the *Range* value. The *Max* value is adapted then.

Note:
The scaling values can never be higher or lower than the scaling values set under Viewport.

By means of the *Unit* combo box, the unit of the values can be changed again, the values are converted automatically.

Setting graphics cursors into a representation

There are two cursors available for measurements inside the graphs: A red cursor and a green one. The cursors are shaped as a vertical line. The cursors can be placed by mouse in certain positions.

1. Left-click on one of the cursors and hold down the left mouse button. Drag the mouse to the position where you want to place the cursor. Release the mouse button.

Note:

> *If you choose a Viewport where the cursors are not located, it will be impossible to use the mouse to manipulate the cursors. In this case or in order to place the cursors precisely, the cursor can be positioned by an* **value entry***.*

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2. In the ***Cursor 1*** group box, the cursor position on the X-axis is set. In the ***Cursor 2*** group box, the cursor position on the Y-axis is set. Type the exact position in the ***t*** field.

    The cursor moves to the defined position, giving the Y-axis values in the ***i(t)*** und ***q(t)*** fields. The values are not editable. In the ***Delta: 0 - X*** group box, the difference (delta) between the X-axis value and Y-axis value of the cursor position is displayed.

3. Optional, in the ***Delta: 1 - 2*** group box, a value can be entered and the red cursor will adapt to the desired delta value.

    The signal can be analyzed.

Zoom Out **button**

If a waveform has been zoomed, the ***Zoom Out*** button changes from inactive to active. The ***Zoom Out*** button always returns the display to the state before all zoom operations.

Help Menu

R&S WinIQSIM2 is equipped with a context-sensitive help function. A help page can be called any time during software operation. The context-sensitive page which is opened with the ***F1*** button is part of a comprehensive help system. It is possible to move from this context-sensitive page to any page of the help system. An overview of the contents of the online help can be reached via the menu ***Help →*** ***Contents***. A search for keywords within the help function is available via menu item ***Help → Index***.

Main Window - Signal Flow Diagram

The block diagram's look-and-feel is based on the R&S SMU firmware.
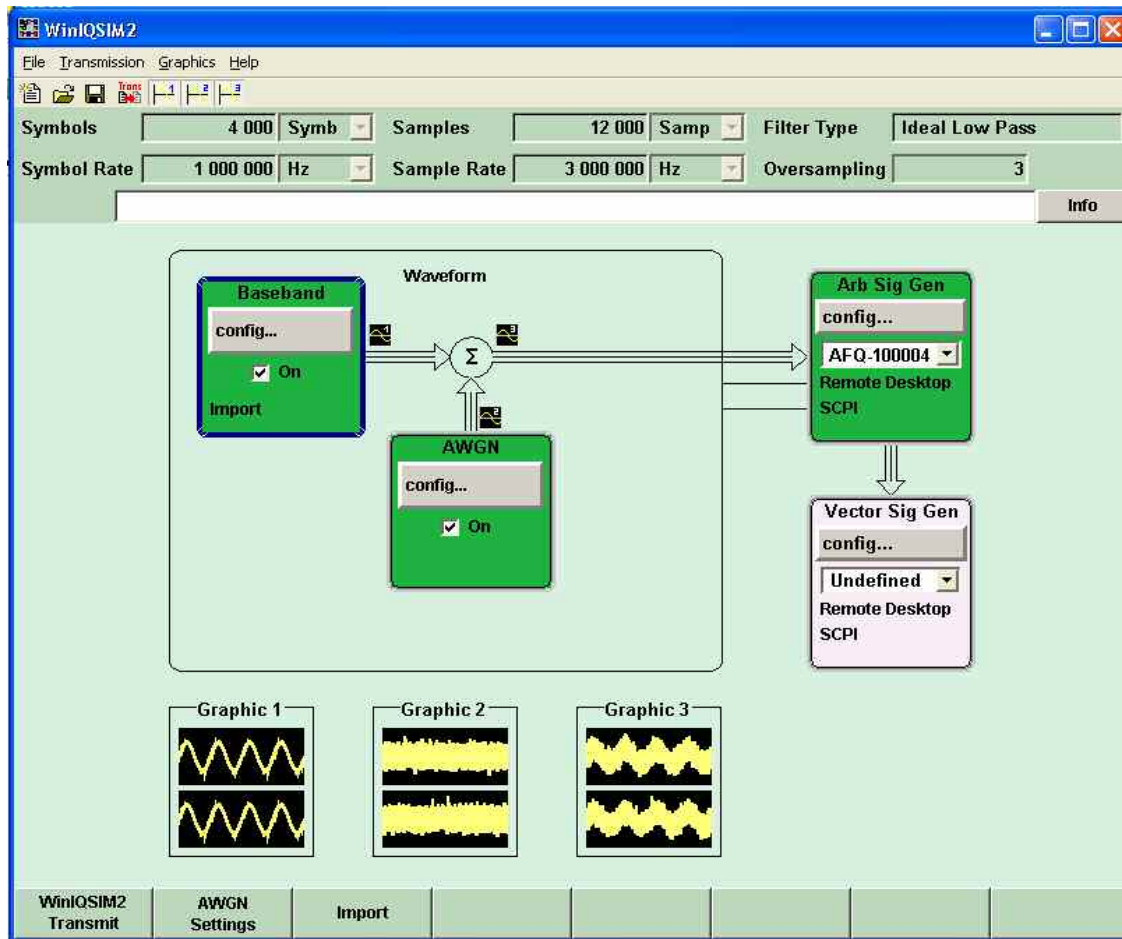
The signal flow diagram is the core control element of R&S WinIQSIM2. The framed area symbolizes R&S WinIQSIM2 containing the blocks for signal generation and signal alteration. The block diagram shows provided options, signal configuration, and the signal flow of the generator. Signal generation can be completely operated from the block diagram. The highlighted function block can be directly switched on and off with the On / Off check box.

The Main window of R&S WinIQSIM2 contains the whole system: The PC running R&S WinIQSIM2 displayed as one entity in the frame as well as the connected instruments. The user controls the whole system from one panel.

The signal flow is represented by thick arrows. Summation points are indicated by a sum sigma. Control connections are displayed as thin lines leading from R&S WinIQSIM2 to the corresponding blocks that represent external instruments. Invalid connections are symbolized by crossed out lines.

Each block represents a function of signal generation. The function is indicated in the headline of the block, e.g., **Baseband**. In this block, digital standards, custom digital modulation, and multi carrier scenarios are set, for instance. In the **AWGN** block, additive white gaussian noise can be added to the baseband signal.

Outside the frame, the signal or modulation generators that are connected or can be connected are symbolized by two blocks; **Arb Sig Gen** represents the ARB Modulation Generators and **Vec Sig Gen** represents the Vector Signal Generators. Two connection lines symbolize the two possible connections (**Remote Desktop** or **SCPI**) between the PC with WinIQSIM2 and the instrument.

Working with the Baseband Block

1. In the **Baseband** block diagram, below the **config** button, the state check box is located. Here, the states On or Off of the component block are controlled. By activating the block, it turns its color to green and contributes to the signal flow from now on. Click the **config** Button.

    A menu with a list of optional standards opens.

2. In the menu, the following digital standards can be set:

TDMA standards

– GSM/EDGE	Generation of waveforms according to the digital standard GSM/EDGE.

CDMA standards

– 3GPP FDD	Generation of waveforms according to the digital standard 3GPP FDD, release 8, including HSDPA, HSUPA and HSPA+.
– CDMA2000	Generation of waveforms according to the digital standard CDMA200, release C, in line with 3GPP2 C.S0002-C, including 1xEV-DV.
– TD-SCDMA	Generation of waveforms according to the digital standard WCDMA 3GPP TDD LCR (TD-SCDMA)
– 1xEV-DO	Generation of waveforms according to the digital standard 1xEV-DO, in line with Release A.

WLAN standards

– IEEE 802.11 WLAN	Generation of waveforms according to the digital standard IEEE 802.11 a/b/c, in line with IEEE 802.11a-1999, IEEE 802.11b-1999, IEEE 802.11g-2003.
– IEEE 802.11n	Generation of waveforms according to the digital standard IEEE 802.11 n, in line with IEEE 802.11n - Release D4.0

− UWB MB-OFDM	Generation of waveforms according to the digital standard ECMA-368, in line with Release Candidate 1.2s

Beyong 3G Standards

− IEEE 802.16 WiMAX	Generation of waveforms according to the digital standard IEEE 802.16, in line with IEEE 802.16-2004/Cor1-2005 and 802.16e-2005 nad IEE 802.16-Rev2/D3.
− EUTRA/LTE	Generation of waveforms according to the digital standard EUTRA/LTE.

Broadcast Standards

− DVB	Generation of waveforms according to the digital standard DVB-H (Digital Video Broadcasting - Transmission System for Handheld Terminals).

misc

− Custom Digital Mod	There are two options: − Generation of waveforms with common modulation and coding schemes − Generation of waveforms with user defined parameters
− Multi Carrier CW	Generation of continuous waveforms on multiple different carriers.
− Multi Carrier	Generation of waveforms built from previously generated waveforms on multiple different carriers.
− Multi Segment	Generation of waveforms built from previously generated waveforms to form a segmented waveform.
− Import	Import of waveforms via server stream.

3. By selecting one of the offered options, a dialog opens. Parameter entries for the selected digital standard can be made.

   Example: Standard **3GPP FDD**
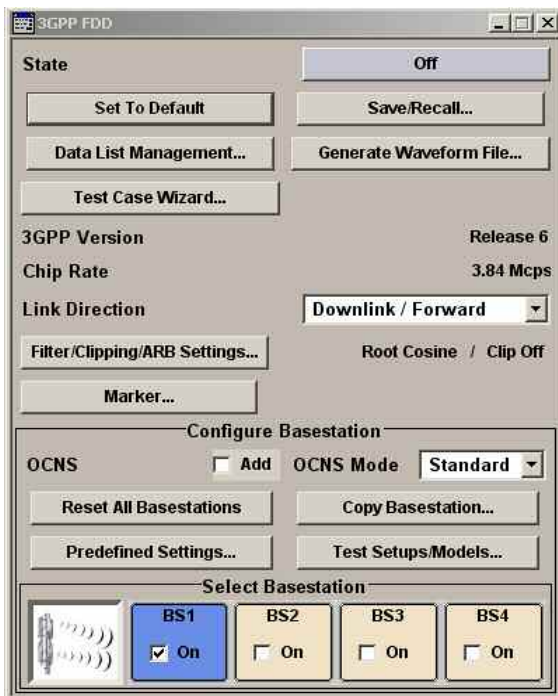
For more information on generation of digital standard waveforms, see the context-sensitive help page of the corresponding dialog (opened with the **F1** button) or the help system. An overview of the contents of the online help can be reached via the menu *Help → Contents*.

Some of the hardware specific components of the instruments are not relevant for R&S WinIQSIM2, because R&S WinIQSIM2 is not based on real time hardware. For this reason, the following features are not supported:
−Trigger
−Clock
−Marker delay
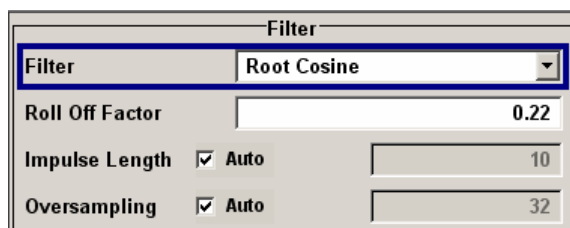
The following filter parameters are added to R&S WinIQSIM2:
− Impulse length
  Displays the number of filter tabs. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.
− Oversampling
  Determines the upsampling factor. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

Note:
  When the digital standard is activated, a coherence check is performed. The entries are checked. The following parameters are part of the check:
  Sequence length, impulse length, oversampling, and instrument limits.
  When the coherence check is positive, the waveform is generated and the internally used parameter values are displayed in the gray fields.

Working with the AWGN Block

The noise generator generates an AWGN signal (Additive White Gaussian Noise) in the digital baseband, i.e. the noise power density has a Gaussian distribution and is distributed evenly across the frequency. This noise signal superimposes the (interference-free) useful signal (**Additive Noise** mode). Typical applications for the noise generator are bit-error or block-error measurements, depending on the set C/N ratio.

The Gaussian noise is generated by means of software feedback shift registers with subsequent probability transformation. The switching configuration is such that virtually ideal statistical characteristics are achieved:
− I and Q paths are decorrelated from each other.
− The crest factor of 18 dB allows very small probabilities to be realized.

Apart from the **Additive Noise** mode, there are also the **Noise Only** and the **CW Interferer** mode. In the **Noise Only** mode, a pure noise signal is generated and modulated to the carrier. In the **CW Interferer** mode, a sinusoidal signal with an adjustable frequency offset to the baseband signal is generated and added to the baseband signal.
The achievable noise bandwidth can not exceed the sampling rate of the baseband. This rate is assumed to be 50 MHz in case of **Noise Only** where 100.000 samples are generated.

Adding AWGN to the Baseband Signal

1. In the *AWGN* block diagram, click *config*.

   The *AWGN Settings* dialog opens.
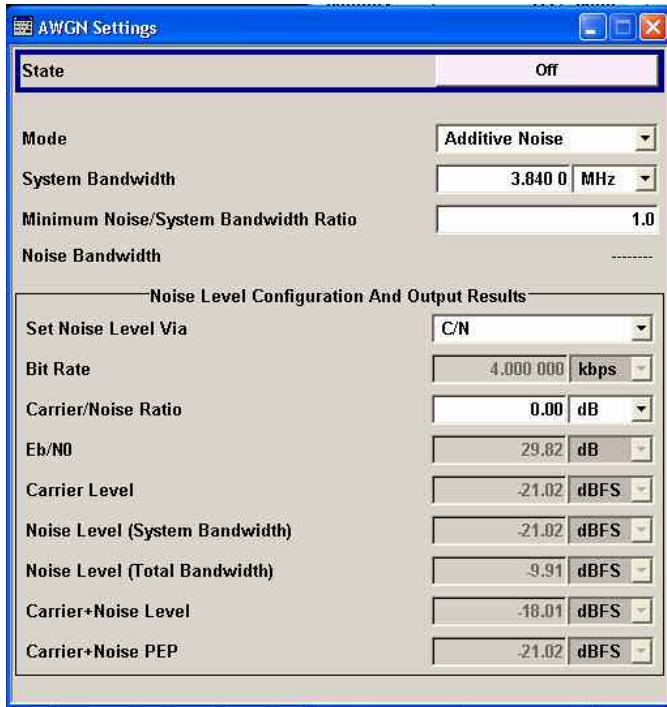
2. In the **A***WGN Settings* dialog, the following fields and buttons are displayed for setting the AWGN:

State	Activates/deactivates the noise/interferer generation. The interferer (AWGN or CW interferer, depending on the selected mode) is generated as after the generator is activated.
	Remote-control command: SOUR:AWGN:STAT ON

Mode	Selects the mode for generating the interfering signal.
	– **Additive Noise** The AWGN noise signal with selectable system bandwidth is added to the baseband signal.
	– **Noise only** The pure AWGN noise signal with selectable system bandwidth is modulated to the carrier. The connection to the baseband is interrupted.
	– **CW Interferer** A sinusoidal with a defined frequency offset is added to the baseband signal. The calculation of E_b / N_0 ratio is omitted.
	Remote-control command: `SOUR:AWGN:MODE CW`
Sample Rate	**(Noise Only)**
	Sets the sample rate of the AWGN noise signal.
	The sample rate depends on the configured instrument. If the configured instrument is changed, the value range of this parameter is changed as well.
	The maximum value of the sample rate has to be lower or equal to the maximum clock frequency of the selected instrument.
	Remote-control command: `SOUR:AWGN:SRAT 50MHz`
Sequence Length	**(Noise Only only)**
	Sets the sequence length of the signal in samples.
	The sequence length depends on the configured instrument. If the configured instrument is changed, the value range of this parameter is changed as well.
	Remote-control command: `SOUR:AWGN:SLEN 1024`
System Bandwidth	**(Additive Noise and Noise Only)**
	Sets the bandwidth to which the set carrier/noise ratio relates.
	Within this frequency range, the signal is superimposed with a noise signal whose level corresponds exactly to the set C/N ratio.
	Note: *The noise signal is not generated arbitrarily for a particular bandwidth, but instead it is generated in steps. Noise therefore also occurs outside the set system bandwidth.*
	Remote-control command: `SOUR:AWGN:BWID 1.23 MHz`

Minimum Noise/System Bandwidth Ratio	**(Additive Noise and Noise Only)**
	Sets the ratio of minimum noise bandwidth to system bandwidth.
	Note: *The noise signal is not generated arbitrarily for a particular bandwidth, but instead it is generated in steps. Noise therefore also occurs outside the set system bandwidth.*
	With this parameter, the minimum real noise bandwidth can be set as required by some standards. It does not influence the calculation of level from the set C/N ratio in relation to system bandwidth.
	The value range of this parameter is automatically adjusted depending on the selected instrument. The maximum ratio minimum noise bandwidth to system bandwidth is determinate by the max sample clock of the selected instrument and is calculated so that the overall bandwidth "System BW x Minimum Noise/System BW Ratio" has to be less or equal to the sampling rate of the selected instrument.
	Remote-control command: SOUR:AWGN:BWID:RAT 2
Noise Bandwidth	**(Additive Noise and Noise Only)**
	Indicates the real noise bandwidth. The value is only indicated for **State On.**
	Note: *The noise signal is not generated arbitrarily for a particular bandwidth, but instead it is generated in steps. Noise therefore also occurs outside the set system bandwidth.*
	The noise bandwidth can not exceed the sampling rate of the baseband signal since white Gaussian noise is generated and added offline to the baseband signal. In case of **Noise Only** mode, noise bandwidth can not exceed 50 MHz.
	Remote-control command: SOUR:AWGN:BWID:NOIS?
Target CW Frequency Offset	**(CW Interferer only)**
	Sets the desired frequency offset of the sinusoidal in **CW Interferer** mode. The range of this parameter is limited to ± (Symbol Rate + Sample Rate)/4
	Remote-control command: SOUR:AWGN:FREQ:TARG 3.4 MHz
Resulting CW Frequency Offset	**(CW Interferer only)**
	Indication of the actual CW frequency offset of the sinusoidal signal in **CW Interferer** mode. The resulting CW Frequency Offset is the correction of the desired value based on generating an integer multiple of periods out of the output sequence length.
	Remote-control command: SOUR:AWGN:FREQ:RES?

Set Noise Level Via	**(Additive Noise only)**
	Selects the mode for setting the noise level .
	C/N
	The noise level is set on the basis of the value entered for the carrier/noise ratio. With digital modulation, the associated E_b/N_0 value is determined and displayed.
	E_b/N_0
	The noise level is set on the basis of the value entered for the ratio of bit energy to noise power density.
	The associated C/N value is displayed. The correlation between the two values is as follows:
	$$\frac{C}{N} = \frac{E_b}{N_0} \cdot \frac{f_{bit}}{B_{sys}}$$
	f bit = Bit rate (Symbol rate x Modulation value)
	Bsys = System bandwidth
	With **Custom Dig Mod** signals, the bit rate used for calculation is defined by the selected standard in the **Custom Digital Mod** menu.
	With **Digital Standard** signals, the bit rate to be used for calculating the Eb/N0 can be entered at **Bit Rate**.
	Some test cases with the 3GPP base station tests (TS 25.141) specify, for example, E/N settings that apply to channel-coded data or block segments.
	Remote-control command: `SOUR:AWGN:POW:MODE EN`
Bit Rate	**(Additive Noise only)**
	Sets or indicates the bit rate used for converting C/N to E_b/N_0.
	With **Custom Digital Mod** signals, the bit rate used is indicated here. It is defined by the choice of the standard in the **Custom Digital Mod** menu.
	With **Digital Standard** signals, the bit rate used for converting C/N to E_b/N_0 is set here.
	When generating a **Digital Standard**, it is thus possible to select which bit rate is to be used for calculating the ratio of bit energy to noise power density, e.g. the bit rate before or after channel coding.
	Remote-control command: `SOUR:AWGN:BRAT 3.4E6`
Carrier Noise Ratio *Carrier Interferer Ratio*	**(Additive Noise and CW Interferer only)**
	Sets the carrier/noise or carrier/interferer ratio, depending on the AWGN mode.
	Remote-control command: `SOUR:AWGN:CNR 10 dB`

EB/N0	**(Additive Noise only)**
	Sets the ratio of bit energy to noise power density in **Additive Noise** mode.
	The level of the noise signal which is derived from the entered Eb/N0 value is displayed under **Noise Level (System Bandwidth)**.
	The level of the useful signal is displayed in the menu under **Carrier Level**.
	The level of the output signal is displayed under **Carrier Level + Noise**.
	These levels are additionally scaled after the generation of the interferer/noise so that the peak of the output signal corresponds to 0 dBFS (Full Scale).
	If **Set Noise Level via C/N** is selected, the associated Eb/N_0 value is displayed here.
	Remote-control command: `SOUR:AWGN:ENR 10 dB`
Carrier Level	**(Additive Noise and CW Interferer only)**
	Displays the value for the carrier level.
	Remote-control command: `SOUR:AWGN:POW:CARR?`
Noise Level (System Bandwidth) ***Interferer Level***	Displays the level of the noise signal in the system bandwidth.

Note:
> *The noise signal is not generated arbitrarily for a particular bandwidth, but instead it is generated in steps. Noise therefore also occurs outside the set system bandwidth. This means that the total measurable noise level (see below) usually exceeds the value displayed here. Correct measurement of the noise level within the system bandwidth is possible by means of channel power measurement using a signal analyzer.*
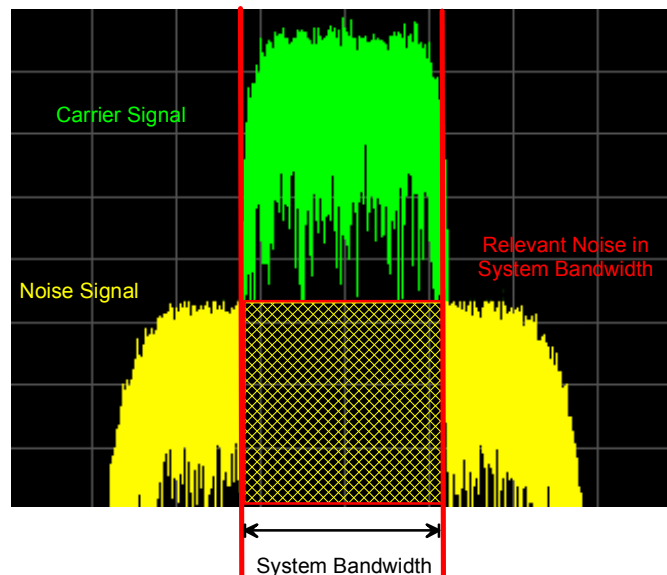
Remote-control command:
`SOUR:AWGN:POW:NOIS?`

Noise Level (Total Bandwidth)	**(Additive Noise and Noise Only only)**
	
	Displays the level of the noise signal in the total bandwidth.
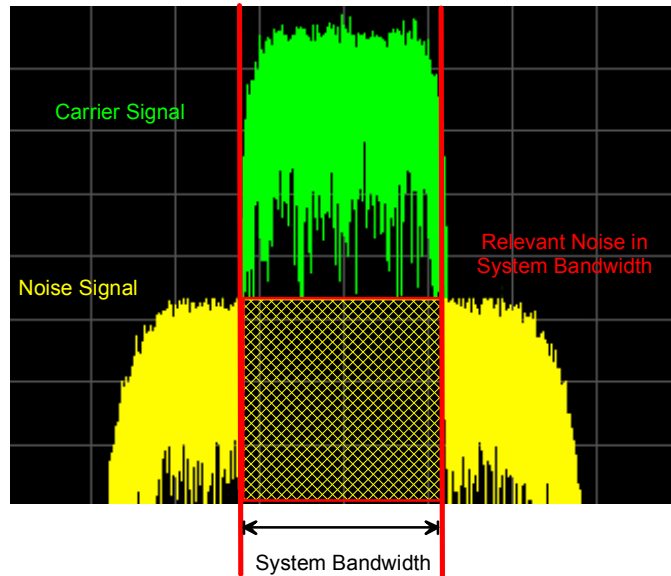	
	Remote-control command:
	`SOUR:AWGN:POW:NOIS:TOT?`
	`Response: 19 dB`

Carrier+Noise Level ***Carrier+Interferer Level***	**(Additive Noise and CW Interferer only)** Displays the overall level of the noise signal plus useful signal. Remote-control command: `SOUR:AWGN:POW:SUM?`
Carrier+Noise PEP ***Carrier +Interferer PEP*** ***Noise PEP***	The peak envelope power is displayed. This value is set to 0 dBFS where all other display power values are shown relative to the PEP after noise generation. Remote-control command: `SOUR:AWGN:POW:SUM:PEP?`

3. Click the **Off** button to change the AWGN state from Off to On.

   The AWGN is activated and added to the baseband signal. The active AWGN is indicated in the AWGN block diagram.

Note:
  For multi carrier and multi segment signals, the AWGN status is set to Off.

Working with the Gen Blocks Arb Sig and Vec Sig

The block diagrams symbolize the signal or modulation generators that are connected or can be connected to R&S WinIQSIM2. *Arb Sig Gen* represents an ARB Modulation Generators, e.g., R&S AFQ. *Vec Sig Gen* represents Vector Signal Generators, e.g., R&S SMU. The two blocks are operated in a similar fashion so both blocks are referred to as **Sig Gen** block.
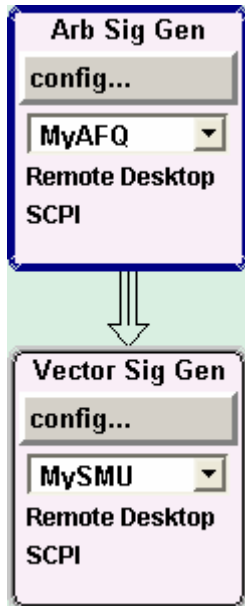
Selecting an Instrument in a Sig Gen Block

◆ In the **Main** window, in the *Sig Gen* block, select an instrument form the combo box. The list contains the alias names of the defined instruments.
  For more information see section *Creating New Instruments*, page 29.

Note:
  *In the **ARB Sig Gen** block, only ARB instruments are listed, in the **Vec Sig Gen** block only vector signal generators are listed.*

Two connection lines symbolize the two possible physical connections between instrument and the PC with R&S WinIQSIM2. The lines are labeled with **Remote Desktop** (Remote Desktop) and **SCPI** (remote control connection via VISA). If SCPI via TCP/IP is used, only one physical line is indicated. However, the logical connections for remote desktop and remote control (SCPI) are displayed as two different lines.

Note:
  If the instrument is not responding on the corresponding connection, the line will be crossed out. The instrument is offline.

For signal calculation, it is not necessary that an instrument is connected. The signal calculation can be performed for a dummy instrument (offline) and the waveform can later be transmitted to an instrument (online). However, keep in mind, that the general instrument settings affect various functions, e.g., the maximum size of the file the waveform is stored in. Therefore, it is important that the calculation is performed for exactly the instrument which will later be the destination for the signal.

Configuring Instrument Related Issues

◆   To configure the signal generation, in the *Sig Gen Block*, click the *Config* button.

A menu opens and the following options for configuring the signal generation are displayed:

Instruments	Opens the **Instruments** dialog.
	For more information see section *Creating New Instruments*, page 29.
Remote Desktop	Opens the standard Windows Remote Desktop connection to the chosen instrument.
Remote Control (SCPI)	Opens the **Remote Control** menu.
	For more information see section *Remote Control Dialog*, page 49.

If the Remote Desktop connection or the Remote Control dialog is active, the block turns green to indicate an active remote connection to the instrument.

Remote Control Dialog

This dialog provides the option to remotely control the chosen instrument by means of a basic set of control functions. The instrument can be controlled without Remote Desktop.

In the **Remote Control** dialog, the current instrument configuration is always displayed and can be checked. Here, the settings of the instrument can be changed remotely.

Note:
  If one or more of these settings are changed on the instrument without using the Remote Control menu, the menu will be updated automatically to the new settings.

Note:
  When the Remote Control dialog is open, the Remote LED on the Front Panel of the instrument starts to flash, indicating that the instrument is set to remote state periodically. This is necessary to query the instrument status. The flashing stops when the Remote Control dialog is closed.

For more information see the following sections:

Remote Control of the ARB Generator, page *49*.

Remote Control of the Vector Signal Generator, page 50.

Remote Control of the ARB Generator

◆   In the **Main** window, in the *Arb Sig Gen Block*, select *Config → Remote Control (SCPI)*.

The **Remote Control ARB** dialog opens.
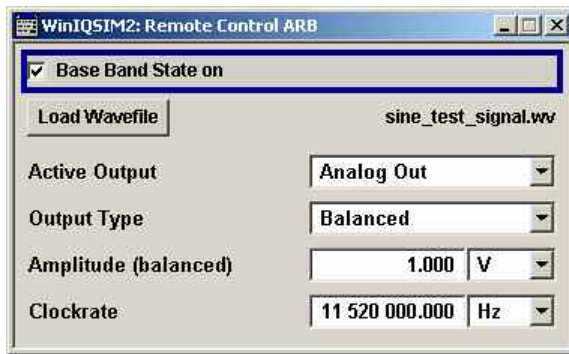
The display of the dialog depends on the selected instrument.

In the **Remote Control ARB** dialog, the following fields and buttons are displayed:

Base Band State on	Enables/disables the baseband output of the instrument.
Load Wavefile	Opens the SCPI File Explorer to select a file on the instrument which is to be loaded into the ARB. The file is displayed in the area right of the button.
Active Output	Sets the active output of the instrument to Analog out or Digital out, if the instrument is equipped accordingly.
Output Type	Selects analog output type options: Balanced Unbalanced No options for digital output type.
Amplitude	Sets the amplitude of an instrument. This depends on the settings of *Active Output* and *Output Type*. The analog output amplitudes are given in Volt, the digital output amplitudes in a value related to Full Scale (FS).
Clockrate	Sets the clock rate of the instrument.

Remote Control of the Vector Signal Generator

◆   In the **Main** window, in the *Vec Sig Gen Block*, select *Config → Remote Control (SCPI)*.

The **Remote Control Vec Sig Gen** dialog opens.
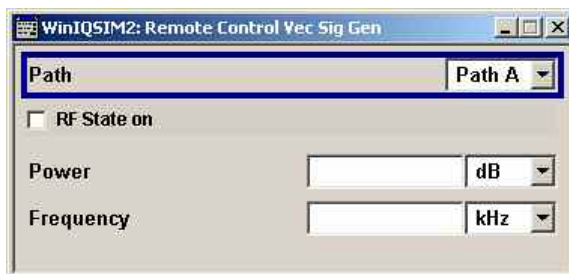
In the **Remote Control Vec Sig Gen** dialog, the following fields are displayed:

Path	Selects the path to be controlled if the instrument is equipped with more than one path.
RF State on	Enables/disables the radio frequency output of the instrument.
Power	Sets the power of the instrument.
Frequency	Sets the frequency of the instrument.

R&S WinIQSIM2 - Remote-control commands

Introduction - WinIQSIM2 Remote-Control Commands

R&S WinIQSIM2 commands contain the remote control commands to set waveform generation, instrument configuration and transmission of the file containing the waveform.

Table of commands

Command	Parameter	Default unit	Comment
[SOURce:]AWGN:BRATe	400... 250E6 bps		
[SOURce:]AWGN:BWIDth	1kHz .. 100 MHz	Hz	
[SOURce:]AWGN:BWIDth:NOISe		kHz	Query only
[SOURce:]AWGN:BWIDth:RATio	1 ... Max		
[SOURce:]AWGN:CNRatio	-50dB..+30dB	dB	
[SOURce:]AWGN:ENRatio	<numeric_value>	dB	
[SOURce:]AWGN:FREQuency:RESult		Hz	Query only
[SOURce:]AWGN:FREQuency:TARGet	Min...Max	Hz	
[SOURce:]AWGN:MODE	ADD | ONLY | CW		
[SOURce:]AWGN:POWer:CARRier		dBFS	Query only
[SOURce:]AWGN:POWer:MODE	CN | EN		
[SOURce:]AWGN:POWer:NOISe		dBFS	Query only
[SOURce:]AWGN:POWer:NOISe:TOTal		dBFS	Query only
[SOURce:]AWGN:POWer:SUM		dBFS	Query only
[SOURce:]AWGN:POWer:SUM:PEP		dBFS	Query only
[SOURce:]AWGN:SLENgth	128 .. 1073741824		
[SOURce:]AWGN:SRATe	400 Hz .. 600 MHz		
[SOURce:]AWGN:STATe	ON | OFF		
GENerate:WAVeform:OSAMpling			Query only
GENerate:WAVeform:SAMPles			Query only
GENerate:WAVeform:DURation			Query only
GENerate:WAVeform:SRATe			Query only
INSTruments:GPIB:ADDRess	1…30, 1…30, 1…30		
INSTruments:REMote:CHANnel	TCPIP | GPIB | USB		
INSTruments:REMote:NAME	"Name", "Name", "Name"		
INSTruments:NAME	"Symbolic name"		
INSTruments:TYPE	AFQB10 | AFQB11 | SMUB9 | SMUB10 | SMUB11 | SMJB9 | SMJB10 | SMJB11 | SMJB50 | SMJB51 | SMATEB9 | SMATEB10 | SMATEB11 | AMUB9 | AMUB10 | AMUB11		
INSTruments:USB:SERial			
TRANsmit:AUTO:STATe	ON | OFF		

Command	Parameter	Default unit	Comment
TRANsmit:AUTO:PATH	A | B		
TRANsmit:COMMent	"string"		
TRANsmit:DESTination	INSTrument | FILE		
TRANsmit:DESTination:IFILe			
TRANsmit:DESTination:LFILe			
TRANsmit:SOURce	INTernal | FILE		
TRANsmit:SOURce:LFILe			
TRANsmit:STATe	ON | OFF		

[SOURce:]AWGN:BRATe 400... 250E6 bps

This command sets the bit rate which is used for calculation of bit energy to noise power ratio from carrier/noise ratio for **Digital Standard** signals. For **Custom Digital Mod** signals, the bit rate which is used for calculation can be queried with this command. Valid units are bps, kbps and Mbps.

Example: `AWGN:BRAT?`

'queries the bit rate which is used for calculation of the E_b/N_0 value from the C/N value.

*RST value	Resolution	SCPI
100 kbps	0.001 bps	Device-specific

[SOURce:]AWGN:BWIDth 1 kHz ... 100 MHz

This command sets the system bandwidth. The noise signal at the level which corresponds to the specified carrier/noise ratio is generated in the bandwidth specified here.

This command is available for modes **Additive Noise** and **Noise Only** (`SOUR:AWGN:MODE ADD|ONLY`).

Example: `AWGN:BWID 10 MHz`

'sets a system bandwidth of 10 MHz.

*RST value	Resolution	SCPI
3.84 MHz	0.1 kHz	Device-specific

[SOURce:]AWGN:BWIDth:NOISe?

This command queries the real noise bandwidth.

This command is available for modes **Additive Noise** and **Noise Only** (`SOUR:AWGN:MODE ADD|ONLY`). The command is a query command and therefore has no *RST value.

Example: `AWGN:BWID:NOIS?`

'queries the noise bandwidth.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:BWIDth:RATio   1.0 ... Max

This command is available for modes **Additive Noise** and **Noise Only** (`SOUR:AWGN:MODE ADD|ONLY`).

This command sets the ratio of minimum real noise bandwidth to system bandwidth.

The value range of this parameter is automatically adjusted depending on the selected instrument. The maximum ratio minimum noise bandwidth to system bandwidth is determinate by the max sample clock of the selected instrument and is calculated so that the overall bandwidth "System BW x Minimum Noise/System BW Ratio" has to be less or equal to the sampling rate of the selected instrument.

Example: `AWGN:BWID:RAT 2`
                    'sets a minimum noise/system bandwidth ratio of 2.

*RST value	Resolution	SCPI
1	0.1	Device-specific

[SOURce:]AWGN:CNRatio   -50 dB ... +30 dB

This command sets the carrier/interferer or carrier/noise ratio, depending on the AWGN mode).

This command is available for modes **Additive Noise** and **CW Interferer** (`SOUR:AWGN:MODE ADD|CW`).

Example: `AWGN:CNR 10`
                    'sets a carrier/noise ratio of 10 dB.

*RST value	Resolution	SCPI
0 dB	0.001 dB	Device-specific

[SOURce:]AWGN:ENRatio   -30 dB ... +30 dB

This command sets the ratio of bit energy to noise power density in **Additive Noise** mode.

For **Digital Standard** signals, the bit rate used for calculation of E_b/N_0 value from C/N value can be entered with command `SOUR:AWGN:BRAT`.

For **Custom Digital Mod** signals, the bit rate used for calculation of E_b/N_0 value from C/N value is determined by the selected standard (`SOURce:BB:DM:STANdard`) and cannot be changed.

Example: `AWGN:ENR 10`
                    'sets a ratio of bit energy to noise power density of 10 dB.

*RST value	Resolution	SCPI
0 dB	0.001 dB	Device-specific

[SOURce:]AWGN:FREQuency:RESulting

This command queries the actual frequency offset of the sine in the **CW Interferer** mode.

The resulting CW Frequency Offset is the correction of the desired value based on generating an integer multiple of periods out of the output sequence length.

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

Example: `AWGN:FREQ:RES?`
                    'queries the actual frequency of the interfering sine.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:FREQuency:TARGet Min ... Max

This command sets the desired frequency offset of the sinusodial in **CW Interferer** mode
(`AWGN:MODE CW`).

The range of this parameter is limited to ± (Symbol Rate + Sample Rate)/4

Example: `AWGN:FREQ:TARG 2kHz`
                'sets a frequency offset of 2 kHz for the interfering sine.

*RST value	Resolution	SCPI
0 Hz	0.07 Hz	Device-specific

[SOURce:]AWGN:MODE ADD | ONLY | CW

This command selects the mode for generating the interfering signal.

Parameters: **ADD**
                The AWGN noise signal is added to the baseband signal.

                ONLY
                The pure AWGN noise signal is modulated to the carrier. The connection to
                the baseband is interrupted.

                CW
                The sine interfering signal with a defined frequency offset is added to the
                baseband signal.

Example: `AWGN:MODE ONLY`
                'activates the generation of a pure noise.

                `AWGN:STAT ON`
                'switches on the generation of a pure noise.

*RST value	Resolution	SCPI
ADD	-	Device-specific

[SOURce:]AWGN:POWer:CARRier?

This command queries the carrier level.

This command is available for modes **Additive Noise** and **CW Interferer** (`SOUR:AWGN:MODE
ADD|CW`).

Example: `AWGN:POW:CARR 10 dBFS`
                'sets a carrier level of 10 dBFS.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:POWer:MODE CN | EN

This command selects the mode for setting the noise level.

This command is available for mode **Additive Noise** (`SOUR:AWGN:MODE ADD`).

Parameters: **CN**
                The noise level is set on the basis of the value entered for the carrier/noise
                ratio (`SOUR:AWGN:CNR`).

                EN
                The noise level is set on the basis of the value entered for the ratio of bit
                energy to noise power density (`SOUR:AWGN:ENR`).

Example: AWGN:POW:MODE CN
            'the noise level is set on the basis of the value entered for the carrier/noise
            ratio (SOUR:AWGN:CNR).

*RST value	Resolution	SCPI
CN		Device-specific

[SOURce:]AWGN:POWer:NOISe?

This command queries the noise level in the system bandwidth depending on the selected AWGN modes:

Example: AWGN:POW:NOIS?
            'queries the noise level in the system bandwidth.

            Response: "10"
            'the noise level in the system bandwidth is 10 dBFS.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:POWer:NOISe:TOTal?

This command queries the noise level in the total bandwidth.

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

Example: AWGN:POW:NOIS:TOT?
            'queries the noise level in the total bandwidth.

            Response: "15"
            'the noise level in the total bandwidth is 15 dBFS.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:POWer:SUM?

This command queries the overall level of the noise signal plus useful signal.

This command is available for modes **Additive Noise** and **CW Interferer** (SOUR:AWGN:MODE ADD|CW). The command is a query command and therefore has no *RST value.

Example: AWGN:POW:SUM?
            'queries the overall level of the noise signal plus useful signal.

*RST value	Resolution	SCPI
		Device-specific

[SOURce:]AWGN:POWer:SUM:PEP?

This command queries the peak envelope power of the overall signal.

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

Example: AWGN:POW:SUM:PEP?
                    'queries the peak envelope power of the overall signal.

*RST value	Resolution	SCPI
0 dBFS		Device-specific

[SOURce:]AWGN:SLENgth   128 .. 1073741824

This command is available for mode **Noise Only** (SOUR:AWGN:MODE ONLY).

Sets the sequence length of the signal in samples.

The sequence length depends on the configured instrument. If the configured instrument is changed, the value range of this parameter is changed as well.

Example: AWGN:MODE ONLY
                    'activates the generation of a pure noise.

                    AWGN:STAT ON
                    'switches on the generation of a pure noise.

                    AWGN:SLEN 1024
                    'sets the sequence legth.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:SRATe   400Hz .. 600 MHz

This command is available for mode **Noise Only** (SOUR:AWGN:MODE ONLY).

Sets the sample rate of the AWGN noise signal.

The sample rate depends on the configured instrument. If the configured instrument is changed, the value range of this parameter is changed as well.

The maximum value of the sample rate has to be lower or equal to the maximum clock frequency of the selected instrument.

Example: AWGN:MODE ONLY
                    'activates the generation of a pure noise.

                    AWGN:STAT ON
                    'switches on the generation of a pure noise.

                    AWGN:SRAT 50MHz
                    'sets the sample rate.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce:]AWGN:STATe ON | OFF

This command activates or deactivates the white noise (AWGN = Additive White Gaussian Noise). The noise signal is either superimposed on the baseband signal (**Additive Noise** mode: SOUR:AWGN:MODE ADD) or is output as a pure noise signal (**Noise Only** mode: SOUR:AWGN:MODE ONLY). In addition, a sine with adjustable frequency offset to the baseband signal can be generated as an RFI signal (**CW Interferer** mode: SOUR:AWGN:MODE CW).

Example: AWGN:STAT ON
                      'activates the RFI signal generator.

*RST value	Resolution	SCPI
OFF	-	Device-specific

GENerate:WAVeform:OSAMpling?

This command queries the baseband oversampling factor. The value is determined by the content of the generated waveform file. To adjust the oversampling rate, the corresponding parameters defined within the standards must be used, e.g., WlanFiltOversampling.

Example: GEN:WAV:OSAM?
                      'queries the oversampling factor.

GENerate:WAVeform:SAMPles?

This command queries the number of available samples within the generated waveform file. It equals to the I and respectively Q sample sequence length (= number of symbols * oversampling factor).

Example: GEN:WAV:SAMP?
                      'queries the number of available samples.

GENerate:WAVeform:DURation?

This command queries the signal duration in seconds of the available samples within the generated waveform file. The value of this parameter is evaluated by parameter GENerate:WAVeform:SAMPles.

Example: GEN:WAV:DUR?
                      'queries the signal duration in seconds.

GENerate:WAVeform:SRATe?

This command queries the sample rate in [Hz] (= number of symbols * oversampling factor).

Example: GEN:WAV:SRAT?
                      'queries the sample rate.

INSTruments:GPIB:ADDRess…1..30, 1..30, 1..30, …

This command defines the GPIB addresses of the instruments in the device list.

Example: INST:GPIB:ADDR 8,9,10
                      'sets the GPIB addresses of the three first devices in the list.

INSTruments:REMote:CHANnel TCPIP | GPIB | USB, …

This command defines the remote channels of the instruments in the device list.

Example: INST:REM:CHAN USB,GPIB,TCPIP
                      'sets the hardware channels of the first three devices in the list.

INSTruments:REMote:NAME…"name", "name"…

This command defines the instrument (device) names of the instruments in the device list. The instrument name of an instrument is used to access the instrument over the network.

Example: `INST:REM:NAME`
`'RSAFQ100A1000001','RSAFQ100A1000002','RSSMU200A1000025'`
'defines the network names of the three devices in the list.

INSTruments:NAME … "symbolic name"

This command defines the symbolic name of the instruments in the device list.

Example: `INST:NAME 'MYAFQ','MYOTHERAFQ','MYSMU'`
'defines the symbolic name of the instruments in the device list.

INSTruments:TYPE AFQB10 | AFQB11 | SMUB9 | SMUB10 | SMUB11 | SMJB9 | SMJB10 | SMJB11 | SMJB50 | SMJB51 | SMATEB9 | SMATEB10 | SMATEB11 | AMUB9 | AMUB10 | AMUB11

This command defines the instrument type in the device list, e.g., R&S AFQ, R&S SMU, R&S AMU, etc.

Example: `INST:TYPE AFQB10,AMUB11,SMUB10`
'defines the device type of one of the three devices in the list.

INSTruments:USB:Serial

This command defines the serial numbers of the instruments in the device list. The serial number of an instrument is required to access it over USB.

Example: `INST:USB:Serial 100001,100002,100025`
'defines the USB serial number of the three devices in the list.

TRANsmit:AUTO:[STATe] On | Off

This command defines whether the transmitted waveform file should be automatically loaded and started on the instrument after the waveform file has been transmitted.

Example: `TRAN:AUTO:STATe On`
'defines the automatically loading of the waveform.

TRANsmit:AUTO:PATH A | B

This command defines on which path of the instrument the signal is to be generated, if a transmitted waveform file shall be automatically loaded and started on the instrument.

Example: `TRAN:AUTO:PATH A`
'defines the generation path of the signal.

TRANsmit:COMMent… "string"

This command specifies a comment which will be written into the header of generated waveform file.

Example: `TRAN:COMM 'This is a comment'`
'sets a comment.

TRANsmit:DESTination INSTrument | FILE   E-3

This command defines the transmission destination of the waveform file. There are two options: The Instrument (arbitrary signal generator) or a file on a local drive.

Example: `TRAN:DEST INST`
                    'sets the transmission destination to the instrument.

TRANsmit:DESTination:IFILe

This command defines the name of the waveform destination file on the instrument, if **INSTrument** is selected as the transmit destination.

Example: `TRAN:DEST INST`
                    'sets the transmission destination to the instrument.

                    `TRAN:DEST:IFIL 'D:\3GPP.WV'`
                    'sets the name of the destination file on the instrument.

TRANsmit:DESTination:LFILe

This command defines the name of the waveform destination file on a local hard disc (file copy), if **FILE** is the selected transmit destination.

Example: `TRAN:DEST FILE`
                    'sets the transmission destination to file.

                    `TRAN:DEST:LFIL 'c:\temp\3gpp.wv'`
                    'sets the destination of the waveform file to the local PC hard disc.

TRANsmit:SOURce INTernal | FILE

This command defines the source of the waveform to be transmitted. The waveform file can be generated internally or generated internally and stored locally.

Example: `TRAN:SOUR INT`
                    'sets the generation of the waveform file to internal. The waveform is not stored.

TRANsmit:SOURce:LFILe… "file_name"

This command defines the name of a source file, that is stored locally and is to be transmitted.

Example: `TRAN:SOUR:LFIL 'c:\temp\3gpp.wv'`
                    'sets the name of a source file.

TRANsmit:STATe

This command starts/stops a transmission. The query informs about the current state of a transmission.

Example: `TRAN:STAT ON`
                    'starts a transmission.

Alphabetical List of Commands

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Description of TCP/IP Import Interface

The following sections apply to programming under National LabWindows CVI 5.0. The commands have similar designations in other development environments. Consult the manuals of the required development environment to familiarize yourself with programming the TCP/IP.

A TCP/IP link consists of a server and one or more several clients. The server gets the data ready and transfers them to the client on request or spontaneously. The client takes the incoming data.

WinIQSIM2 is considered here as the client and the external application as server, although the other solution would also be possible.

Server Name, Port Number, and Items

To build a link to the server, the client must know the name of the server (e.g. 12.34.56.78). Also the parties must agree on a common channel, the so-called port. The default value is 1000 but any other value may be chosen. Some ports are pre-allocated (e.g. 80 for Browser) and are to be avoided.

Communications are exchanged between client and server. Communications from client and server are ASCII strings, messages from the server are in the form of binary blocks.

Item	Meaning
GetServerID	ID query
GetNewState	Query if new data are available
GetSequenceLength	Query of sequence length
GetSymbolRate	Query of symbol/reference point rate in Hz
GetSymbol	Query of the symbols/reference points

Table .4   TCP/IP Items from Client to Server

Format of Query Commands

Query commands are sent with *ClientTCPWrite* (*gHandle*, *request*, *strlen(request)*, *1000*); the last parameter timeout is given in ms.

Format of Replies (Messages) of Import Server

Replies are sent with ServerTCPWrite ().

Note:
The reply must get to WinIQSIM2 within 10 seconds, since otherwise timeout occurs. If the calculation (including transmission) lasts a long time, it must not be triggered by a query. The server must have a data set in reserve which it returns as a response to GetSymbols.

To distinguish between replies to different queries, a header is placed in front of the data section of the reply:

```
typedef enum { SYMBOLRATE, SEQUENCE_LENGTH, SYMBOLS, NEWSTATE, SERVER_ID }

SERVER_MESSAGE_HEADER_TYPE;

typedef struct

{

      SERVER_MESSAGE_HEADER_TYPE type;

      float data;

}

SERVER_MESSAGE_TYPE;

SERVER_MESSAGE_TYPE Reply;

Reply.type = SEQUENCE_LENGTH;

Reply.data = (float)SequenceLength;

ServerTCPWrite (gHandle, (void *)&Reply, sizeof(Reply), 1000);
```

ServerID, NewState and the symbol rate are handled the same way as the sequence length.

The above format cannot be used if the symbol value is to be sent to the WinIQSIM2 because the message is more than 1 float value long.

A free memory block must be filled then with data as follows:

Pos 1 : SYMBOLS (enum, = 2)

Pos 2 : I(0)

Pos 3 : Q(0)

Pos 4 : I(1)

Pos 5 : Q(1)

....

Pos 2*N : I(N-1)

Pos 2*N+1 : Q(N-1)

A pointer on this block will then be transferred to the function ServerTCPWrite().

Note:
Alternatively to transmitting the waveform in one block, the samples can be divided among several blocks. In the latter case, only the first block is sent with a header, the following blocks are without header.

Import Main Menu

The menu for importing an IQ signal can be opened in the Baseband function block.

The Import menu allows to configure the TCP/IP connection to the server.

State - Import	Enables/disables the import of IQ data.
	Remote-control command: SOUR:BB:IMP:STAT ON
Set to Default - Import	Calls the default settings. The values are shown in the following table.
	Remote-control command: SOUR:BB:IMP:PRES

Parameter	Value
Use Local Server	On
Server Name	localhost
Port Number	1000
Transmission Timeout (s)	20
Filter	Cosine
Impulse Length	Auto
Oversampling	Auto
Clipping State	On

Save/Recall - Import

Calls the **Save/Recall** menu.

From the **Save/Recall** menu, the **File Select** windows for saving and recalling the complete settings in the **Import** menu can be called.

```
Recall Import Settings
Save Import Settings
File Manager...
```

The Import settings are stored as files with the predefined file extension ***.import**. The file name and the directory they are stored in are user-definable.

The complete settings in the **Import** menu are saved and recalled.

Recall Import Settings

Opens the **Recall Import Settings** window for loading a saved import configuration.

The configuration of the selected (highlighted) file is loaded by pressing the **Select** button.

Remote-control commands:
```
MMEM:MDIR 'F:\gen\import\sett'
SOUR:BB:IMP:SETT:CAT?
Response:    'import_1', 'import_2'

SOUR:BB:IMP:SETT:LOAD 'import_1'
```

Save Import Settings

Opens the **Save Import Settings** window for saving the current import configuration.

The name of the file is specified in the **File Name** entry field. The file is saved by pressing the **Save** button.
Remote-control command:
```
MMEM:CDIR 'F:\gen\import\sett'

SOUR:BB:IMP:SETT:STOR 'import_1'
```

File Manager Calls the **File Manager**.

The **File Manager** is used to copy, delete and rename files and to create new directories.

Use Local Server - Import Sets the local host as the server from where the IQ data streams will be dowloaded. If activated, the field for entering a remote host is filled with the entry **localhost** automatically and cannot be edited.

Remote-control command:
SOUR:BB:IMP:SERV:LOC:STAT ON

Server Name - Import Enters the name (IP address) of the connected server. To enter the name in this field, the check box **Use Local Server** has to be unchecked.

Remote-control command:
SOUR:BB:IMP:SERV:NAME 12.34.56.78

Port Number - Import Enters the port number for the server connection. The default value is 1000.

Remote-control command:
SOUR:BB:IMP:SERV:PORT 1000

Transmission Timeout (s) - Import Sets the duration after which the transmission is aborted in case of a server timeout.

Remote-control command:
SOUR:BB:IMP:SERV:TTO 20

Update Server Connection - Import Updates the TCP/IP parameter and tries to establish a connection to the server.

Remote-control command:
SOUR:BB:IMP:SERV:UPD

Server ID - Import   Indicates the connected import server. If no import server is
                                connected, **not connected** is displayed. Seraching for a connected
                                server is triggered with **Update Server Connection**.

                                Remote-control command:
                                SOUR:BB:IMP:SERV:ID?

Filter/Clipping - Import   Calls the menu for setting baseband filtering and clipping. The current
                                filter and the clipping state are displayed next to the button.

                                The menu is described in section "Filter / Clipping Settings - Import",
                                page 58 .

                                Remote-control command:n.a.

Marker - Import   Calls the menu for configuring the marker signals.

                                This menu is described in section "Marker Menu - Import", page 61.

                                Remote-control command:n.a.

Filter / Clipping Settings - Import

The **Filter / Clipping** menu is reached via the **Import** main menu.

The baseband filter, sample rate variation, and clipping are defined in this menu.

Filter - Import	Sets the baseband filter.
	Remote-control command: `SOUR:BB:IMP:FILT:TYPE RCOS`

Roll Off Factor - Import	Indicates the filter parameter.
	For the default cosine filter a roll off factor of 0.07 is used.

	Remote-control command:
	`SOUR:BB:IMP:FILT:PAR:APCO25 0.05`
	`SOUR:BB:IMP:FILT:PAR:COS 0.05`
	`SOUR:BB:IMP:FILT:PAR:GAUS 0.15`
	`SOUR:BB:IMP:FILT:PAR:PGA 0.15`
	`SOUR:BB:IMP:FILT:PAR:LPAS 0.05`
	`SOUR:BB:IMP:FILT:PAR:RCOS 0.05`
	`SOUR:BB:IMP:FILT:PAR:SPH 0.15`

Cut Off Frequency Shift - Import	(This feature is available for filter parameter Cosine only)
	Sets the value for the cut off frequency shift. The cut off frequency of the cosine filter can be adjusted to reach spectrum mask requirements.
	The value range is -1.0 to 1.0.
	Remote-control command: SOUR:BB:IMP:FILT:PAR:COS:COFS
Cut Off Frequency Factor - Import	(This feature is 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:IMP:FILT:PAR:LPAS 1.0
Sample Rate Variation - Import	Displays the sample rate of the signal.
	Remote-control command: SOUR:BB:IMP:SRAT:VAR?
Impulse Length - Import	Displays the number of filter tabs. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.
	Remote-control command: SOUR:BB:IMP:FILT:ILEN:AUTO ON SOUR:BB:IMP:FILT:ILEN 120
Oversampling - Import	Determines the upsampling factor. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.
	Remote-control command: SOUR:BB:IMP:FILT:OSAM:AUTO ON SOUR:BB:IMP:FILT:OSAM 20

The settings for clipping are collected in the **Clipping** section.

Clipping State - Import	Switches baseband clipping on and off.
	Baseband clipping is a very simple and effective way of reducing the crest factor of the IQ signal.
	With baseband clipping, the signal level is limited to a settable value (Clipping Level). This level is specified as a percentage of the highest peak value. Since clipping is done prior to filtering, the procedure does not influence the spectrum. The EVM however increases.
	Remote-control command: SOUR:BB:IMP:CLIP:STAT ON

Clipping Level- Import   Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote-control command:
SOUR:BB:IMP:CLIP:LEV 50

Clipping Mode - Import   Selects the clipping method. A graphic illustration of the way in which these two methods work is given in the menu.

Vector | i + q | The limit is related to the amplitude | i + q | . The I and Q components are mapped together, the angle is retained (see also Clipping State - Import). Clipping State).

Remote-control command:
SOUR:BB:IMP:CLIP:MODE VEC

Scalar | i | + | q | The limit is related to the absolute maximum of all the I and Q values | i | + | q |.

The I and Q components are mapped separately, the angle changes.

Remote-control command:
SOUR:BB:IMP:CLIP:MODE SCAL

Marker Menu - Import

The Marker menu is accessed via the **Import** main menu.

Marker Channel x - Import   Selects a marker signal for the associated MARKER output.

Restart   A brief marker signal is generated at the start of the waveform.

Remote-control command:
`SOUR:BB:IMP: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.

Divider		2
Frequency	10.000 00	MHz

Remote-control command:
```
SOUR:BB:IMP:TRIG:OUTP1:MODE PULS
SOUR:BB:IMP:TRIG:OUTP1:PULS:DIV 4
SOUR:BB:IMP: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 command:
```
SOUR:BB:IMP:TRIG:OUTP1:MODE PATT
SOUR:BB:IMP: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.

Start of signal

ON time   OFF time   ON time   OFF time

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.

| On Time | | 1 | Samples ▾ |
| Off Time | | 1 | Samples ▾ |

Remote-control command:
SOUR:BB:IMP:TRIG:OUTP1:MODE RAT
SOUR:BB:IMP:TRIG:OUTP1:ONT 20
SOUR:BB:IMP:TRIG:OUTP1:OFFT 30

SOURce:BB:ARB:MCAR Subsystem - Remote Control Commands

The MCARrrier subsystem contains the commands for setting the Multi Carrier Waveform Generator.

The numeric suffix to SOURce distinguishes between signal output for path A and path B in the case of two-path instruments:

SOURce[1] = path A

SOURce2 = path B

For two-path instruments, the keyword SOURce is optional with commands for path A and can be omitted. For path B, the command must include the keyword with the suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.Section "R&S Signal Generator Waveform and List Format", page 78 describes the ARB waveform format and how it is used to transmit waveforms via the IEC bus.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier:COUNt	1 ... 32	-	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:DELay	-1s ... +1s	s	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:FILE	'file name'		
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:PHASe	0° ... 360°,	RAD	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:POWer	-80... 0 dB	dB	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier:SPACing	0 Hz...50 MHz	Hz	
[SOURce<[1]	2>]:BB:ARB:MCARrier:CARRier<0...31>:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:ARB:MCARrier:CFACtor:MODE	OFF	MAX	MIN		
[SOURce<[1]|2>]:BB:ARB:MCARrier:CLOad			No query
[SOURce<[1]|2>]:BB:ARB:MCARrier:CLOCk			Query only
[SOURce<[1]|2>]:BB:ARB:MCARrier:CREate			No query
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:DELay[:STARt]	-1s ... +1s	s	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:DELay:STEP	-1s ... +1s	s	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:EXECute			No query
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:FILE	'file name'		
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:PHASe[:STARt]	0...360DEG	RAD	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:PHASe:STEP	-360...360DEG	RAD	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:POWer[:STARt]	-80 ... 0 dB	dB	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:POWer:STEP	-80 ... 80 dB	dB	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:STARt	<carrier_index>		
[SOURce<[1]	2>]:BB:ARB:MCARrier:EDIT:CARRier:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:STOP	<carrier_index>		
[SOURce<[1]|2>]:BB:ARB:MCARrier:OFILe	<file_name>		
[SOURce<[1]|2>]:BB:ARB:MCARrier:PRESet	-		
[SOURce<[1]|2>]:BB:ARB:MCARrier:SAMPles		sample	Query only
[SOURce<[1]|2>]:BB:ARB:MCARrier:SETTing:CATalog			Query only
[SOURce<[1]|2>]:BB:ARB:MCARrier:SETTing:LOAD	<file_name>		
[SOURce<[1]|2>]:BB:ARB:MCARrier:SETTing:STORe	<file_name>		
[SOURce<[1]	2>]:BB:ARB:MCARrier:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:ARB:MCARrier:TIME:MODE	LONG	SHORt	OFF		

[SOURce<[1]|2>]: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 80 MHz. 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 80 MHz is not respected when entering the number of carriers.	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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 'D:\IQ_wcdma'"`
                   'selects file 'IQ_wcdma'. The data of the file is modulated onto carrier 15.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 80 MHz.

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 80 MHz is not exceeded on entering the number of carriers (`:BB:ARB:MCAR:CARR:COUN`).	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"`
'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"`
'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"`
                      'sets the default directory to D:\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<[1]|2>]: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	Device-
	`SOUR:BB:ARB:MCAR:SPAC`	0	specific

[SOURce<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"
	'sets the default directory to D:\user\waveform.

":BB:ARB:MCAR:SETT:CAT?"
'reads out all the settings files in the default directory.

Response: "mcar1, mcar2"
'the directory D:\user\waveform contains the configuration files
'mcar1.arb_multcarr' and 'mcar2.arb_multcarr'.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]: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 'D:\user\waveform"
	'sets the default directory to D:\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<[1]|2>]: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 'D:\user\waveform"
	'sets the default directory to D:\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<[1]|2>]:BB:ARB:MCARrier:STATe ON | OFF

The command enables/disables multi carrier generation.

Example: `":BB:ARB:MCAR:STAT ON`
'enables multi carrier generation.

*RST value	Resolution	SCPI
OFF	-	device-specific

[SOURce<[1]|2>]: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.

The numeric suffix to SOURce distinguishes between signal output for path A and path B in the case of two-path instruments:

SOURce[1] = path A

SOURce2 = path B

For two-path instruments, the keyword SOURce is optional with commands for path A and can be omitted. For path B, the command must include the keyword with the suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Section "R&S Signal Generator Waveform and List Format", page 78 describes the ARB waveform format and how it is used to transmit waveforms via the IEC bus.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CATalog			Query only
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CLOCk	max Sample Rate ... 100 MHz		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CLOCk:MODE	UNCHanged | HIGHest | USER		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:COMMent	<string>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:DELete			No query
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:LEVel[:MODE]	UNCHanged | ERMS		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:OFILe	<file_name>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:SEGMent:APPend	<file_name>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:SEGMent:CATalog			Query only
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:SELect	<file_name>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:NEXT	1 ... 1999		
[SOURce<[1]|2>]:BB:ARB:WSEGment:STATe	ON | OFF		

[SOURce<[1]|2>]: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 'D:\user\waveform'"
        'sets the default directory to D:\user\waveform.

          ":BB:ARB:WSEG:CONF:CAT?"
        'reads out all the configuration files in the default directory.

       Response: "mulit1, multi2"
        'the directory D:\user\waveform contains the configuration files
         'multi1.inf_mswv' and 'multi2.inf_mswv'.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CLOCk   max sample rate .. 100MHz

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"
'sets the default directory to D:\user\waveform.

":BB:ARB:WSEG:CONF:DEL 'multi1'"
'deletes configuration file multi1.inf_mswv.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"
'sets the default directory to D:\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<[1]|2>]: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 'D:\user\waveform'"
'sets the default directory to D:\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<[1]|2>]: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 'D:\user\waveform'"
'sets the default directory to D:\user\waveform.

":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<[1]|2>]: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 'D:\user\waveform'"
'sets the default directory to D:\user\waveform.

":BB:ARB:WSEG:CONF:SEL 'new'"
'create configuration file new.inf_mswv in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]:BB:ARB:WSEGment:NEXT 0 ... 2000

This command selects the segment to be output.

Example: "`MMEM:CDIR 'D:\user\waveform`"
           'sets the default directory to D:\user\waveform.

                     "`: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

[SOURce<[1]|2>]:BB:ARB:WSEGment:STATe ON | OFF

This command enables/disables multi segment generation.

Example: "`:BB:ARB:WSEG:STAT ON`"
           'enables multi segment generation.

*RST value	Resolution	SCPI
OFF	-	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: #$d_0 d_1...d_x...d_{N-1}$…}   (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: #011100001010101010010101010100.....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$_0$Q$_0$I$_1$Q$_1$...I$_x$Q$_x$...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$_x$Q$_x$... 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:

```c
#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:

```c
#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.

The numeric suffix to SOURce distinguishes between signal generation for path A and path B in the case of two-path instruments:

[SOURce<1>] = path A
SOURce2 = path B

The keyword SOURce is optional in the case of commands for path A and can be omitted. For path B the command must contain the keyword with suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Table of Commands - DM General Remote-Control Commands

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:ASK:DEPTh	0 ... 100	PCT	
[SOURce<[1]	2>]:BB:DM:CODing	OFF	APCO25	APCO25FSK	CDMA2000	DIFF	DPHS	DGRay	EDGE	GRAY	GSM	ICO	NADC	PDC	PHS	TETRa	PWT	TFTS	INMarsat	VDL	WCDMa		
[SOURce<[1]|2>]:BB:DM:FILTer:ILENgth	1...128		
[SOURce<[1]	2>]:BB:DM:FILTer:ILENgth:AUTO	ON	OFF		
[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling	1...32		
[SOURce<[1]	2>]:BB:DM:FILTer:OSAMpling:AUTO	ON	OFF		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:APCO25	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:COSine	0.05 ... 0.99		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:GAUSs	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:LPASs	0.05 … 2.0		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:PGAus	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:RCOSine	0.05 ... 0.99		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:SPHase	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:TYPE	RCOSine	COSine	GAUSs	LGAuss	CONE	COF705	COEQualizer	COFequalizer	C2K3x	APCO25	SPHase	RECTangle	PGAuss	LPASs	USER	DIRac	ENPShape	EWPShape		

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:FLISt:CATalog			Query only
[SOURce<[1]|2>]:BB:DM:FLISt:DELete	<file name>		
[SOURce<[1]|2>]:BB:DM:FLISt:FREE			Query only
[SOURce<[1]|2>]:BB:DM:FLISt:POINTs			Query only
[SOURce<[1]|2>]:BB:DM:FLISt:SELect	<file name>		
[SOURce<[1]|2>]: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<[1]|2>]:BB:DM:FSK:DEViation	0.1 x Symbol Rate ... 1.5 x Symbol Rate	Hz	
[SOURce<[1]|2>]:BB:DM:FSK:VARiable:TYPE	4FSK | 8FSK | 16 FSK		
[SOURce<[1]|2>]:BB:DM:FSK:VARiable:SYMBol<0...15>:DEViation	-1.5 x Symbol Rate ... 1.5 x Symbol Rate (max 10 MHz)	Hz	
[SOURce<[1]|2>]:BB:DM:PATTern	#B0 ... #B111...1, 1...64		
[SOURce<[1]|2>]:BB:DM:PRAMp:ATTenuation	0.0 ... 50	dB	
[SOURce<[1]|2>]:BB:DM:PRAMp:FDELay	-4.0 ... +4.0 symbols		
[SOURce<[1]|2>]:BB:DM:PRAMp:RDELay	-4.0 ... +4.0 symbols		
[SOURce<[1]|2>]:BB:DM:PRAMp:SHAPe	LINear | COSine		
[SOURce<[1]|2>]:BB:DM:PRAMp:SOURce	INTernal | EXTernal		
[SOURce<[1]|2>]:BB:DM:PRAMp[:STATe]	ON | OFF		
[SOURce<[1]|2>]:BB:DM:PRAMp:TIME	0.25 ... 32 symbols		
[SOURce<[1]|2>]:BB:DM:PRBS[:LENGth]	9 | 11 | 15 | 16 | 20 | 21 | 23		
[SOURce<[1]|2>]:BB:DM:PRESet			
[SOURce<[1]|2>]:BB:DM:SLENgth	1...Max		
[SOURce<[1]|2>]:BB:DM:SOURce	ZERO | ONE | PRBS | PATTern | DLISt | SERial | PARallel		
[SOURce<[1]|2>]:BB:DM:SRATe	400 Hz ... 15 MHz (FSK) / 27 MHz	Hz	
[SOURce<[1]|2>]:BB:DM:STANdard	USER | BLUetooth | CFORward | CREVerse | DECT | ETC | GSM | GSMEdge | NADC | PDC | PHS | TDSCdma | TETRa | TFTS | W3GPp | WORLdspace		
[SOURce<[1]|2>]:BB:DM:STATe	ON | OFF		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:MODE	CLISt | PULSe | PATTern | RATio		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:OFFTime	1 ... (2^20 - 1) symbols		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:ONTime	1 ... (2^20 - 1) symbols		

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:PATTern	#B0, 1 ... #B111...1,32		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 2^10		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:PULSe:FREQ?			Query only
[SOURce<[1]|2>]:BB:DM:WAVeform:CREate			No query

[SOURce<[1]|2>]: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<[1]|2>]: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 except the user-defined modulation type USER.

*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<[1]|2>]:BB:DM:FILTer:ILENgth 1...128

The command sets the impulse length (number of filter tabs).

Example: `":BB:DM:FILT:ILEN 10"`
'sets the number of filter tabs to 10.

*RST value	Resolution	SCPI
10	1	Device-specific

[SOURce<[1]|2>]:BB:DM:FILTer:ILENgth:AUTO ON | OFF

The command acivates/deactivates the impulse length state. If activated, the most sensible parameter values are selected. The value depends on the coherence check.

Example: `":BB:DM:FILT:ILEN:AUTO ON"`
                'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling 1...32

The command sets the upsampling factor.

Example: `":BB:DM:FILT:OSAM 32"`
                'sets the upsampling factor to 32.

*RST value	Resolution	SCPI
32	-	Device-specific

[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling:AUTO ON | OFF

The command acivates/deactivates the upsampling factor state. If activated, the most sensible parameter values are selected. The value depends on the coherence check. If deactivated, the values can be changed manually.

Example: `":BB:DM:FILT:OSAM:AUTO ON"`
                'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:FSK:DEViation   <numeric_value>   E-2

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:PRAMp:SOURce   INTernal | EXTernal

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.

EXTernal

The digital control signals LEV_ATT and BURST are supplied via the control signal inputs on the AUX I/O connector.

Example: `":BB:DM:PRAM:SOUR EXT"`

'enables the use of external control signals for power ramp control. The signals must be supplied via the AUX I/O interface.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:SLENgth　　1...Max

Sets the sequence length of the signal in symbols. The signal is calculated in advance, saved as waveform file, and output in the selected arbitrary waveform generator.

Note:
　　Sequence Length x Oversampling must not exceed the maximum number of samples in the arbitrary waveform generator.

Example:　　　　`":BB:DM:SLEN 500"`
　　　　　　'sets the sequence length to 500 symbols.

*RST value	Resolution	SCPI
10.000	-	Device-specific

[SOURce<[1]|2>]:BB:DM:SOURce ZERO | ONE | PRBS | PATTern | DLISt | SERial | PARallel

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.

SERial
External data from the serial interface is used (in case of two-path instruments, path A).

PARallel
External data from the serial interface is used (in case of two-path instruments, path A).

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:STATe   ON | OFF

The command enables or disables digital modulation. Switching on digital modulation turns off all the other digital standards (in case of two-path instruments, this affects the same path).

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 (in case of two-path instruments, this affects the same path.	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:MODE   CLISt | PULSe | PATTern | RATio

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.

Example: `":BB:DM:TRIG:OUTP2:MODE PULS"`
                  'selects the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RATio	-	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two-path instruments, on path A).

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two-path instruments, on path A).

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two path instruments, path A) 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<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two-path instruments; for the path A) 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<[1]|2>]:BB:DM:WAVeform:CREate <file_name>

This command creates a waveform using the current settings of the **Digital Modulation** menu. The file name is entered with the command. The file is stored with the predefined file extension ***.wv**. The file name and the directory it is stored in are user-definable.

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

Example: "MMEM:CDIR 'D:\user\waveform'"
                      'sets the default directory to D:\user\waveform.

                      ":BB:DM:WAV:CRE 'dm_1'"
                      'creates the waveform file dm_1.wv in the default directory.

*RST value	Resolution	SCPI
-	-	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<[1]|2>]:BB:DM:CLISt:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:CLISt:COPY	<new_control_list_name>		No query
[SOURce<[1]|2>]:BB:DM:CLISt:DATA	0 | 1, {0 | 1} | block data		No query
[SOURce<[1]|2>]:BB:DM:CLISt:DELete	<control_list_name>		No query
[SOURce<[1]|2>]:BB:DM:CLISt:POINts			Query only
[SOURce<[1]|2>]:BB:DM:CLISt:SELect	<control_list_name>		Query only
[SOURce<[1]|2>]:BB:DM:CLISt:TAG?	<control_list_name>, <tag_name>		Query only
[SOURce<[1]|2>]:BB:DM:DLISt:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:DLISt:COPY	<new_data_list_name>		No query
[SOURce<[1]|2>]:BB:DM:DLISt:DATA	0 | 1, {0 | 1} | block data		
[SOURce<[1]|2>]:BB:DM:DLISt:DATA:APPend	0 | 1, {0 | 1} | block data		
[SOURce<[1]|2>]:BB:DM:DLISt:DELete	<data_list_name>		No query
[SOURce<[1]|2>]:BB:DM:DLISt:POINts			
[SOURce<[1]|2>]:BB:DM:DLISt:SELect	<data_list_name>		
[SOURce<[1]|2>]:BB:DM:DLISt:TAG?	<data_list_name>, <tag_name>		Query only
[SOURce<[1]|2>]:BB:DM:MLISt:CATlog			Query only
[SOURce<[1]|2>]:BB:DM:MLISt:DELete	<user_mapping_list_name>		
[SOURce<[1]|2>]:BB:DM:MLISt:FREE			Query only
[SOURce<[1]|2>]:BB:DM:MLISt:POINts			Query only
[SOURce<[1]|2>]:BB:DM:MLISt:SELect	<user_mapping_list_name>		
[SOURce<[1]|2>]:BB:DM:SETTing:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:SETTing:DELete	"setting_file"		No query
[SOURce<[1]|2>]:BB:DM:SETTingt:LOAD	"setting_file"		No query
[SOURce<[1]|2>]:BB:DMSETTing:STORe	"setting_file"		No query
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:DELete	"user_list"		No query

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:LOAD	"user_list"		No query
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:STORe	"user_list"		No query

[SOURce<[1]|2>]: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 'D:/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<[1]|2>]: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<[1]|2>]: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
Marker 3		4
Marker 4		8
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<[1]|2>]: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<[1]|2>]:BB:DM:CLISt:POINts?   E-2

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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. The numeric suffix on SOURce<[1]|2> is ignored in this command.

Example: MMEM:CDIR 'D:/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<[1]|2>]: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<[1]|2>]:BB:DM:DLISt:DATA 0 | 1 {,0 | 1 }.| block data

[SOURce<[1]|2>]: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. Response:"???"
    '1024 bits of the file dlist1 are read out starting at bit 2048.

*RST has no effect on data lists.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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. The numeric suffix on SOURce<[1]|2> is ignored in this command.

Example: ":BB:DM:DLIS:DEL ' d_list2'"
    'deletes data list d_list2.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:FLISt:CATalog? E-2

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 'D:\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<[1]|2>]: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 'D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\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<[1]|2>]: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 'D:\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<[1]|2>]: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 'D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\dig_mod`
                'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\dig_mod"`
                  'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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:IMPort Subsystem - Remote-Control Commands

The IMPort subsystem contains the commands for importing IQ signal data files via TCP/IP into WinIQSIM2.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:IMPort:CLIPping:LEVel	1...100	PCT	
[SOURce<[1]|2>]:BB:IMPort:CLIPping:MODE	VECTor | SCALar		
[SOURce<[1]|2>]:BB:IMPort:CLIPping:STATe	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth	1...128		
[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth:AUTO	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling	1...32		
[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling:AUTO	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:APCO25	0.05 ... 0.99		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine	0.00 ... 0.99		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine:COFS	-1.0 … +1.0		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:GAUSs	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:LPASs	0.05 ...2.0		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:PGAus	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:RCOSine	0.00 ... 0.99		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:SPHase	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:IMPort:FILTer:TYPE	RCOSine | COSine | GAUSs | APCO25 | SPHase | PGAuss | LPASs		
[SOURce<[1]|2>]:BB:IMPort:PRESet			
[SOURce<[1]|2>]:BB:IMPort:SERVer:ID			Query only
[SOURce<[1]|2>]:BB:IMPort:SERVer:LOCAl[:STATe]	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:SERVer:NAME			
[SOURce<[1]|2>]:BB:IMPort:SERVer:PORT	0...65536		
[SOURce<[1]|2>]:BB:IMPort:SERVer:TTOut	10...10000		
[SOURce<[1]|2>]:BB:IMPort:SERVer:UPDate			
[SOURce<[1]|2>]:BB:IMPort:SETTingt:CATalog			Query only
[SOURce<[1]|2>]:BB:IMPort:SETTingt:LOAD	"setting_file"		No query
[SOURce<[1]|2>]:BB:IMPort:SETTingt:STORe	"setting_file"		No query
[SOURce<[1]|2>]:BB:IMPort:SRATe:VARiation			Query only
[SOURce<[1]|2>]:BB:IMPort:STATe	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:MODE	RESTart | PULSe | PATTern | RATio		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:OFFTime	1 ... (2^20 - 1) symbols		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:ONTime	1 ... (2^20 - 1) symbols		
[SOURce<[1]|2>]:BB:IMP:TRIGger:OUTPut<[1]...4>:PATTern	#B0, 1 ... #B111...1,32		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 2^10		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PULSe:FREQ?			Query only

[SOURce<[1]|2>]:BB:IMPort:CLIPping:LEVel 0 ... 100 PCT

The command sets the limit for level clipping. This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Level clipping is activated with the command `SOUR:BB:IMP:CLIP:STAT ON`

Example: `":BB:IMP:CLIP:LEV 80PCT"`
'sets the limit for level clipping to 80% of the maximum level.

`":BB:IMP:CLIP:STAT ON"`
'activates level clipping.

*RST value	Resolution	SCPI
100 PCT	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:CLIPping:MODE VECTor | SCALar

The command sets the method for level clipping (Clipping).

Parameters: **VECTor**
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

Example: `":BB:IMP:CLIP:MODE SCAL"`
'selects the absolute maximum of all the I and Q values as the reference level.

`":BB:IMP:CLIP:LEV 80PCT"`
'sets the limit for level clipping to 80% of this maximum level.

`":BB:IMP:CLIP:STAT ON"`
'activates level clipping.

*RST value	Resolution	SCPI
VECTor	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:CLIPping:STATe ON | OFF

The command activates level clipping (Clipping). The value is defined with the command `[SOURce]:BB:IMPort:CLIPping:LEVel`, the mode of calculation with the command `[SOURce]:BB:IMPort:CLIPping:MODE`.

Example: `":BB:IMP:CLIP:STAT ON"`
'activates level clipping.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth 1...128

The command sets the impulse length (number of filter tabs).

Example: `":BB:IMP:FILT:ILEN 10"`
                      'sets the number of filter tabs to 10.

*RST value	Resolution	SCPI
10	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth:AUTO] ON | OFF

The command acivates/deactivates the impulse length state. If activated, the most sensible parameter values are selected. The value depends on the coherence check.

Example: `":BB:IMP:FILT:ILEN:AUTO ON"`
                      'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling 1...32

The command sets the upsampling factor.

Example: `":BB:IMP:FILT:OSAM 32"`
                      'sets the upsampling factor to 32.

*RST value	Resolution	SCPI
32	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling:AUTO ON | OFF

The command acivates/deactivates the upsampling factor state. If activated, the most sensible parameter values are selected. The value depends on the coherence check. If deactivated, the values can be changed manually.

Example: `":BB:IMP:FILT:OSAM:AUTO ON"`
                      'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:APCO25 0.05 ... 0.99

The command sets the roll-off factor for filter type APCO25.

Example: `":BB:IMP:FILT:PAR:APCO25 0.2"`
                      'sets the roll-off factor to 0.2 for filter type APCO25.

*RST value	Resolution	SCPI
0.20	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine   0.00 ... 0.99   E-2

The command sets the roll-off factor for the Cosine filter type.

Example: `":BB:IMP:FILT:PAR:COS 0.35"`
                  'sets the roll-off factor to 0.35 for filter type Cosine.

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine:COFS   -0.1 … 1.0

The command sets the "cut of frequency shift" value for the Cosine filter type.

Example: `":BB:IMP:FILT:PAR:COS:COFS 0.04"`
                  'the "cut of frequency shift" value is set to 0.04.

*RST value	Resolution	SCPI
		Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:GAUSs 0.15 … 2.5

The command sets the roll-off factor for the Gauss filter type.

Example: `":BB:IMP:FILT:PAR:GAUS 0.5"`
                  'sets B x T to 0.5 for the Gauss filter type.

*RST value	Resolution	SCPI
0.3	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:LPASs   0.05...2.0

The command sets the cut off frequency factor for the Lowpass filter type.

Example: `":BB:IMP:FILT:PAR:LPAS 0.5"`
                  'the cut of frequency factor is set to 0.5.

*RST value	Resolution	SCPI
0.50		Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:PGAuss 0.15 … 2.5

The command sets the roll-off factor for the Pure Gauss filter type.

Example: `":BB:IMP:FILT:PAR:PGA 0.5"`
                  'sets B x T to 0.5 for the Pure Gauss filter type.

*RST value	Resolution	SCPI
0.5	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:RCOSine 0.05 ... 0.99

The command sets the roll-off factor for the Root Cosine filter type.

Example: ":BB:IMP:FILT:PAR:RCOS 0.22"
                     'sets the roll-off factor to 0. 22 for filter type Root Cosine.

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:SPHase 0.15 … 2.5

The command sets B x T for the Split Phase filter type.

Example: ":BB:IMP:FILT:PAR:SPH 0.5"
                     'sets B x T to 0.5 for the Split Phase filter type.

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:TYPE   RCOSine | COSine | GAUSs | APCO25 | SPHase | PGAuss | LPASs

The command selects the filter type.

Example: ":BB:IMP:FILT:TYPE COS"
                     'selects the Cosine filter type.

*RST value	Resolution	SCPI
COSine	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:PRESet

The command calls the default settings for IQ data import.

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

Example: ":BB:IMP:PRES"
                     'calls the default settings for IQ data import.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:ID?

The command queries the connected import server. If no import server is connected, **not connected** is displayed. Seraching for a connected server is triggered with **Update Server Connection**.

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

Example: ":BB:IMP:SERV?"
                     'queries the connected import server.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:LOCal[:STATe]

The command   ownloade or deactivates the local host as the server from where the IQ data streams will be   ownloaded. If activated, the field for entering a remote host is filled with the entry **localhost** automatically and cannot be edited.

Example: `":BB:IMP:SERV:LOC:STAT ON"`
                'sets the localhost as the connected server.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:NAME <server_name>

The command enters the name (IP address) of the connected server. To enter the name in this field, the check box **Use Local Server** has to be unchecked.

Example: `":BB:IMP:SERV:NAME 12.34.45.78"`
                'enters the IP address of the connected server.

*RST value	Resolution	SCPI
localhost	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:PORT 0…65536

The command enters the port number for the server connection.

Example: `":BB:IMP:SERV:PORT 1000"`
                'sets port 1000 for the server connection.

*RST value	Resolution	SCPI
1000	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:TTOut 10...10.000

The command sets the duration after which the transmission is aborted in case of a server timeout.

Example: `":BB:IMP:SERV:TTO 20"`
                'sets the transmission timeout to 20 seconds.

*RST value	Resolution	SCPI
20 s	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:UPDate

The command udates the TCP/IP parameter and tries to establish a connection to the server.

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

Example: `":BB:IMP:SERV:UPD`
                'updates the server connection.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SETTing:CATalog?

This command reads out the files with import settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension ***.import** will be listed.

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

Example: "`MMEM:CDIR 'D:\user\waveform'`"
                    'sets the default directory to D:\user\waveform.

                    "`:BB:IMP:SETT:CAT?`"
                    'reads out all the files with import settings in the default directory.

                    Response: "'import_1', 'import_2'"
                    'the files 'import_1' and 'import_2' with import settings are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SETTing:LOAD <file_name>

This command loads the selected file with import 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 ***.import** will be loaded.

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

Example: "`:BB:IMP:SETT:LOAD 'import_1'`"
                    'loads file 'import_1'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SETTing:STORe <file_name>

This command stores the current import 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. Import settings are stored as files with the specific file extensions ***.import**.

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

Example: "`:BB:IMP:SETT:STOR 'import_1'`"
                    'stores the current import settings into file '`import_1`'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SRATe:VARiation ?

This command queries the sample rate variation.

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

Example: "`:BB:BB:IMP:SETT:STOR 'import_1'`"
                    'stores the current import settings into file '`import_1`'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:STATe ON | OFF

The command enables or disables the import of IQ data.

Example: `":BB:IMP:STAT ON"`
'enables the import of IQ data.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:MODE RESTart | PULSe | PATTern | RATio

The command defines the signal for the selected marker output.

Parameter: **RESTart**
A brief marker signal is generated at the start of the waveform.

PULSe
A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:IMP:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:IMP: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 command `SOURce:BB:IMP: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:IMP:TRIGger:OUTPut:OFFT` and `SOURce:BB:IMP:TRIGger:OUTPut:ONT` is generated.

Example: `":BB:IMP:TRIG:OUTP2:MODE PULS"`
'selects the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RESTart	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:OFFTime 1 ... (2^24) -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:IMPort:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example: `":BB:IMP:TRIG:OUTP2:OFFT 20"`
'sets an OFF time of 20 symbols for marker signal 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:ONTime   1 ... (2^24) -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:IMPort:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Example: `":BB:IMP:TRIG:OUTP2:ONT 20"`
                'sets an ON time of 20 symbols for marker 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PATTern   #B0,1 ... #B111...1, 32

The command defines the bit pattern used to generate the marker signal in the setting `SOURce:BB:IMP:TRIGger:OUTPut:MODE PATTern`. 0 is marker off, 1 is marker on.

Example: `":BB:IMP:TRIG:OUTP2:PATT #B000000011111111,15"`
                'sets a bit pattern.

                `":BB:IMP: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<[1]|2>]:BB:IMP:TRIGger:OUTPut<[1]...4>:PULSe:DIVider   2 ... 2^10

The command sets the divider for the Pulse marker mode (`SOUR:BB:IMP:TRIG:OUTP:MODE PULSe`). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Example: `":BB:IMP:TRIG:OUTP2:PULS:DIV 2"`
                'sets the divider to 2 for the marker signal on output MARKER 2.

                `":BB:IMP: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<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency?   E-2

The command queries the pulse frequency of the pulsed marker signal in the setting
`SOURce:BB:IMP: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:IMP:TRIG:OUTP2:PULS:DIV 2"`
                      'sets the divider marker signal on output MARKER 2 to the value 2.

                      `":BB:IMP:TRIG:OUTP2:MODE PULS"`
                      'enables the pulsed marker signal.

                      `":BB:IMP: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

Alphabetical List of Commands

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Baseband Block WinIQSIM2

R&S® WinIQSIM2
1008.0858.42

ROHDE & SCHWARZ
Test and Measurement Division

Dear Customer,

The Signal Generator includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/).

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

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 thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, 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 documentación 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.

Contents - Baseband Block WinIQSIM2

WinIQSIM2 Baseband Block

The Signal Generation Software R&S WinIQSIM2 provides you with the ability to generate digital modulation signals in accordance with the definitions in the digital standards or with user-definable characteristics. You can then load these files 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 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.

The equipment layout for generating the internal, digital modulation signals includes the options Multi Carrier CW Signal Generation and the option Import IQ Data.

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 loaded with noise (see section "Working wit the AWGN Block" in Software Manual "Signal Generation Software R&S WinIQSIM2").

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.

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
- Control signals

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).
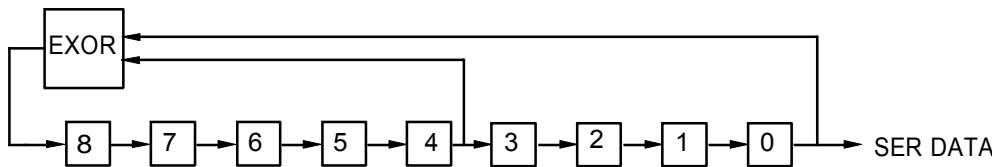
Fig. 1   9-bit PRBS generator

Note:
For PRBS15 and PRBS23, a CCITT V.52-compliant data inversion is performed in the feedback path automatically as shown below:
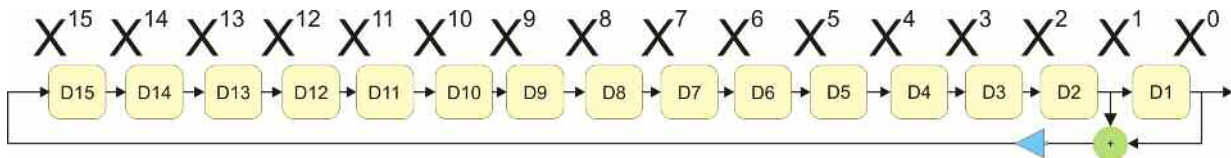
The pseudo-random sequence from a PRBS generator is uniquely defined by the register number and the feedback. The following table describes all the available PRBS generators:

Table 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
15-bit	$2^{15} - 1 = 32767$	Registers 1, 0	PRBS 15
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
23-bit	$2^{23} - 1 = 8388607$	Registers 5, 0	PRBS 23

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 hard disk. 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.
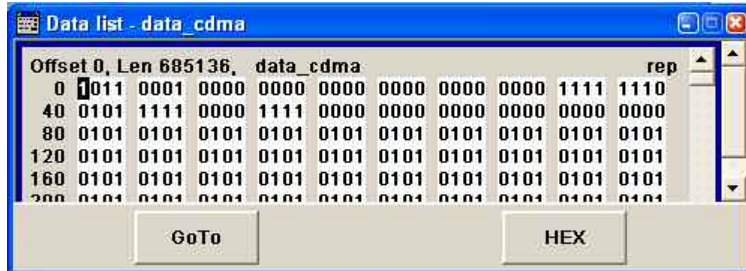
The maximum length of a data list is determined by the size of the data list memory (see data sheet). There is no restriction on the number of lists that can be stored.

Control Signals

The following control signals are processed in the R&S WinIQSIM2:

- **Burst Gate** and **Level Attenuation** for power ramping

Note:
 CW for controlling the CW (continuous wave) mode is not used in R&S WinIQSIM2. However, a control list generated for R&S Signal Generator can contain CW controls.

A separate file with the file extension ***.dm_iqc** is created for each defined control signal.

Power Ramping and Level Attenuation

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.
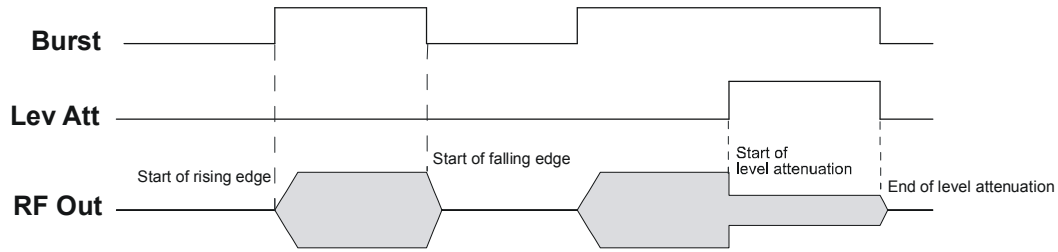
Fig. 2   Signal behavior when power ramping is enabled. The **Burst** Gate signal defines the start of
the rising and falling edges of the envelope, and the **Lev Att** signal defines the start and end
of level attenuation. The level attenuation value is defined in the **Power Ramp Control**
menu.

Marker Output Signals

The R&S WinIQSIM2 generates user-definable marker information which will can be processed by the
R&S Signal Generator to output the appropriate markers signals. All four available marker outputs are
configurable.

Digital Modulation - Custom Digital Modulation

The R&S WinIQSIM2 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

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.
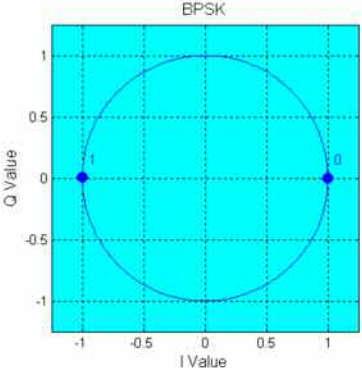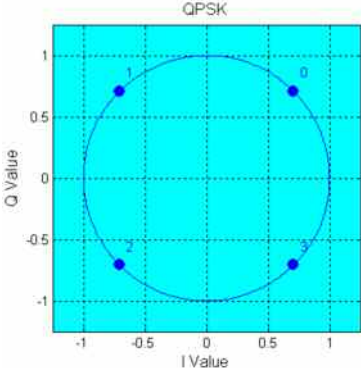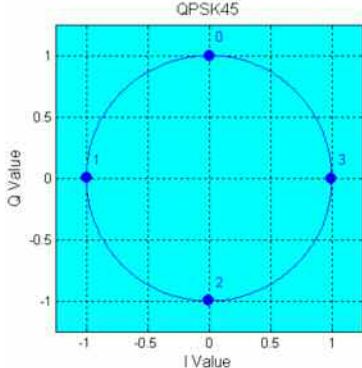
The mapping for the selected modulation type is displayed in the **More..**. submenu in the **Modulation** menu section (see "More - Modulation Type - Digital Modulation", page *22*)

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 1   Modulation type and associated mapping

PSK

BPSK	QPSK	QPSK 45° Offset
1 bit per symbol	2 bits per symbol	2 bits per symbol 45° rotation
`SOUR:BB:DM:FORM BPSK`	`SOUR:BB:DM:FORM QPSK`	`SOUR:BB:DM:FORM QPSK45`

QPSK EDGE

2 bits per symbol
3pi/4 rotation

`SOUR:BB:DM:FORM QEDGe`

EDGE QPSK (3PI/4 rotation)
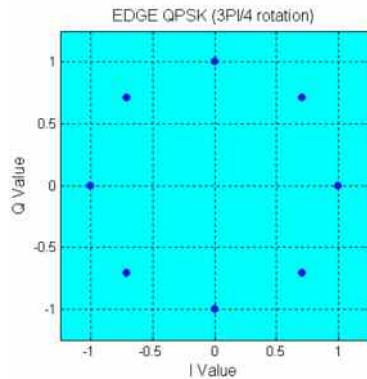
OQPSK

2 bits per symbol
Q offset

`SOUR:BB:DM:FORM OQPSK`

OQPSK
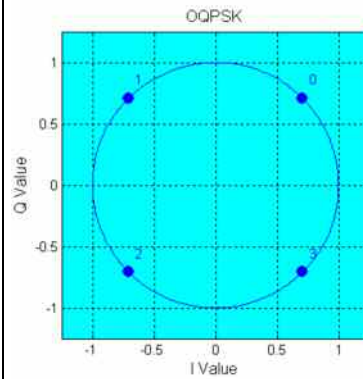
pi/4-QPSK

2 bits per symbol
pi/4rotation

`SOUR:BB:DM:FORM P4QP`

PI/4 QPSK
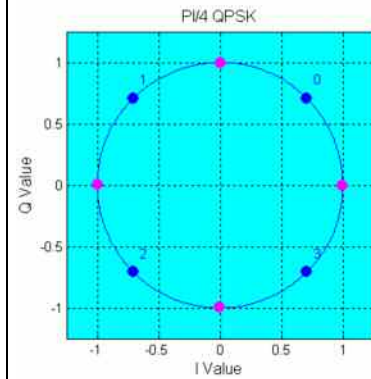
pi/2-DBPSK

1 bit per symbol
Differential coding, pi/2 rotation

`SOUR:BB:DM:FORM P2DB`

PI/2 DBPSK
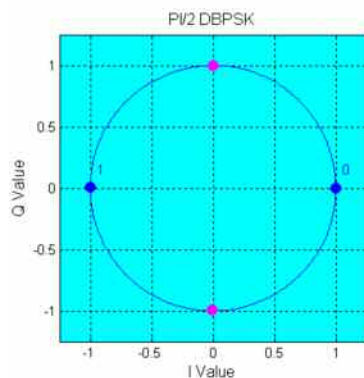
pi/4-DQPSK

2 bits per symbol
Differential coding, pi/4 rotation

`SOUR:BB:DM:FORM P4DQ`

PI/4 DQPSK
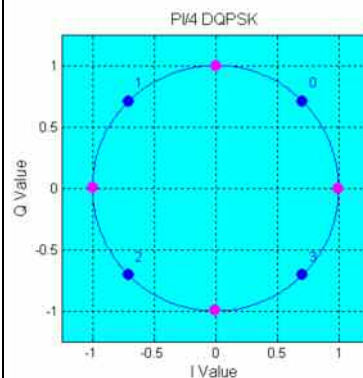
pi/8-D8PSK

3 bits per symbol
Differential coding, pi/8 rotation

`SOUR:BB:DM:FORM P8D8`

PI/8 D8PSK
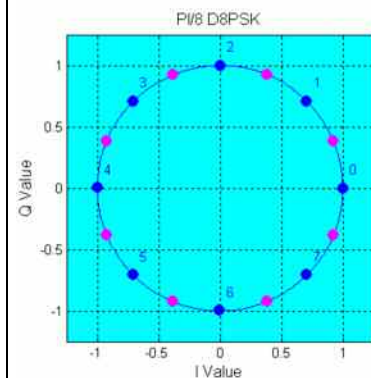
8PSK

3 bits per symbol

`SOUR:BB:DM:FORM PSK8`
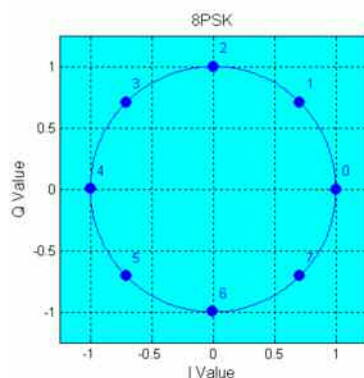
8PSK

8PSK EDGE (3pi/8 8PSK)

3 bits per symbol
Edge coding, 3pi/8 rotation

`SOUR:BB:DM:FORM P8ED`

3PI/8 8PSK

QAM
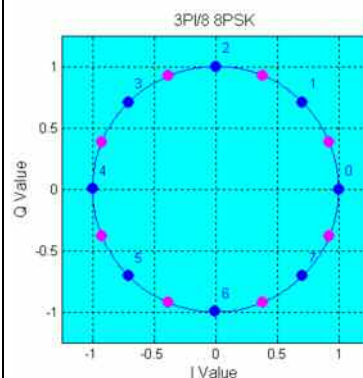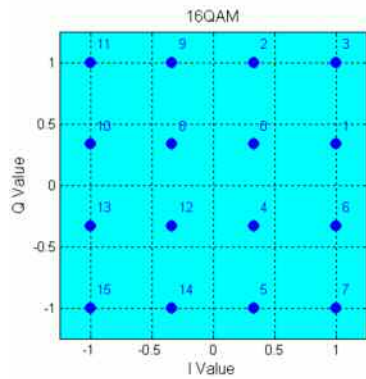
16QAM	16QAM EDGE	32QAM
4 bits per symbol	4 bits per symbol, pi/4 rotation	5 bits per symbol
`SOUR:BB:DM:FORM QAM16`	`SOUR:BB:DM:FORM QAM16EDge`	`SOUR:BB:DM:FORM QAM32`
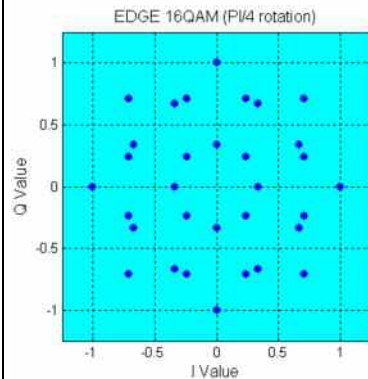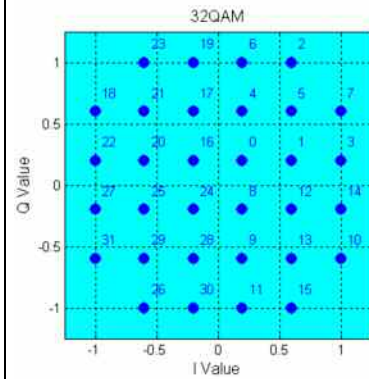
32QAM EDGE	64QAM	128QAM
5 bits per symbol, -pi/4 rotation	6 bits per symbol	7 bits per symbol
`SOUR:BB:DM:FORM QAM32EDge`	`SOUR:BB:DM:FORM QAM64`	`SOUR:BB:DM:FORM QAM128`
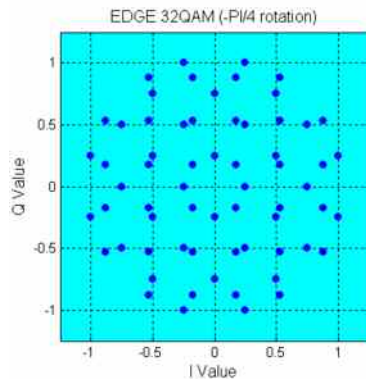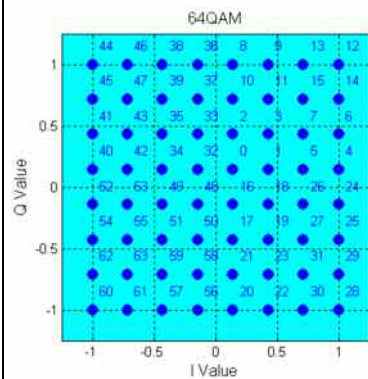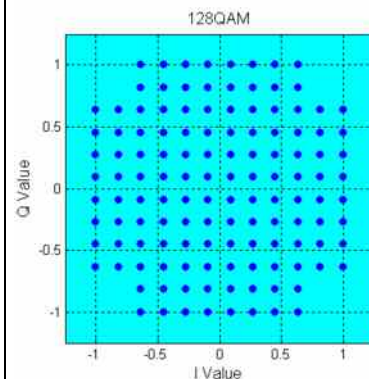
256QAM	1024QAM
8 bits per symbol	10 bits per symbol
`SOUR:BB:DM:FORM QAM256`	`SOUR:BB:DM:FORM QAM1024`
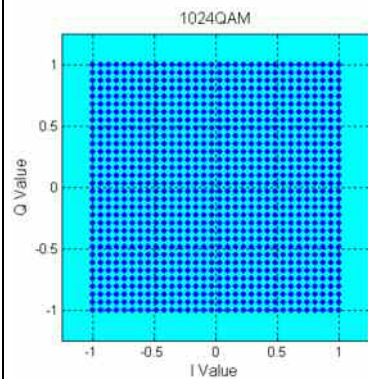
FSK

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`
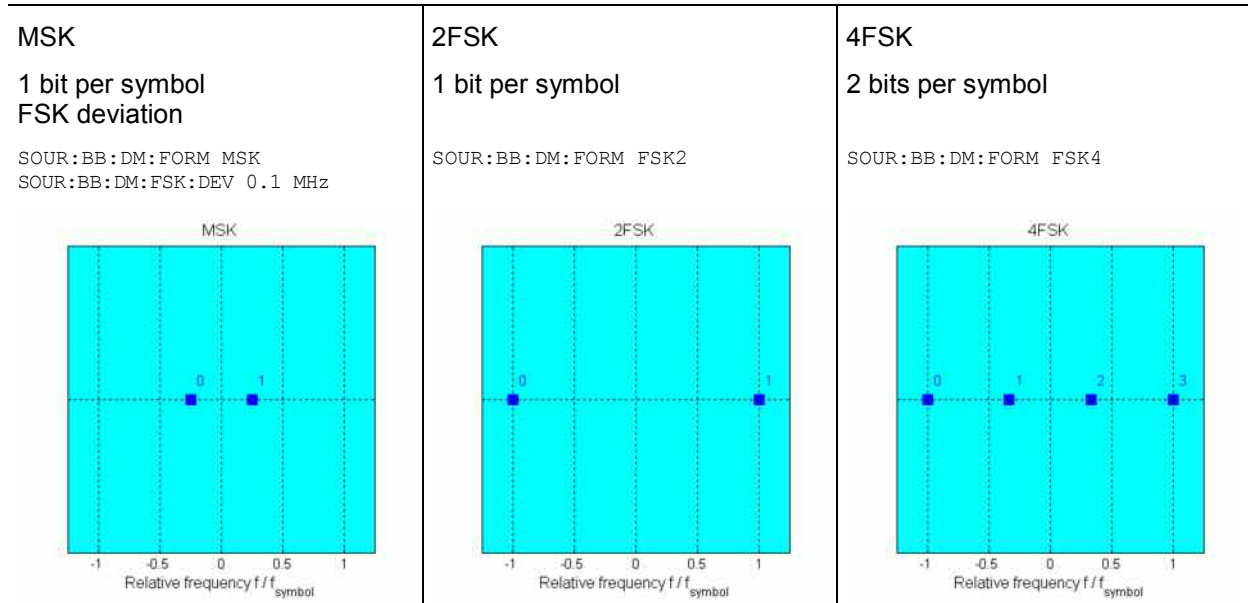
User Mapping

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 WinIQSIM2.
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 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 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 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 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.

$a0_n$ —→ [INMARSAT CODING] —→ $b0_n$

$a1_n$ (MSB) —→ —→ $b1_n$ (MSB)
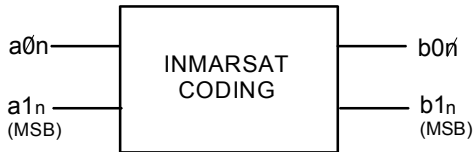
$b_{1n} =$ [NOT $(a_{1n}$ EXOR $a_{0n})$ AND $(a_{1n}$ EXOR $b_{1(n-1)})$]   OR

[$(a_{1n}$ EXOR $a_{0n})$ AND $(a_{1n}$ EXOR $b_{0(n-1)})$]
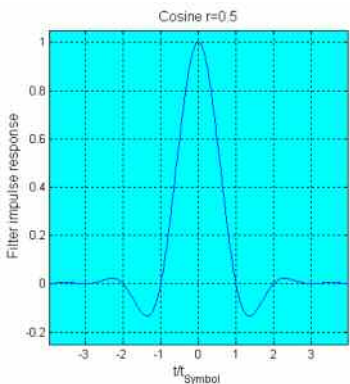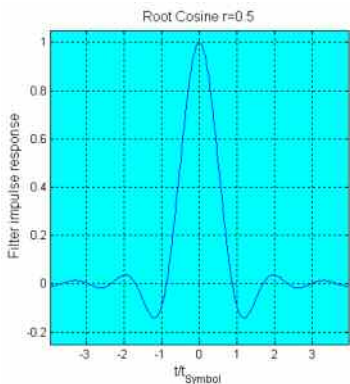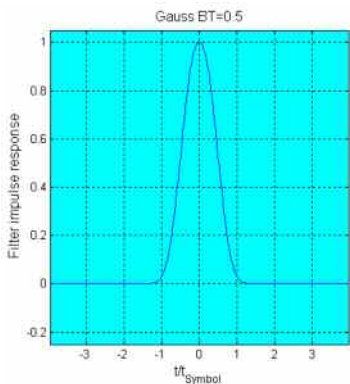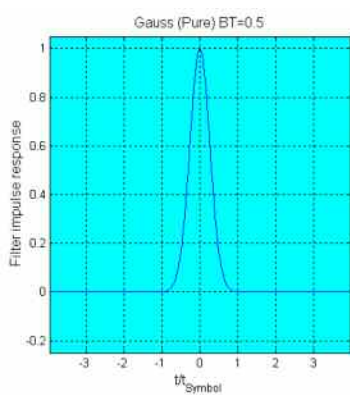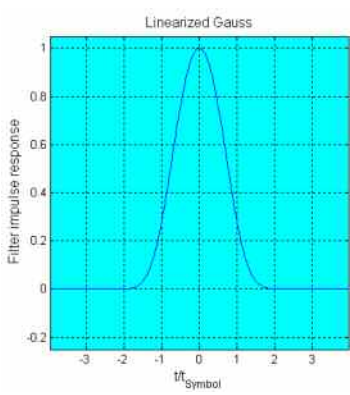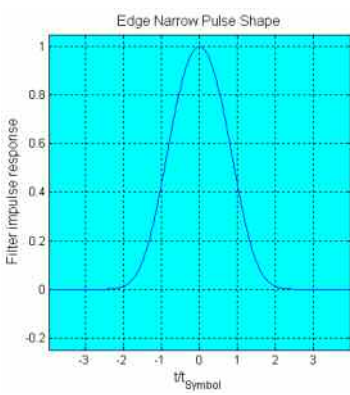
$b_{0n} =$ [NOT $(a_{1n}$ EXOR $a_{0n})$ AND $(a_{0n}$ EXOR $b_{0(n-1)})$]   OR

[$(a_{1n}$ EXOR $a_{0(n-1)})$ AND $(a_{0n}$ EXOR $b_{1(n-1)})$]

Baseband Filter - Custom Digital Mod

The R&S WinIQSIM2 offers a wide selection of predefined baseband filters. Each filter can be optimized for low adjacent-channel leakage power or low vector error. The filter characteristic for the selected filter is displayed in the **More...** submenu in the **Filter** menu section (see "More - Filter - Digital Modulation", page 24). 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 2   Baseband filter

Cosine	Root Cosine ($\sqrt{\cos}$)	Gauss (FSK)
Roll Off Factor	Roll Off Factor	B x T
`SOUR:BB:DM:FILT:TYPE COS` `SOUR:BB:DM:FILT:PAR:COS 0.99`	`SOUR:BB:DM:FILT:TYPE RCOS` `SOUR:BB:DM:FILT:PAR:RCOS 0.99`	`SOUR:BB:DM:FILT:TYPE GAUS` `SOUR:BB:DM:FILT:PAR:GAUS 2.5`
Pure Gauss	Gauss Linearized	Edge Narrow Pulse Shape
B x T		
`SOUR:BB:DM:FILT:TYPE PGA` `SOUR:BB:DM:FILT:PAR:PGA 2.5`	`SOUR:BB:DM:FILT:TYPE LGA`	`SOUR:BB:DM:FILT:TYPE ENPShape`

Edge Wide Pulse Shape	cdmaOne	cdmaOne 705 kHz
`SOUR:BB:DM:FILT:TYPE EWPShape`	`SOUR:BB:DM:FILT:TYPE CONE`	`SOUR:BB:DM:FILT:TYPE COF705`
cdmaOne + Equalizer	cdmaOne 705 kHz + Equalizer	cdma2000 3X
`SOUR:BB:DM:FILT:TYPE COE`	`SOUR:BB:DM:FILT:TYPE COFE`	`SOUR:BB:DM:FILT:TYPE DM3x`
APCO25 Roll Off Factor	Split Phase BxT	Rectangular
`SOUR:BB:DM:FILT:TYPE APCO25` `SOUR:BB:DM:FILT:PAR:APC 0.5`	`SOUR:BB:DM:FILT:TYPE  SPH` `SOUR:BB:DM:FILT:PAR:SPH 0.15`	`SOUR:BB:DM:FILT:TYPE RECT`
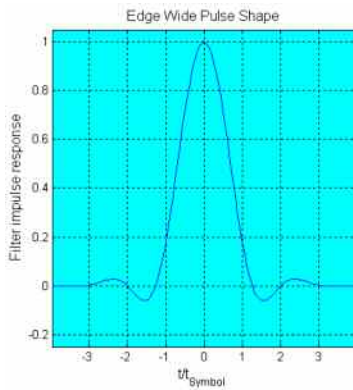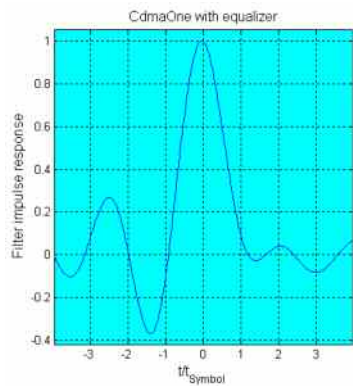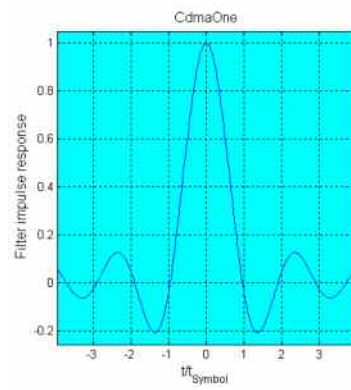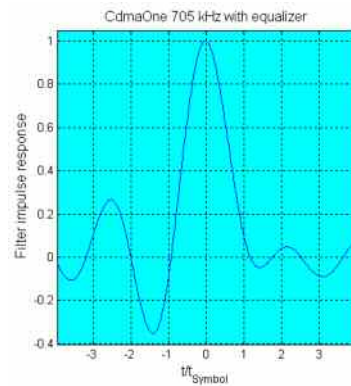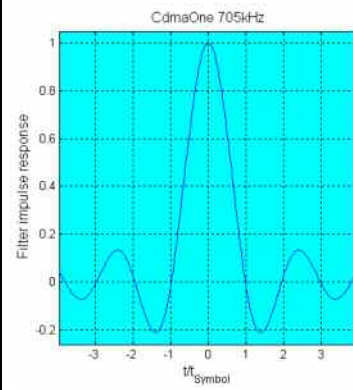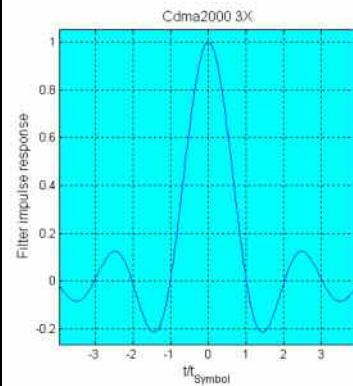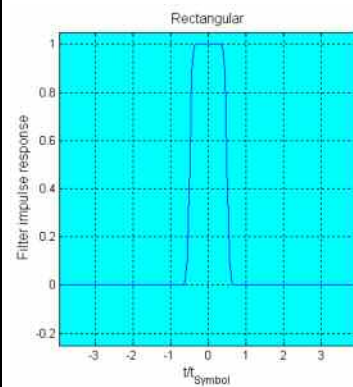
Lowpass	Dirac
`SOUR:BB:DM:FILT:TYPE LPASs`	`SOUR:BB:DM:FILT:TYPE DIRac`
Ideal Lowpass (0.25)	Dirac
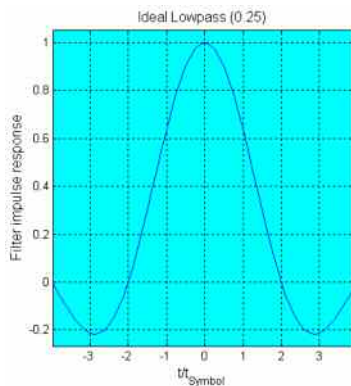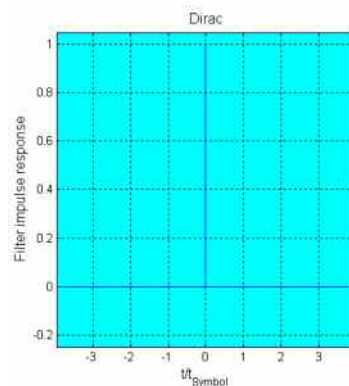
User filter

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 WinIQSIM2. 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 WinIQSIM2 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.

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.
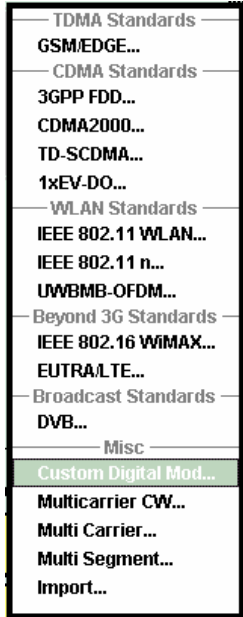
The **Custom Digital Modulation** menu enables direct selection of the data source, standard, symbol rate, coding, modulation type and filter. All other settings are entered in submenus which are called via **More** buttons.

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 **Generate Waveform File** opens the submenu for storing the current signal in a waveform file.
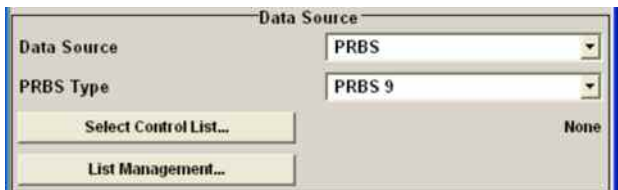
The data source is selected and set in the **Data Source** section.

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.
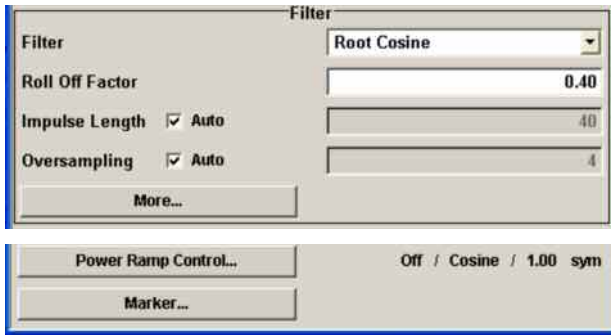
The filter is set in the **Filter** section.

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 the markers.

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

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
Clock	
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.
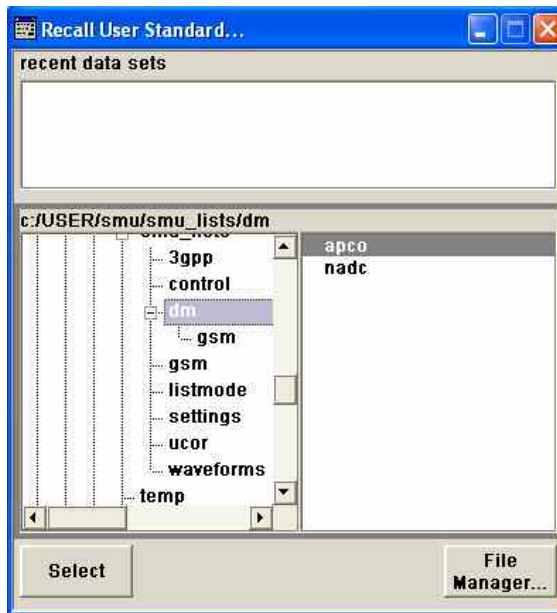
Remote-control commands:
```
MMEM:MDIR '\gen\dig_mod\sett'

SOUR:BB:DM:SETT:CAT?
SOUR:BB:DM:SETT:DEL
SOUR:BB:DM:SETT:LOAD
SOUR:BB:DM:SETT:STOR
```

Generate Waveform File - Digital Modulation

Opens the submenu for storing the current signal as ARB signal in a waveform file.

The file name is entered in the submenu. The file is stored with the predefined file extension ***.wv**. The file name and the directory it is stored in are user-definable.

Remote-control commands:
```
SOUR:BB:DM:WAV:CRE "D:\temp\winiqsim2_wv"
```

Sequence Length - Digital Modulation	Sets the sequence length of the signal in symbols. The signal is calculated in advance, saved as waveform file, and output in the selected arbitrary waveform generator.

Note:

*Sequence Length * Oversampling must not exceed the maximum number of samples in the arbitrary waveform generator.*

Remote-control commands:
```
SOUR:BB:DM:SLEN 500
```

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 1).

You may choose from the following data sources:

All 0	0 data or 1 data is internally generated.
All 1	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	Data lists will be used.
	...Select Data	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.

Select Data...	BIG

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 25).

Dig. Mod. A: Data Source		
Data List...		data_cdma
Edit Data List...		
Control List...		all_up
Edit Control List...		

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 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 'F:\gen\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 9).
	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 5).
	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 Manage**r menu is used to display and delete files.
	Remote-control command: `MMEM:MDIR 'F:\gen\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.
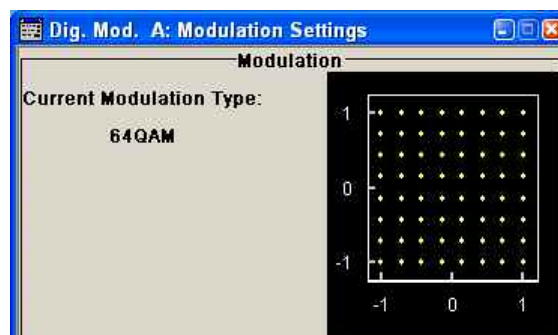
In case of selection **Variable FSK**, the FSK type and the deviation for each symbols is set in the **Variable FSK** section.
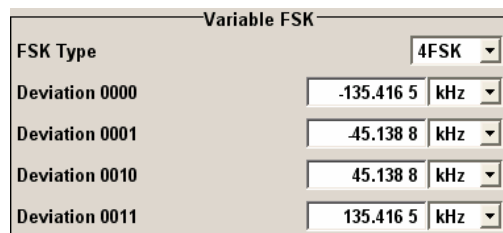
FSK Type - Digital Modulation	**(Variable FSK only)**
	Selects the FSK modulation type for selection **Variable FSK**.
	You may choose from 4FSK, 8FSK and 16FSK.
	Remote-control command: `SOUR:BB:DM:FSK:VAR:TYPE FSK8`

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`
Current Modulation Type - Digital Modulation	Displays the currently selected modulation type together with its associated mapping.
	Remote-control command: n.a.

The filter is set in the **Filter** section.

Filter - Digital Modulation	Selects the baseband filter (see also section "Baseband Filter - Custom Digital Mod", page 12).
	Remote-control command: `SOUR:BB:DM:FILT:TYPE COS`
Filter Parameter - Digital Modulation	Sets the filter parameter.
	The rolloff factor determines the excess bandwidth of the filter. For example, a rolloff factor of .5 means that the bandwidth of the filter is 1.5 times the input sampling frequency, Fd. This also means that the transition band of the filter extends from .5 * Fd to 1.5 * Fd.
	Normalized bandwidth B x Tsymbols. (bandwidth-multiplied-by-symbol-time).
	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	**(This feature is 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`
Impulse Length - Digital Modulation	Displays the number of filter tabs. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

	Remote-control command:
	`SOUR:BB:DM:FILT:ILEN:AUTO ON`
	`SOUR:BB:DM:FILT:ILEN 120`

Oversampling - Digital Modulation	Determines the upsampling factor. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

	Remote-control command:
	`SOUR:BB:IMP:FILT:OSAM:AUTO ON`
	`SOUR:BB:IMP:FILT:OSAM 20`

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 'F:\gen\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.
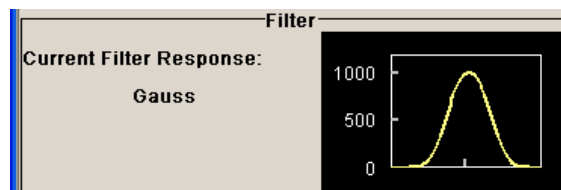
Remote-control command: n.a.

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 33).
	Remote-control command: n.a.
Marker - Digital Modulation	Calls the **Marker** menu. The **Marker**menu is used to configure the marker output signals (see section *"Marker - Custom Digital Modulation"*, page *Error! Bookmark not defined.*.
	Remote-control command: n.a.

List Management - Digital Modulation Menu

The **List Management** menu is called from the **Digital Modulation** main menu.

List Management...
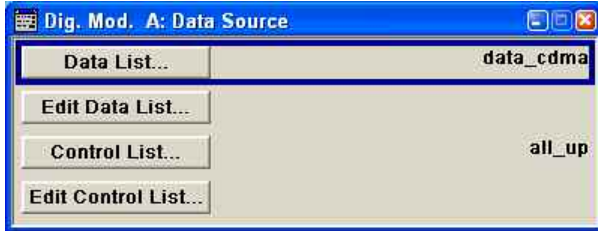
The data and control lists are selected and created in the **File Select** menu which is called up by means of the **Data List...** and **Control List...** buttons.

The **File Manager** is used to copy, rename and delete files and to create directories.

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 - Selects data/control list. This opens the **File Select** window in which the
Digital Modulation data/control list can be selected.
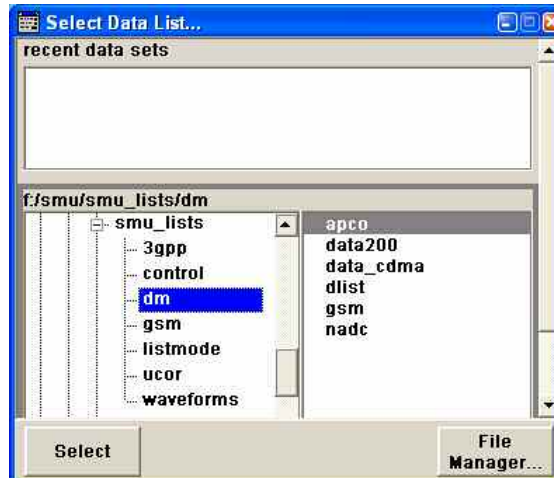
Remote-control commands:
```
SOUR:BB:DM:DLIS:SEL "d_list1"
SOUR:BB:DM:CLIS:SEL "c_list3"
```

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.
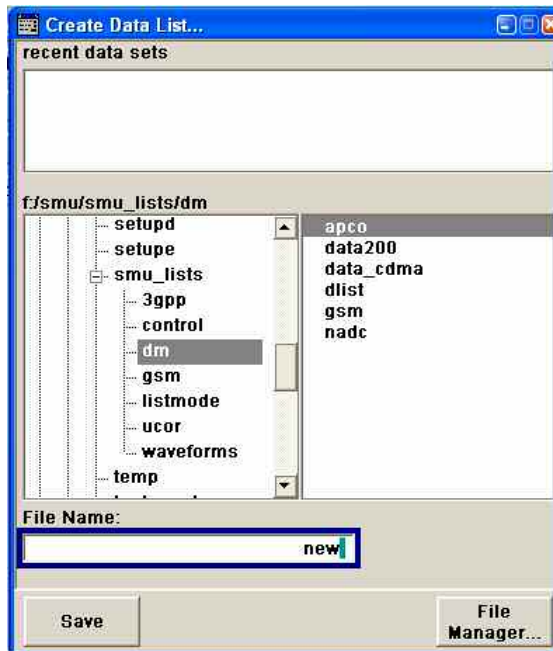
The file name has to be entered in field **File Name:**. The new list contains no data, it can be edited in the list editor.

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 "D:\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.

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.

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.

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
```
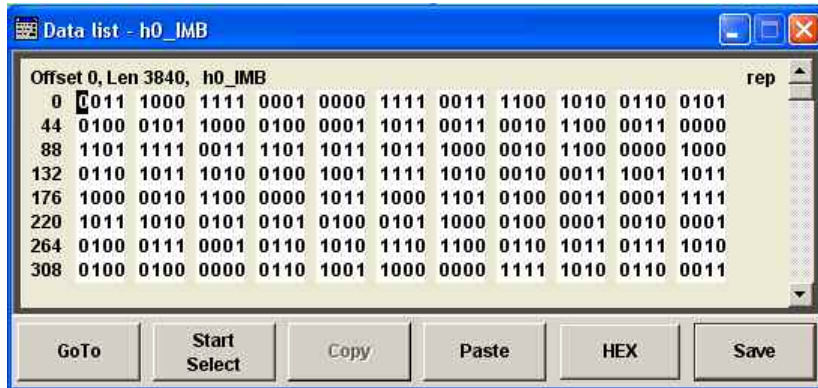

GoTo - Digital Modulation Opens the entry window for the bit position. The cursor marks the bit at the selected position.
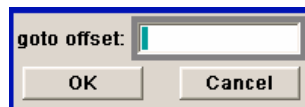
Remote-control command: n.a.

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.
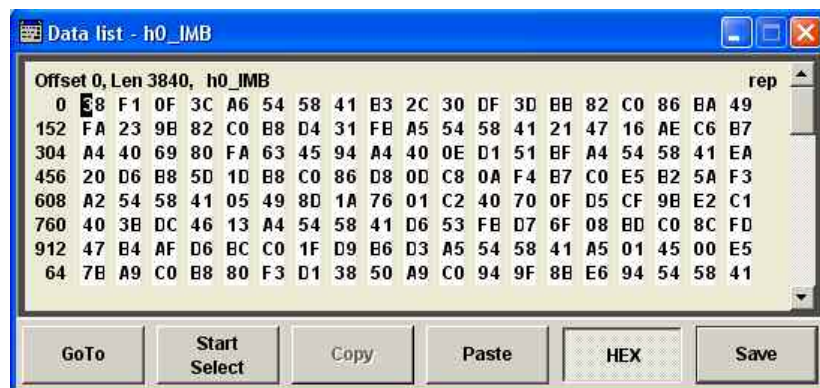
Each four bits are displayed as a hexadecimal value: To increase readability, the hexadecimal values in turn are displayed in pairs of two. The hex functions are automatically assigned to the numeric keys at the front panel.

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.

Edit Control List...

The four 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 **Marker** menu.*

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.

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.
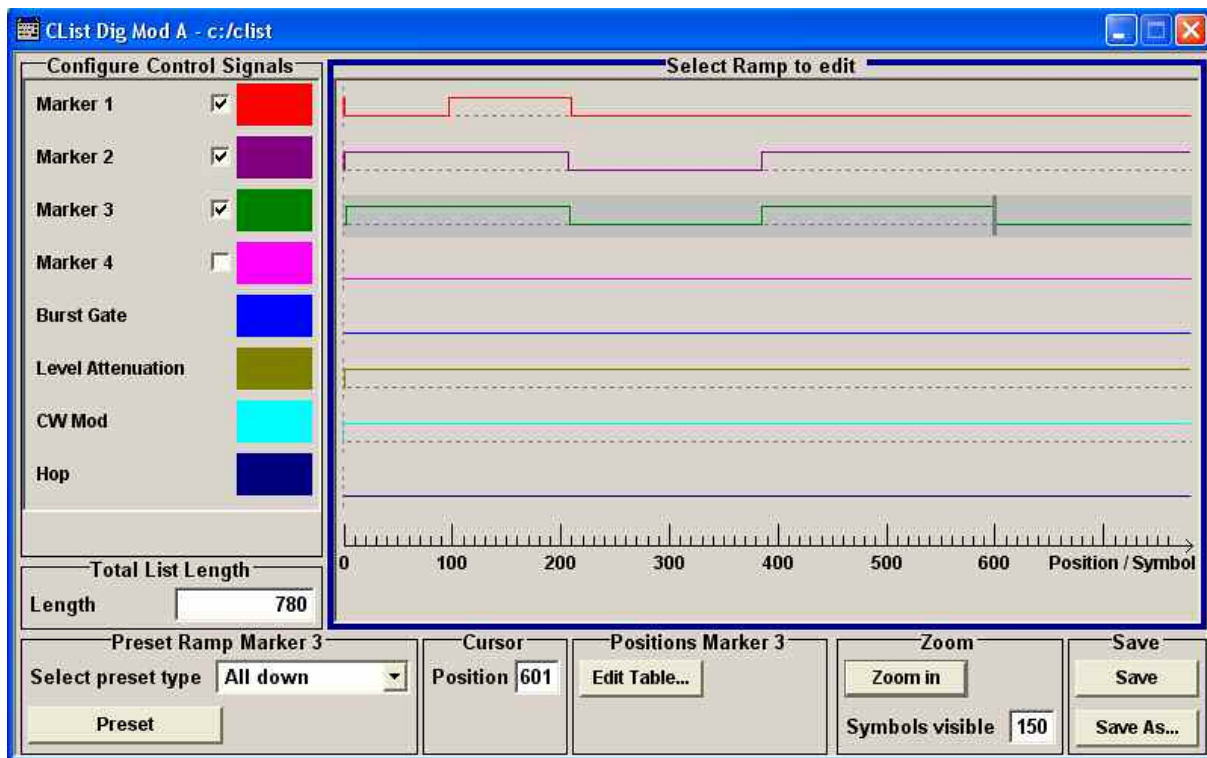
Configure Control Signal - Digital Modulation	Displays the colour the marker/control signal has been assigned.

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.

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.
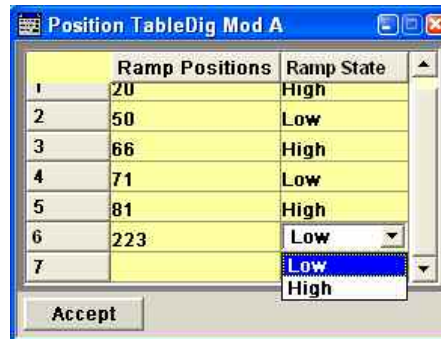
The bit position is specified in the **Ramp Position** column, the high or low signal status in the **Ramp State** column. At the end of the list, there is always a blank row for entering new values.

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 sves 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 3).

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.

Cust Dig Mod : Power Ramp	
State	On
Ramp Function	Cosine
Ramp Time	1.00 sym
Rise Delay	0.00 sym
Fall Delay	0.00 sym
Attenuation	15.0 dB
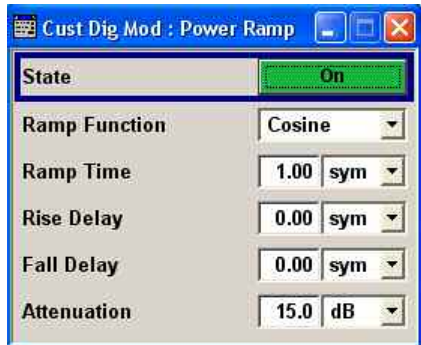
State - Power Ramp Control - Digital Modulation	Enables/disables power ramping.
	Remote-control command: `SOUR:BB:DM:PRAM:STAT ON`
Ramp Function - Digital Modulation	Enters the form of the transmitted power, i.e. the shape of the rising and falling edges during power ramp control.

	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 (see figure),the envelope length decreases) and a negative value causes an advance (the envelope length increases). The setting is expressed in symbols.
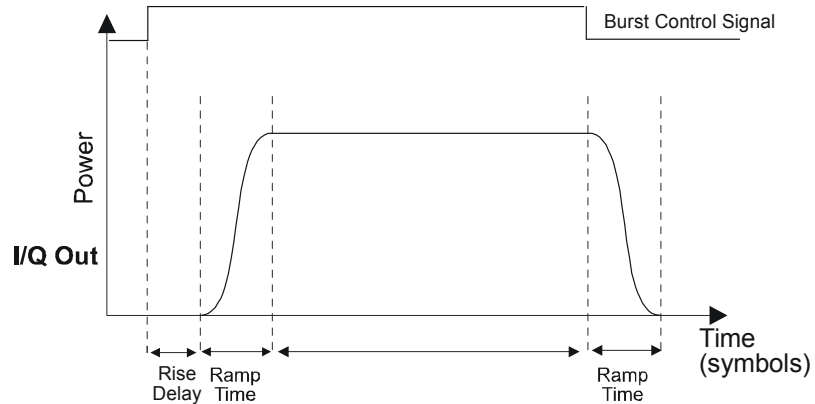
Remote-control command:
`SOUR:BB:DM:PRAM:RDEL -1`

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.
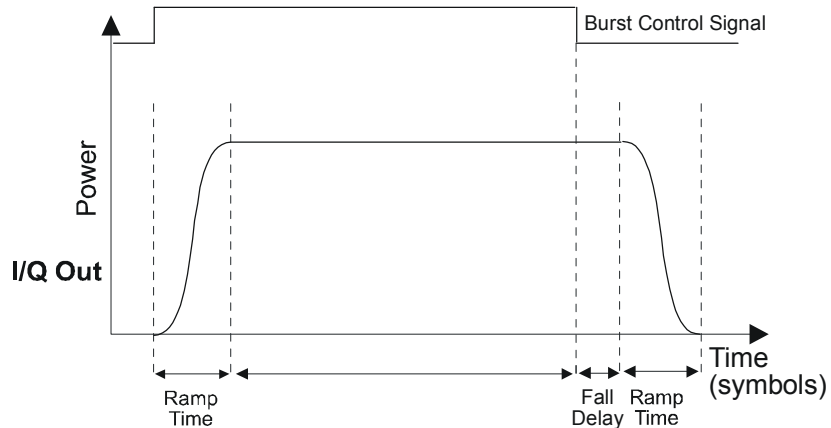
Remote-control command:
`SOUR:BB:DM:PRAM:FDEL -1`

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** or supplied via the LEV_ATT pin on the AUX I/O interface.

Remote-control command:
`SOUR:BB:DM:PRAM:ATT 15 dB`

The marker output signal for synchronizing external instruments is configured in the **Marker Settings** section **Reconfigure Marker**.

Marker - Custom Digital Modulation Menu

The marker output signal for synchronizing external instruments is configured in the **Marker** menu.
The **Marker** menu is where the marker signals at the MARKER output connectors are configured.
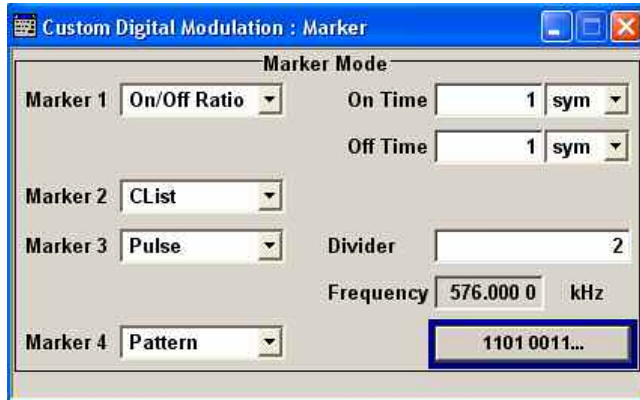
| **Marker x - Digital Modulation** | | Selects a marker signal for the associated MARKER output. |

| | **CList** | A marker signal that is defined in the selected control list is generated. The selection window for the control list opens when CLIST is selected. |

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. |
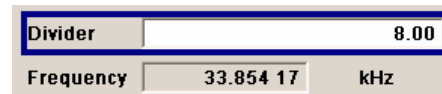
Remote-control commands:
```
SOUR:BB:DM:TRIG:OUTP1:MODE PULS
SOUR:BB:DM:TRIG:OUTP1:PULS:DIV 4
SOUR:BB:DM:TRIG:OUTP1:PULS:FREQ?
```

| | **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.

Start of signal

ON time   OFF time   ON time   OFF time
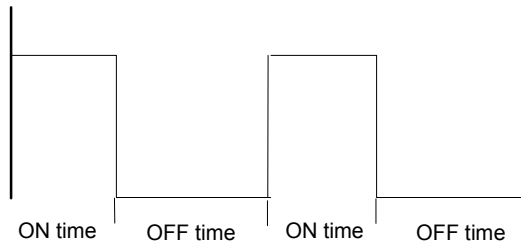
The ON time and OFF time are each expressed as a number of symbols and are set in an input field which opens when **ON/OFF ratio** is selected.

On Time	2	Sym ▼
Off Time	3	Sym ▼

Remote-control commands:
```
SOUR:BB:DM:TRIG:OUTP1:MODE RAT
SOUR:BB:DM:TRIG:OUTP1:OFFT 20
SOUR:BB:DM:TRIG:OUTP1:ONT  20
```

Multi Segment Waveforms

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.

Multi Segment Waveform 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**)
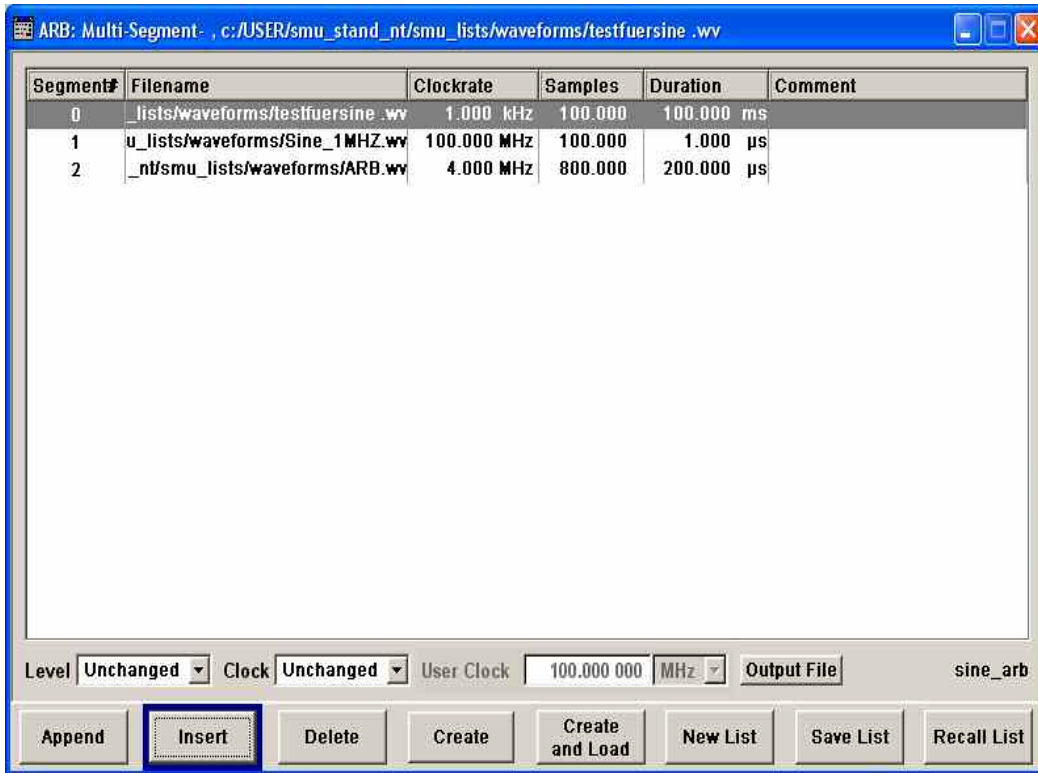
State - Multi Segment ARB   Enables/disables multi segment generation.

Remote-control command:
SOUR:BB:ARB:WSEG:STAT ON

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.

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"`

Multi Carrier Waveforms

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**)

Multi Carrier Waveform Menu

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** menu 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.
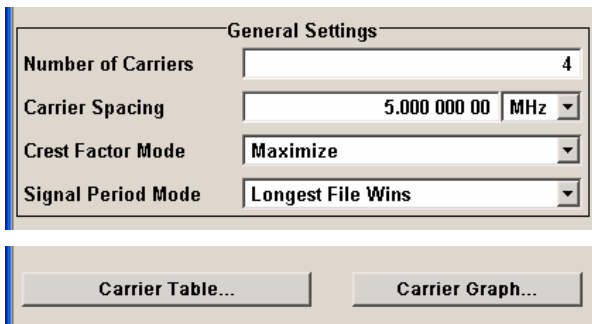
The **General Settings** section is used to configure the main multi carrier waveform.

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.
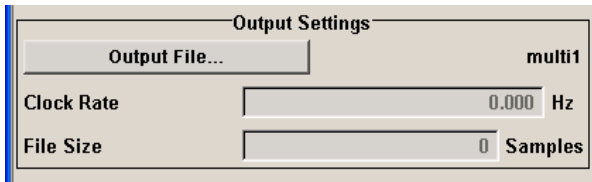
The **Output Settings** section indicates the name, the size and the clock rate of the multi carrier waveform (after calculation).

The upper part of the menu is used for calling the default settings and saving and recalling existing ARB multi carrier submenu settings.

State - ARB Multi Carrier

Enables/disables multi carrier generation.

Remote-control command:
`SOUR:BB:ARB:MCAR:STAT ON`

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 'F:\gen\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 80 MHz.

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 baseband DC line 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`

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**.
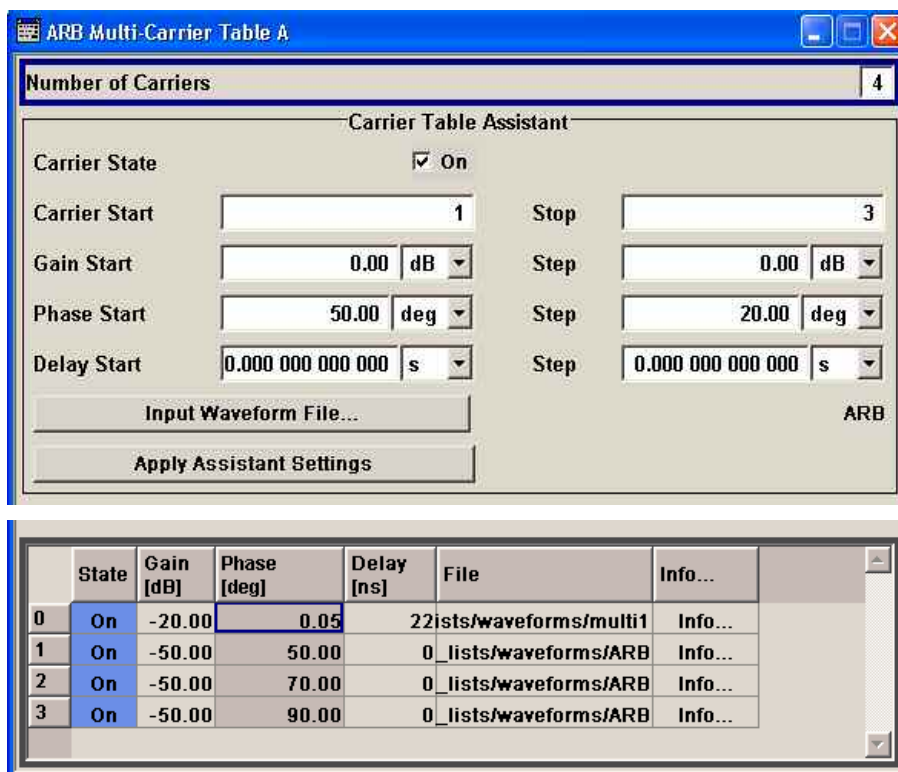
The **Carrier Table Assistant** serves as a optional mean to quickly set up a multi carrier scenario within a specified carrier range.

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	On	-20.00	0.05	22	ists/waveforms/multi1	Info...
1	On	-50.00	50.00	0	_lists/waveforms/ARB	Info...
2	On	-50.00	70.00	0	_lists/waveforms/ARB	Info...
3	On	-50.00	90.00	0	_lists/waveforms/ARB	Info...

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.
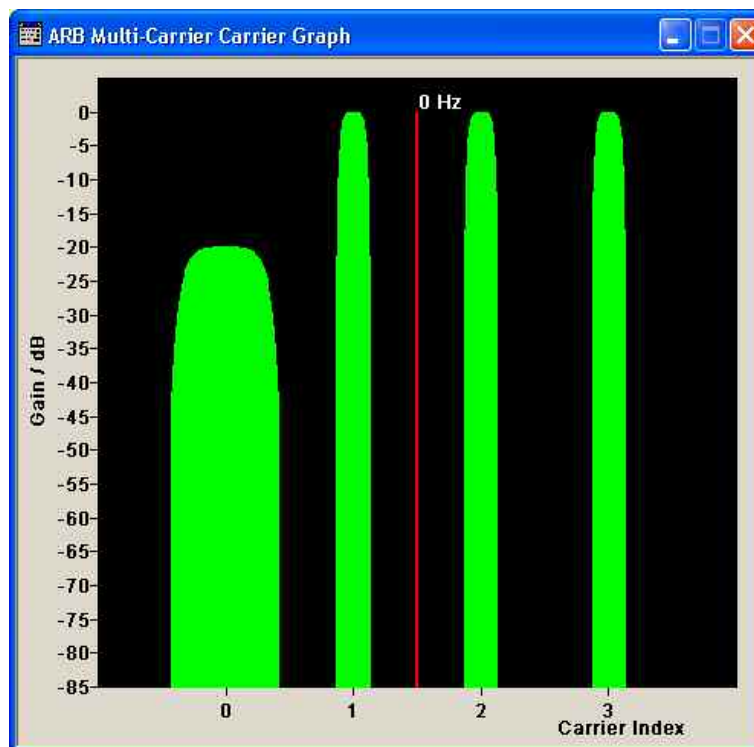
The **Output Settings** section in the multi carrier main menu indicates the name, the size and the clock rate of the currently calculated multi carrier output file.

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 carrier

Import IQ Data

Introduction - Import System

The import system makes it possible to extend WinIQSIM2 by user-specific systems.

A second program running at the same time as WinIQSIM2 transfers the waveform (unprocessed signal) to WinIQSIM2. In WinIQSIM2, the signal undergoes all known processing stages from filtering to signal transfer to the selected signal or modulation generator (SMU, SMJ, SMATE, AFQ, or AMU).

So, all the user has to do is generate the (unfiltered) waveform. All other functions such as filtering, graphics display, and transferring the signal to the selected instrument are provided by WinIQSIM2.

The communication between WinIQSIM2 and an application take place via an TCP/IP interface.
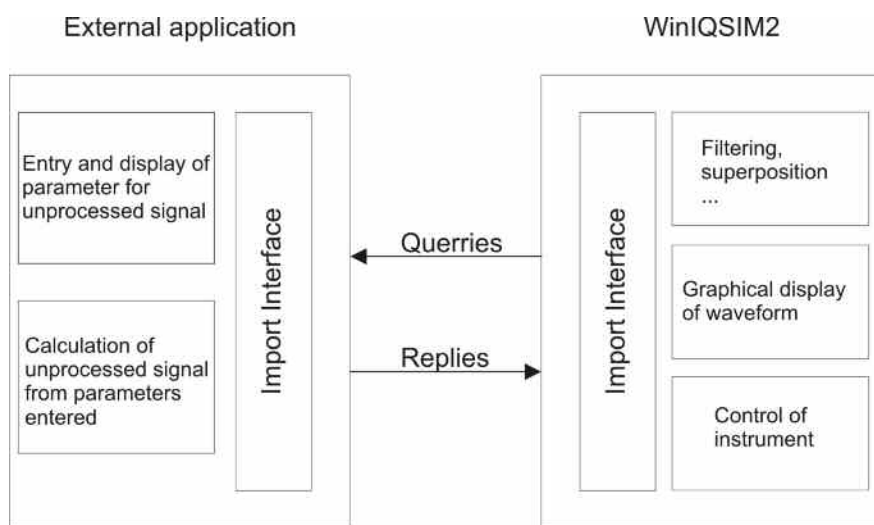
Fig. 3   Division of tasks between external application and WinIQSIM2

The external application is used as a server for the data and is referred to as "import server" in the following. In certain operating states, WinIQSIM2 outputs queries to the data server to which the import server replies. The following queries are defined:

- Server identity

- Parameter status

- Sequence length

- Symbol rate

- Waveform

To be able to use the TCP/IP interface, the TCP/IP driver must be installed on the PC. This is the case if, for example, the processor has a connection to a LAN or to the internet.

The advantage of the TCP/IP link is that the server can run on other processors as WinIQSIM2 and use any operating system, e. g. LINUX.

TCP/IP is supported by all known development systems.

The communication between server and client can be described by means of the parameters *ServerName* (= IP Address) and *PortNumber*.

Description of TCP/IP Import Interface

The following sections apply to programming under National LabWindows CVI 5.0. The commands have similar designations in other development environments. Consult the manuals of the required development environment to familiarize yourself with programming the TCP/IP.

A TCP/IP link consists of a server and one or more several clients. The server gets the data ready and transfers them to the client on request or spontaneously. The client takes the incoming data.

WinIQSIM2 is considered here as the client and the external application as server, although the other solution would also be possible.

Server Name, Port Number, and Items

To build a link to the server, the client must know the name of the server (e.g. 12.34.56.78). Also the parties must agree on a common channel, the so-called port. The default value is 1000 but any other value may be chosen. Some ports are pre-allocated (e.g. 80 for Browser) and are to be avoided.

Communications are exchanged between client and server. Communications from client and server are ASCII strings, messages from the server are in the form of binary blocks.

Item	Meaning
GetServerID	ID query
GetNewState	Query if new data are available
GetSequenceLength	Query of sequence length
GetSymbolRate	Query of symbol/reference point rate in Hz
GetSymbol	Query of the symbols/reference points

Table .4   TCP/IP Items from Client to Server

Format of Query Commands

Query commands are sent with *ClientTCPWrite* (*gHandle*, *request*, *strlen(request)*, *1000*); the last parameter timeout is given in ms.

Format of Replies (Messages) of Import Server

Replies are sent with ServerTCPWrite ().

Note:
The reply must get to WinIQSIM2 within 10 seconds, since otherwise timeout occurs. If the calculation (including transmission) lasts a long time, it must not be triggered by a query. The server must have a data set in reserve which it returns as a response to GetSymbols.

To distinguish between replies to different queries, a header is placed in front of the data section of the reply:

```
typedef enum { SYMBOLRATE, SEQUENCE_LENGTH, SYMBOLS, NEWSTATE, SERVER_ID }
SERVER_MESSAGE_HEADER_TYPE;

typedef struct
{
     SERVER_MESSAGE_HEADER_TYPE type;
     float data;
}
SERVER_MESSAGE_TYPE;
SERVER_MESSAGE_TYPE Reply;
Reply.type = SEQUENCE_LENGTH;
Reply.data = (float)SequenceLength;
ServerTCPWrite (gHandle, (void *)&Reply, sizeof(Reply), 1000);
```

ServerID, NewState and the symbol rate are handled the same way as the sequence length.

The above format cannot be used if the symbol value is to be sent to the WinIQSIM2 because the message is more than 1 float value long.

A free memory block must be filled then with data as follows:

Pos 1 : SYMBOLS (enum, = 2)

Pos 2 : I(0)

Pos 3 : Q(0)

Pos 4 : I(1)

Pos 5 : Q(1)

....

Pos 2*N : I(N-1)

Pos 2*N+1 : Q(N-1)

A pointer on this block will then be transferred to the function ServerTCPWrite().

Note:
Alternatively to transmitting the waveform in one block, the samples can be divided among several blocks. In the latter case, only the first block is sent with a header, the following blocks are without header.

Import Main Menu

The menu for importing an IQ signal can be opened in the Baseband function block.

```
┌─────── TDMA standards ───────┐
│ GSM/EDGE...                   │
│ ──────── CDMA standards ───── │
│ 3GPP FDD...                   │
│ CDMA2000...                   │
│ TD-SCDMA...                   │
│ ── OFDM/WLAN standards ────── │
│ IEEE 802.11 WLAN...           │
│ IEEE 802.16 WiMAX...          │
│ DVB...                        │
│ EUTRA/LTE...                  │
│ ──────── misc ─────────────── │
│ Custom Digital Mod...         │
│ Multicarrier CW...            │
│ Multi Carrier...              │
│ Multi Segment...              │
│ Import...                     │
└───────────────────────────────┘
```

The Import menu allows to configure the TCP/IP connection to the server.

State	On
Set To Default	Save/Recall...

TCP/IP Parameters

Use Local Server	☑
Server Name	localhost
Port Number	1 000
Transmission Timeout (s)	20

Update Server Connection	Server ID	Simple Function Generator TCP/IP
Filter/Clipping...		Cosine / Clipping Off
Marker...		

State - Import	Enables/disables the import of IQ data.
	Remote-control command: `SOUR:BB:IMP:STAT ON`
Set to Default - Import	Calls the default settings. The values are shown in the following table.
	Remote-control command: `SOUR:BB:IMP:PRES`

Parameter	Value
Use Local Server	On
Server Name	localhost
Port Number	1000
Transmission Timeout (s)	20
Filter	Cosine
Impulse Length	Auto
Oversampling	Auto
Clipping State	On

Save/Recall - Import

Calls the **Save/Recall** menu.

From the **Save/Recall** menu, the **File Select** windows for saving and recalling the complete settings in the **Import** menu can be called.

The Import settings are stored as files with the predefined file extension ***.import**. The file name and the directory they are stored in are user-definable.

The complete settings in the **Import** menu are saved and recalled.

Recall Import Settings

Opens the **Recall Import Settings** window for loading a saved import configuration.

The configuration of the selected (highlighted) file is loaded by pressing the **Select** button.

Remote-control commands:
```
MMEM:MDIR 'F:\gen\import\sett'
SOUR:BB:IMP:SETT:CAT?
Response:    'import_1', 'import_2'

SOUR:BB:IMP:SETT:LOAD 'import_1'
```

Save Import Settings

Opens the **Save Import Settings** window for saving the current import configuration.

The name of the file is specified in the **File Name** entry field. The file is saved by pressing the **Save** button.
Remote-control command:
```
MMEM:CDIR 'F:\gen\import\sett'

SOUR:BB:IMP:SETT:STOR 'import_1'
```

File Manager Calls the **File Manager**.

The **File Manager** is used to copy, delete and rename files and to create new directories.

Use Local Server - Import Sets the local host as the server from where the IQ data streams will be dowloaded. If activated, the field for entering a remote host is filled with the entry **localhost** automatically and cannot be edited.

Remote-control command:
`SOUR:BB:IMP:SERV:LOC:STAT ON`

Server Name - Import Enters the name (IP address) of the connected server. To enter the name in this field, the check box **Use Local Server** has to be unchecked.

Remote-control command:
`SOUR:BB:IMP:SERV:NAME 12.34.56.78`

Port Number - Import Enters the port number for the server connection. The default value is 1000.

Remote-control command:
`SOUR:BB:IMP:SERV:PORT 1000`

Transmission Timeout (s) - Import Sets the duration after which the transmission is aborted in case of a server timeout.

Remote-control command:
`SOUR:BB:IMP:SERV:TTO 20`

Update Server Connection - Import Updates the TCP/IP parameter and tries to establish a connection to the server.

Remote-control command:
`SOUR:BB:IMP:SERV:UPD`

Server ID - Import   Indicates the connected import server. If no import server is
                                connected, **not connected** is displayed. Seraching for a connected
                                server is triggered with **Update Server Connection**.

                                Remote-control command:
                                SOUR:BB:IMP:SERV:ID?

Filter/Clipping - Import   Calls the menu for setting baseband filtering and clipping. The current
                                filter and the clipping state are displayed next to the button.

                                The menu is described in section "Filter / Clipping Settings - Import",
                                page 58 .

                                Remote-control command:n.a.

Marker - Import   Calls the menu for configuring the marker signals.

                                This menu is described in section "Marker Menu - Import", page 61.

                                Remote-control command:n.a.

Filter / Clipping Settings - Import

The **Filter / Clipping** menu is reached via the **Import** main menu.

The baseband filter, sample rate variation, and clipping are defined in this menu.

Filter - Import　　　　　　Sets the baseband filter.

Remote-control command:
`SOUR:BB:IMP:FILT:TYPE RCOS`

Roll Off Factor - Import　　Indicates the filter parameter.

For the default cosine filter a roll off factor of 0.07 is used.

Remote-control command:
```
SOUR:BB:IMP:FILT:PAR:APCO25 0.05
SOUR:BB:IMP:FILT:PAR:COS 0.05
SOUR:BB:IMP:FILT:PAR:GAUS 0.15
SOUR:BB:IMP:FILT:PAR:PGA 0.15
SOUR:BB:IMP:FILT:PAR:LPAS 0.05
SOUR:BB:IMP:FILT:PAR:RCOS 0.05
SOUR:BB:IMP:FILT:PAR:SPH 0.15
```

Cut Off Frequency Shift - Import	(This feature is available for filter parameter Cosine only)
	Sets the value for the cut off frequency shift. The cut off frequency of the cosine filter can be adjusted to reach spectrum mask requirements.
	The value range is -1.0 to 1.0.
	Remote-control command: `SOUR:BB:IMP:FILT:PAR:COS:COFS`
Cut Off Frequency Factor - Import	(This feature is 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:IMP:FILT:PAR:LPAS 1.0`
Sample Rate Variation - Import	Displays the sample rate of the signal.
	Remote-control command: `SOUR:BB:IMP:SRAT:VAR?`
Impulse Length - Import	Displays the number of filter tabs. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

	Remote-control command:
	`SOUR:BB:IMP:FILT:ILEN:AUTO ON`
	`SOUR:BB:IMP:FILT:ILEN 120`

Oversampling - Import	Determines the upsampling factor. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

	Remote-control command:
	`SOUR:BB:IMP:FILT:OSAM:AUTO ON`
	`SOUR:BB:IMP:FILT:OSAM 20`

The settings for clipping are collected in the **Clipping** section.

Clipping State - Import	Switches baseband clipping on and off.
	Baseband clipping is a very simple and effective way of reducing the crest factor of the IQ signal.
	With baseband clipping, the signal level is limited to a settable value (Clipping Level). This level is specified as a percentage of the highest peak value. Since clipping is done prior to filtering, the procedure does not influence the spectrum. The EVM however increases.
	Remote-control command: `SOUR:BB:IMP:CLIP:STAT ON`

Clipping Level- Import   Sets the limit for clipping.

This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Remote-control command:
SOUR:BB:IMP:CLIP:LEV 50

Clipping Mode - Import   Selects the clipping method. A graphic illustration of the way in which these two methods work is given in the menu.

Vector | i + q | The limit is related to the amplitude | i + q | . The I and Q components are mapped together, the angle is retained (see also Clipping State - Import). Clipping State).

Remote-control command:
SOUR:BB:IMP:CLIP:MODE VEC

Scalar | i | + | q | The limit is related to the absolute maximum of all the I and Q values | i | + | q |.

The I and Q components are mapped separately, the angle changes.

Remote-control command:
SOUR:BB:IMP:CLIP:MODE SCAL

Marker Menu - Import

The Marker menu is accessed via the **Import** main menu.

Marker Channel x - Import   Selects a marker signal for the associated MARKER output.

Restart	A brief marker signal is generated at the start of the waveform.
	Remote-control command: `SOUR:BB:IMP: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.

Divider		2
Frequency	10.000 00	MHz

Remote-control command:
```
SOUR:BB:IMP:TRIG:OUTP1:MODE PULS
SOUR:BB:IMP:TRIG:OUTP1:PULS:DIV 4
SOUR:BB:IMP: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 command:
```
SOUR:BB:IMP:TRIG:OUTP1:MODE PATT
SOUR:BB:IMP: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.

Start of signal

ON time   OFF time   ON time   OFF time

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.

On Time	1	Samples ▼
Off Time	1	Samples ▼

Remote-control command:
```
SOUR:BB:IMP:TRIG:OUTP1:MODE RAT
SOUR:BB:IMP:TRIG:OUTP1:ONT 20
SOUR:BB:IMP:TRIG:OUTP1:OFFT 30
```

SOURce:BB:ARB:MCAR Subsystem - Remote Control Commands

The MCARrrier subsystem contains the commands for setting the Multi Carrier Waveform Generator.

The numeric suffix to SOURce distinguishes between signal output for path A and path B in the case of two-path instruments:

SOURce[1] = path A

SOURce2 = path B

For two-path instruments, the keyword SOURce is optional with commands for path A and can be omitted. For path B, the command must include the keyword with the suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.Section "R&S Signal Generator Waveform and List Format", page 78 describes the ARB waveform format and how it is used to transmit waveforms via the IEC bus.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier:COUNt	1 ... 32	-	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:DELay	-1s ... +1s	s	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:FILE	'file name'		
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:PHASe	0° ... 360°,	RAD	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier<0...31>:POWer	-80... 0 dB	dB	
[SOURce<[1]|2>]:BB:ARB:MCARrier:CARRier:SPACing	0 Hz...50 MHz	Hz	
[SOURce<[1]	2>]:BB:ARB:MCARrier:CARRier<0...31>:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:ARB:MCARrier:CFACtor:MODE	OFF	MAX	MIN		
[SOURce<[1]|2>]:BB:ARB:MCARrier:CLOad			No query
[SOURce<[1]|2>]:BB:ARB:MCARrier:CLOCk			Query only
[SOURce<[1]|2>]:BB:ARB:MCARrier:CREate			No query
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:DELay[:STARt]	-1s ... +1s	s	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:DELay:STEP	-1s ... +1s	s	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:EXECute			No query
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:FILE	'file name'		
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:PHASe[:STARt]	0...360DEG	RAD	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:PHASe:STEP	-360...360DEG	RAD	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:POWer[:STARt]	-80 ... 0 dB	dB	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:POWer:STEP	-80 ... 80 dB	dB	
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:STARt	<carrier_index>		
[SOURce<[1]	2>]:BB:ARB:MCARrier:EDIT:CARRier:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:ARB:MCARrier:EDIT:CARRier:STOP	<carrier_index>		
[SOURce<[1]|2>]:BB:ARB:MCARrier:OFILe	<file_name>		
[SOURce<[1]|2>]:BB:ARB:MCARrier:PRESet	-		
[SOURce<[1]|2>]:BB:ARB:MCARrier:SAMPles		sample	Query only
[SOURce<[1]|2>]:BB:ARB:MCARrier:SETTing:CATalog			Query only
[SOURce<[1]|2>]:BB:ARB:MCARrier:SETTing:LOAD	<file_name>		
[SOURce<[1]|2>]:BB:ARB:MCARrier:SETTing:STORe	<file_name>		
[SOURce<[1]	2>]:BB:ARB:MCARrier:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:ARB:MCARrier:TIME:MODE	LONG	SHORt	OFF		

[SOURce<[1]|2>]: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 80 MHz. 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 80 MHz is not respected when entering the number of carriers.	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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 'D:\IQ_wcdma'"`
                     'selects file 'IQ_wcdma'. The data of the file is modulated onto carrier 15.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 80 MHz.

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 80 MHz is not exceeded on entering the number of carriers (`:BB:ARB:MCAR:CARR:COUN`).	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform`"
                    'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform`"
                    'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"`
                      'sets the default directory to D:\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<[1]|2>]: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	Device-
	`SOUR:BB:ARB:MCAR:SPAC`	0	specific

[SOURce<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"
                    'sets the default directory to D:\user\waveform.

                    ":BB:ARB:MCAR:SETT:CAT?"
                    'reads out all the settings files in the default directory.

                    Response: "mcar1, mcar2"
                    'the directory D:\user\waveform contains the configuration files
                    'mcar1.arb_multcarr' and 'mcar2.arb_multcarr'.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]: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 'D:\user\waveform"
                    'sets the default directory to D:\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<[1]|2>]: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 'D:\user\waveform"
                    'sets the default directory to D:\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<[1]|2>]:BB:ARB:MCARrier:STATe   ON | OFF

The command enables/disables multi carrier generation.

Example: ```:BB:ARB:MCAR:STAT ON```
                    'enables multi carrier generation.

*RST value	Resolution	SCPI
OFF	-	device-specific

[SOURce<[1]|2>]: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.

The numeric suffix to SOURce distinguishes between signal output for path A and path B in the case of two-path instruments:

SOURce[1] = path A

SOURce2 = path B

For two-path instruments, the keyword SOURce is optional with commands for path A and can be omitted. For path B, the command must include the keyword with the suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Section "R&S Signal Generator Waveform and List Format", page 78 describes the ARB waveform format and how it is used to transmit waveforms via the IEC bus.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CATalog			Query only
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CLOCk	max Sample Rate ... 100 MHz		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CLOCk:MODE	UNCHanged | HIGHest | USER		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:COMMent	<string>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:DELete			No query
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:LEVel[:MODE]	UNCHanged | ERMS		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:OFILe	<file_name>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:SEGMent:APPend	<file_name>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:SEGMent:CATalog			Query only
[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:SELect	<file_name>		
[SOURce<[1]|2>]:BB:ARB:WSEGment:NEXT	1 ... 1999		
[SOURce<[1]|2>]:BB:ARB:WSEGment:STATe	ON | OFF		

[SOURce<[1]|2>]: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 'D:\user\waveform"
　　　　　'sets the default directory to D:\user\waveform.

　　　　　":BB:ARB:WSEG:CONF:CAT?"
　　　　　'reads out all the configuration files in the default directory.

　　　　　Response: "mulit1, multi2"
　　　　　'the directory D:\user\waveform contains the configuration files
　　　　　'multi1.inf_mswv' and 'multi2.inf_mswv'.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]:BB:ARB:WSEGment:CONFigure:CLOCk   max sample rate .. 100MHz

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"
                'sets the default directory to D:\user\waveform.

                ":BB:ARB:WSEG:CONF:DEL 'multi1'"
                'deletes configuration file multi1.inf_mswv.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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 'D:\user\waveform"
                'sets the default directory to D:\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<[1]|2>]: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 'D:\user\waveform'"
                    'sets the default directory to D:\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<[1]|2>]: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 'D:\user\waveform'"
                    'sets the default directory to D:\user\waveform.

                    ":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<[1]|2>]: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 'D:\user\waveform'"
                    'sets the default directory to D:\user\waveform.

                    ":BB:ARB:WSEG:CONF:SEL 'new'"
                    'create configuration file new.inf_mswv in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

[SOURce<[1]|2>]:BB:ARB:WSEGment:NEXT 0 ... 2000

This command selects the segment to be output.

Example: "`MMEM:CDIR 'D:\user\waveform`"
        'sets the default directory to D:\user\waveform.

        "`: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

[SOURce<[1]|2>]:BB:ARB:WSEGment:STATe ON | OFF

This command enables/disables multi segment generation.

Example: "`:BB:ARB:WSEG:STAT ON`"
        'enables multi segment generation.

*RST value	Resolution	SCPI
OFF	-	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: #$d_0 d_1...d_x...d_{N-1}$…}   (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: #011100001010101010010101010100.....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:␣#`*`IQIQIQIQIQIQIQIQI ... 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:

```c
#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.

The numeric suffix to SOURce distinguishes between signal generation for path A and path B in the case of two-path instruments:

[SOURce<1>] = path A
SOURce2 = path B

The keyword SOURce is optional in the case of commands for path A and can be omitted. For path B the command must contain the keyword with suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Table of Commands - DM General Remote-Control Commands

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:ASK:DEPTh	0 ... 100	PCT	
[SOURce<[1]|2>]:BB:DM:CODing	OFF| APCO25 | APCO25FSK | CDMA2000 | DIFF| DPHS| DGRay | EDGE | GRAY| GSM| ICO| NADC| PDC| PHS| TETRa | PWT| TFTS| INMarsat | VDL | WCDMa		
[SOURce<[1]|2>]:BB:DM:FILTer:ILENgth	1...128		
[SOURce<[1]|2>]:BB:DM:FILTer:ILENgth:AUTO	ON | OFF		
[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling	1...32		
[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling:AUTO	ON | OFF		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:APCO25	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:COSine	0.05 ... 0.99		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:GAUSs	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:LPASs	0.05 … 2.0		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:PGAus	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:RCOSine	0.05 ... 0.99		
[SOURce<[1]|2>]:BB:DM:FILTer:PARameter:SPHase	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:DM:FILTer:TYPE	RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | COFequalizer | C2K3x | APCO25 | SPHase | RECTangle | PGAuss | LPASs | USER | DIRac | ENPShape | EWPShape		

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:FLISt:CATalog			Query only
[SOURce<[1]|2>]:BB:DM:FLISt:DELete	<file name>		
[SOURce<[1]|2>]:BB:DM:FLISt:FREE			Query only
[SOURce<[1]|2>]:BB:DM:FLISt:POINts			Query only
[SOURce<[1]|2>]:BB:DM:FLISt:SELect	<file name>		
[SOURce<[1]|2>]: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<[1]|2>]:BB:DM:FSK:DEViation	0.1 x Symbol Rate ... 1.5 x Symbol Rate	Hz	
[SOURce<[1]|2>]:BB:DM:FSK:VARiable:TYPE	4FSK | 8FSK | 16 FSK		
[SOURce<[1]|2>]:BB:DM:FSK:VARiable:SYMBol<0...15>:DEViation	-1.5 x Symbol Rate ... 1.5 x Symbol Rate (max 10 MHz)	Hz	
[SOURce<[1]|2>]:BB:DM:PATTern	#B0 ... #B111...1, 1...64		
[SOURce<[1]|2>]:BB:DM:PRAMp:ATTenuation	0.0 ... 50	dB	
[SOURce<[1]|2>]:BB:DM:PRAMp:FDELay	-4.0 ... +4.0 symbols		
[SOURce<[1]|2>]:BB:DM:PRAMp:RDELay	-4.0 ... +4.0 symbols		
[SOURce<[1]|2>]:BB:DM:PRAMp:SHAPe	LINear | COSine		
[SOURce<[1]|2>]:BB:DM:PRAMp:SOURce	INTernal | EXTernal		
[SOURce<[1]|2>]:BB:DM:PRAMp[:STATe]	ON | OFF		
[SOURce<[1]|2>]:BB:DM:PRAMp:TIME	0.25 ... 32 symbols		
[SOURce<[1]|2>]:BB:DM:PRBS[:LENGth]	9 | 11 | 15 | 16 | 20 | 21 | 23		
[SOURce<[1]|2>]:BB:DM:PRESet			
[SOURce<[1]|2>]:BB:DM:SLENgth	1...Max		
[SOURce<[1]|2>]:BB:DM:SOURce	ZERO | ONE | PRBS | PATTern | DLISt | SERial | PARallel		
[SOURce<[1]|2>]:BB:DM:SRATe	400 Hz ... 15 MHz (FSK) / 27 MHz	Hz	
[SOURce<[1]|2>]:BB:DM:STANdard	USER | BLUetooth | CFORward | CREVerse | DECT | ETC | GSM | GSMEdge | NADC | PDC | PHS | TDSCdma | TETRa | TFTS | W3GPp | WORLdspace		
[SOURce<[1]|2>]:BB:DM:STATe	ON | OFF		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:MODE	CLISt | PULSe | PATTern | RATio		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:OFFTime	1 ... (2^20 - 1) symbols		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:ONTime	1 ... (2^20 - 1) symbols		

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:PATTern	#B0, 1 ... #B111...1,32		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 2^10		
[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:PULSe:FREQ?			Query only
[SOURce<[1]|2>]:BB:DM:WAVeform:CREate			No query

[SOURce<[1]|2>]: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<[1]|2>]: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 except the user-defined modulation type USER.

*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<[1]|2>]:BB:DM:FILTer:ILENgth 1...128

The command sets the impulse length (number of filter tabs).

Example: ":BB:DM:FILT:ILEN 10"
'sets the number of filter tabs to 10.

*RST value	Resolution	SCPI
10	1	Device-specific

[SOURce<[1]|2>]:BB:DM:FILTer:ILENgth:AUTO ON | OFF

The command acivates/deactivates the impulse length state. If activated, the most sensible parameter values are selected. The value depends on the coherence check.

Example: `":BB:DM:FILT:ILEN:AUTO ON"`
                'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling 1...32

The command sets the upsampling factor.

Example: `":BB:DM:FILT:OSAM 32"`
                'sets the upsampling factor to 32.

*RST value	Resolution	SCPI
32	-	Device-specific

[SOURce<[1]|2>]:BB:DM:FILTer:OSAMpling:AUTO ON | OFF

The command acivates/deactivates the upsampling factor state. If activated, the most sensible parameter values are selected. The value depends on the coherence check. If deactivated, the values can be changed manually.

Example: `":BB:DM:FILT:OSAM:AUTO ON"`
                'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:PRAMp:SOURce   INTernal | EXTernal

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.

                       EXTernal
                       The digital control signals LEV_ATT and BURST are supplied via the control
                       signal inputs on the AUX I/O connector.

Example: ":BB:DM:PRAM:SOUR EXT"
                       'enables the use of external control signals for power ramp control. The
                       signals must be supplied via the AUX I/O interface.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:SLENgth   1...Max

Sets the sequence length of the signal in symbols. The signal is calculated in advance, saved as waveform file, and output in the selected arbitrary waveform generator.

Note:
   Sequence Length x Oversampling must not exceed the maximum number of samples in the arbitrary waveform generator.

Example: `":BB:DM:SLEN 500"`
                  'sets the sequence length to 500 symbols.

*RST value	Resolution	SCPI
10.000	-	Device-specific

[SOURce<[1]|2>]:BB:DM:SOURce ZERO | ONE | PRBS | PATTern | DLISt | SERial | PARallel

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.

SERial

External data from the serial interface is used (in case of two-path instruments, path A).

PARallel

External data from the serial interface is used (in case of two-path instruments, path A).

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]:BB:DM:STATe ON | OFF

The command enables or disables digital modulation. Switching on digital modulation turns off all the other digital standards (in case of two-path instruments, this affects the same path).

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 (in case of two-path instruments, this affects the same path.	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>:MODE CLISt | PULSe | PATTern | RATio

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.

Example: `":BB:DM:TRIG:OUTP2:MODE PULS"`
                     'selects the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RATio	-	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two-path instruments, on path A).

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two-path instruments, on path A).

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two path instruments, path A) 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<[1]|2>]:BB:DM:TRIGger:OUTPut<[1]...4>: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 (in case of two-path instruments; for the path A) 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<[1]|2>]:BB:DM:WAVeform:CREate <file_name>

This command creates a waveform using the current settings of the **Digital Modulation** menu. The file name is entered with the command. The file is stored with the predefined file extension ***.wv**. The file name and the directory it is stored in are user-definable.

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

Example: "MMEM:CDIR 'D:\user\waveform'"
'sets the default directory to D:\user\waveform.

":BB:DM:WAV:CRE 'dm_1'"
'creates the waveform file dm_1.wv in the default directory.

*RST value	Resolution	SCPI
-	-	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<[1]|2>]:BB:DM:CLISt:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:CLISt:COPY	<new_control_list_name>		No query
[SOURce<[1]|2>]:BB:DM:CLISt:DATA	0 | 1, {0 | 1} | block data		No query
[SOURce<[1]|2>]:BB:DM:CLISt:DELete	<control_list_name>		No query
[SOURce<[1]|2>]:BB:DM:CLISt:POINts			Query only
[SOURce<[1]|2>]:BB:DM:CLISt:SELect	<control_list_name>		Query only
[SOURce<[1]|2>]:BB:DM:CLISt:TAG?	<control_list_name>, <tag_name>		Query only
[SOURce<[1]|2>]:BB:DM:DLISt:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:DLISt:COPY	<new_data_list_name>		No query
[SOURce<[1]|2>]:BB:DM:DLISt:DATA	0 | 1, {0 | 1} | block data		
[SOURce<[1]|2>]:BB:DM:DLISt:DATA:APPend	0 | 1, {0 | 1} | block data		
[SOURce<[1]|2>]:BB:DM:DLISt:DELete	<data_list_name>		No query
[SOURce<[1]|2>]:BB:DM:DLISt:POINts			
[SOURce<[1]|2>]:BB:DM:DLISt:SELect	<data_list_name>		
[SOURce<[1]|2>]:BB:DM:DLISt:TAG?	<data_list_name>, <tag_name>		Query only
[SOURce<[1]|2>]:BB:DM:MLISt:CATlog			Query only
[SOURce<[1]|2>]:BB:DM:MLISt:DELete	<user_mapping_list_name>		Query only
[SOURce<[1]|2>]:BB:DM:MLISt:FREE			Query only
[SOURce<[1]|2>]:BB:DM:MLISt:POINts			Query only
[SOURce<[1]|2>]:BB:DM:MLISt:SELect	<user_mapping_list_name>		
[SOURce<[1]|2>]:BB:DM:SETTing:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:SETTing:DELete	"setting_file"		No query
[SOURce<[1]|2>]:BB:DM:SETTingt:LOAD	"setting_file"		No query
[SOURce<[1]|2>]:BB:DMSETTing:STORe	"setting_file"		No query
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:CATalog?			Query only
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:DELete	"user_list"		No query

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:LOAD	"user_list"		No query
[SOURce<[1]|2>]:BB:DM:STANdard:ULISt:STORe	"user_list"		No query

[SOURce<[1]|2>]: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 'D:/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<[1]|2>]: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<[1]|2>]: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
Marker 3		4
Marker 4		8
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<[1]|2>]: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<[1]|2>]:BB:DM:CLISt:POINts?   E-2

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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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. The numeric suffix on SOURce<[1]|2> is ignored in this command.

Example: `MMEM:CDIR 'D:/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<[1]|2>]: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<[1]|2>]:BB:DM:DLISt:DATA   0 | 1 {,0 | 1 }.| block data

[SOURce<[1]|2>]: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. Response:"???"
          '1024 bits of the file dlist1 are read out starting at bit 2048.

*RST has no effect on data lists.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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. The numeric suffix on SOURce<[1]|2> is ignored in this command.

Example: `":BB:DM:DLIS:DEL ' d_list2'"`
          'deletes data list d_list2.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\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<[1]|2>]: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 'D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\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<[1]|2>]: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 'D:\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<[1]|2>]: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 'D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\dig_mod`

'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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 'D:\user\dig_mod"`
                'sets the default directory to D:\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<[1]|2>]: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<[1]|2>]: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<[1]|2>]: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:IMPort Subsystem - Remote-Control Commands

The IMPort subsystem contains the commands for importing IQ signal data files via TCP/IP into WinIQSIM2.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:IMPort:CLIPping:LEVel	1...100	PCT	
[SOURce<[1]|2>]:BB:IMPort:CLIPping:MODE	VECTor | SCALar		
[SOURce<[1]|2>]:BB:IMPort:CLIPping:STATe	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth	1...128		
[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth:AUTO	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling	1...32		
[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling:AUTO	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:APCO25	0.05 ... 0.99		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine	0.00 ... 0.99		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine:COFS	-1.0 … +1.0		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:GAUSs	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:LPASs	0.05 ...2.0		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:PGAus	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:RCOSine	0.00 ... 0.99		
[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:SPHase	0.15 ... 2.5		
[SOURce<[1]|2>]:BB:IMPort:FILTer:TYPE	RCOSine | COSine | GAUSs | APCO25 | SPHase | PGAuss | LPASs		
[SOURce<[1]|2>]:BB:IMPort:PRESet			
[SOURce<[1]|2>]:BB:IMPort:SERVer:ID			Query only
[SOURce<[1]|2>]:BB:IMPort:SERVer:LOCAl[:STATe]	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:SERVer:NAME			
[SOURce<[1]|2>]:BB:IMPort:SERVer:PORT	0...65536		
[SOURce<[1]|2>]:BB:IMPort:SERVer:TTOut	10...10000		
[SOURce<[1]|2>]:BB:IMPort:SERVer:UPDate			
[SOURce<[1]|2>]:BB:IMPort:SETTingt:CATalog			Query only
[SOURce<[1]|2>]:BB:IMPort:SETTingt:LOAD	"setting_file"		No query
[SOURce<[1]|2>]:BB:IMPort:SETTingt:STORe	"setting_file"		No query
[SOURce<[1]|2>]:BB:IMPort:SRATe:VARiation			Query only
[SOURce<[1]|2>]:BB:IMPort:STATe	ON | OFF		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:MODE	RESTart | PULSe | PATTern | RATio		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:OFFTime	1 ... (2^20 - 1) symbols		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:ONTime	1 ... (2^20 - 1) symbols		
[SOURce<[1]|2>]:BB:IMP:TRIGger:OUTPut<[1]...4>:PATTern	#B0, 1 ... #B111...1,32		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 2^10		
[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PULSe:FREQ?			Query only

[SOURce<[1]|2>]:BB:IMPort:CLIPping:LEVel 0 ... 100 PCT

The command sets the limit for level clipping. This value indicates at what point the signal is clipped. It is specified as a percentage, relative to the highest level. 100% indicates that clipping does not take place.

Level clipping is activated with the command `SOUR:BB:IMP:CLIP:STAT ON`

Example: `":BB:IMP:CLIP:LEV 80PCT"`
'sets the limit for level clipping to 80% of the maximum level.

`":BB:IMP:CLIP:STAT ON"`
'activates level clipping.

*RST value	Resolution	SCPI
100 PCT	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:CLIPping:MODE   VECTor | SCALar

The command sets the method for level clipping (Clipping).

Parameters: **VECTor**
The reference level is the amplitude | i+jq |.

SCALar
The reference level is the absolute maximum of the I and Q values.

Example: `":BB:IMP:CLIP:MODE SCAL"`
'selects the absolute maximum of all the I and Q values as the reference level.

`":BB:IMP:CLIP:LEV 80PCT"`
'sets the limit for level clipping to 80% of this maximum level.

`":BB:IMP:CLIP:STAT ON"`
'activates level clipping.

*RST value	Resolution	SCPI
VECTor	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:CLIPping:STATe   ON | OFF

The command activates level clipping (Clipping). The value is defined with the command `[SOURce]:BB:IMPort:CLIPping:LEVel`, the mode of calculation with the command `[SOURce]:BB:IMPort:CLIPping:MODE`.

Example: `":BB:IMP:CLIP:STAT ON"`
'activates level clipping.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth 1...128

The command sets the impulse length (number of filter tabs).

Example: ```":BB:IMP:FILT:ILEN 10"```

                 'sets the number of filter tabs to 10.

*RST value	Resolution	SCPI
10	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:ILENgth:AUTO] ON | OFF

The command acivates/deactivates the impulse length state. If activated, the most sensible parameter values are selected. The value depends on the coherence check.

Example: ```":BB:IMP:FILT:ILEN:AUTO ON"```

                 'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling 1...32

The command sets the upsampling factor.

Example: ```":BB:IMP:FILT:OSAM 32"```

                 'sets the upsampling factor to 32.

*RST value	Resolution	SCPI
32	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:OSAMpling:AUTO ON | OFF

The command acivates/deactivates the upsampling factor state. If activated, the most sensible parameter values are selected. The value depends on the coherence check. If deactivated, the values can be changed manually.

Example: ```":BB:IMP:FILT:OSAM:AUTO ON"```

                 'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:APCO25 0.05 ... 0.99

The command sets the roll-off factor for filter type APCO25.

Example: ```":BB:IMP:FILT:PAR:APCO25 0.2"```

                 'sets the roll-off factor to 0.2 for filter type APCO25.

*RST value	Resolution	SCPI
0.20	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine   0.00 ... 0.99   E-2

The command sets the roll-off factor for the Cosine filter type.

Example: `":BB:IMP:FILT:PAR:COS 0.35"`
                   'sets the roll-off factor to 0.35 for filter type Cosine.

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:COSine:COFS   -0.1 … 1.0

The command sets the "cut of frequency shift" value for the Cosine filter type.

Example: `":BB:IMP:FILT:PAR:COS:COFS 0.04"`
                   'the "cut of frequency shift" value is set to 0.04.

*RST value	Resolution	SCPI
		Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:GAUSs 0.15 … 2.5

The command sets the roll-off factor for the Gauss filter type.

Example: `":BB:IMP:FILT:PAR:GAUS 0.5"`
                   'sets B x T to 0.5 for the Gauss filter type.

*RST value	Resolution	SCPI
0.3	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:LPASs   0.05...2.0

The command sets the cut off frequency factor for the Lowpass filter type.

Example: `":BB:IMP:FILT:PAR:LPAS 0.5"`
                   'the cut of frequency factor is set to 0.5.

*RST value	Resolution	SCPI
0.50		Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:PGAuss 0.15 … 2.5

The command sets the roll-off factor for the Pure Gauss filter type.

Example: `":BB:IMP:FILT:PAR:PGA 0.5"`
                   'sets B x T to 0.5 for the Pure Gauss filter type.

*RST value	Resolution	SCPI
0.5	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:RCOSine 0.05 ... 0.99

The command sets the roll-off factor for the Root Cosine filter type.

Example: ":BB:IMP:FILT:PAR:RCOS 0.22"
                      'sets the roll-off factor to 0. 22 for filter type Root Cosine.

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:PARameter:SPHase 0.15 … 2.5

The command sets B x T for the Split Phase filter type.

Example: ":BB:IMP:FILT:PAR:SPH 0.5"
                      'sets B x T to 0.5 for the Split Phase filter type.

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>]:BB:IMPort:FILTer:TYPE   RCOSine | COSine | GAUSs | APCO25 | SPHase | PGAuss | LPASs

The command selects the filter type.

Example: ":BB:IMP:FILT:TYPE COS"
                      'selects the Cosine filter type.

*RST value	Resolution	SCPI
COSine	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:PRESet

The command calls the default settings for IQ data import.

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

Example: ":BB:IMP:PRES"
                      'calls the default settings for IQ data import.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:ID?

The command queries the connected import server. If no import server is connected, **not connected** is displayed. Seraching for a connected server is triggered with **Update Server Connection**.

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

Example: ":BB:IMP:SERV?"
                      'queries the connected import server.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:LOCal[:STATe]

The command   ownloade or deactivates the local host as the server from where the IQ data streams will be   ownloaded. If activated, the field for entering a remote host is filled with the entry **localhost** automatically and cannot be edited.

Example: `":BB:IMP:SERV:LOC:STAT ON"`
                      'sets the localhost as the connected server.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:NAME <server_name>

The command enters the name (IP address) of the connected server. To enter the name in this field, the check box **Use Local Server** has to be unchecked.

Example: `":BB:IMP:SERV:NAME 12.34.45.78"`
                      'enters the IP address of the connected server.

*RST value	Resolution	SCPI
localhost	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:PORT 0…65536

The command enters the port number for the server connection.

Example: `":BB:IMP:SERV:PORT 1000"`
                      'sets port 1000 for the server connection.

*RST value	Resolution	SCPI
1000	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:TTOut 10...10.000

The command sets the duration after which the transmission is aborted in case of a server timeout.

Example: `":BB:IMP:SERV:TTO 20"`
                      'sets the transmission timeout to 20 seconds.

*RST value	Resolution	SCPI
20 s	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SERVer:UPDate

The command udates the TCP/IP parameter and tries to establish a connection to the server.

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

Example: `":BB:IMP:SERV:UPD`
                      'updates the server connection.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SETTing:CATalog?

This command reads out the files with import settings in the default directory. The default directory is set using command `MMEM:CDIRectory`. Only files with the file extension ***.import** will be listed.

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

Example: `"MMEM:CDIR 'D:\user\waveform'"`
        'sets the default directory to D:\user\waveform.

        `":BB:IMP:SETT:CAT?"`
        'reads out all the files with import settings in the default directory.

        Response: "'import_1', 'import_2'"
        'the files 'import_1' and 'import_2' with import settings are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SETTing:LOAD <file_name>

This command loads the selected file with import 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 ***.import** will be loaded.

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

Example: `":BB:IMP:SETT:LOAD 'import_1'"`
        'loads file 'import_1'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SETTing:STORe <file_name>

This command stores the current import 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. Import settings are stored as files with the specific file extensions ***.import**.

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

Example: `":BB:IMP:SETT:STOR 'import_1'"`
        'stores the current import settings into file `import_1`'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:SRATe:VARiation ?

This command queries the sample rate variation.

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

Example: `":BB:BB:IMP:SETT:STOR 'import_1'"`
        'stores the current import settings into file `import_1`'.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:STATe ON | OFF

The command enables or disables the import of IQ data.

Example: `":BB:IMP:STAT ON"`
'enables the import of IQ data.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:MODE RESTart | PULSe | PATTern | RATio

The command defines the signal for the selected marker output.

Parameter: **RESTart**
A brief marker signal is generated at the start of the waveform.

PULSe
A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:IMP:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:IMP: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 command `SOURce:BB:IMP: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:IMP:TRIGger:OUTPut:OFFT` and `SOURce:BB:IMP:TRIGger:OUTPut:ONT` is generated.

Example: `":BB:IMP:TRIG:OUTP2:MODE PULS"`
'selects the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RESTart	-	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:OFFTime 1 ... (2^24) -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:IMPort:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example: `":BB:IMP:TRIG:OUTP2:OFFT 20"`
'sets an OFF time of 20 symbols for marker signal 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:ONTime   1 ... (2^24) -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:IMPort:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Example: `":BB:IMP:TRIG:OUTP2:ONT 20"`
                  'sets an ON time of 20 symbols for marker 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PATTern   #B0,1 ... #B111...1, 32

The command defines the bit pattern used to generate the marker signal in the setting `SOURce:BB:IMP:TRIGger:OUTPut:MODE PATTern`. 0 is marker off, 1 is marker on.

Example: `":BB:IMP:TRIG:OUTP2:PATT #B000000011111111,15"`
                  'sets a bit pattern.

                  `":BB:IMP: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<[1]|2>]:BB:IMP:TRIGger:OUTPut<[1]...4>:PULSe:DIVider   2 ... 2^10

The command sets the divider for the Pulse marker mode (`SOUR:BB:IMP:TRIG:OUTP:MODE PULSe`). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Example: `":BB:IMP:TRIG:OUTP2:PULS:DIV 2"`
                  'sets the divider to 2 for the marker signal on output MARKER 2.

                  `":BB:IMP: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<[1]|2>]:BB:IMPort:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency?   E-2

The command queries the pulse frequency of the pulsed marker signal in the setting
`SOURce:BB:IMP: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:IMP:TRIG:OUTP2:PULS:DIV 2"`
                     'sets the divider marker signal on output MARKER 2 to the value 2.

                     `":BB:IMP:TRIG:OUTP2:MODE PULS"`
                     'enables the pulsed marker signal.

                     `":BB:IMP: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

Alphabetical List of Commands

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Supplement

Multi Carrier CW Signal Generator

R&S® AMU-K61
1402.7102.02

R&S® AFQ-K261
1401.6802.02

R&S® SMATE-K61
1404.5707.02

R&S® AMU-K261
1402.8609.02

R&S® SMJ-K61
1404.0705.02

R&S® SMJ-K261
1409.1516.02

R&S® SMU-K61
1160.8505.02

R&S® SMU-K261
1408.6514.02

ROHDE&SCHWARZ

Test and Measurement Division

Dear Customer,

The Signal Generator includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (http://www.openssl.org/).

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Trade names are trademarks of the owners.

Contents- Multi Carrier Continuous Wave

Multi Carrier Continuous Wave

Introduction - Multi Carrier CW

The R&S Signal Generator can generate a Multi Carrier CW signal with user-definable offset from carrier, based on a selection of up to 8192 unmodulated carriers. Each carrier can be separately set and switched on, or multiple carriers can be jointly configured. Automatic start phase setting is provided in order to minimize the crest factor.

Multi Carrier CW signals can be very easily configured as broadband test signals and used for such purposes as receiver tests.

The equipment layout for generating multi carrier signals includes the options Baseband Main Module (B13) and one of the options Baseband Generator (B9/B10/B11) and option Multi Carrier CW (K61).

The menu for setting a Multi Carrier CW signal can be opened either in the Baseband function block or in the menu tree for the MENU key under Baseband.
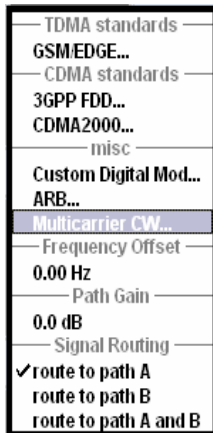
Multi Carrier CW Menu

The **Multi Carrier CW** menu is divided into the following sections.
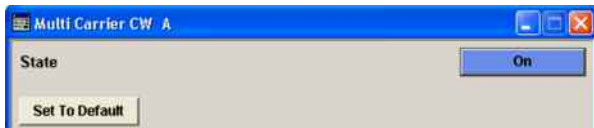
The upper part of the menu is used for powering up the Multi Carrier CW and calling the default settings.
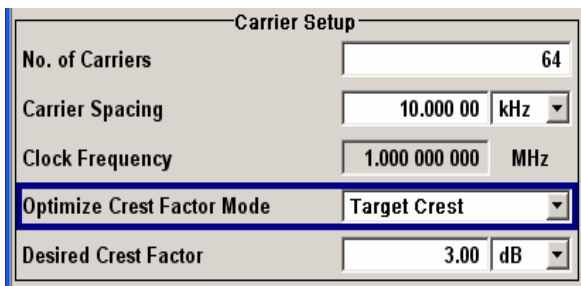
The **Carrier Setup** section is used to configure the Multi Carrier CW signal.
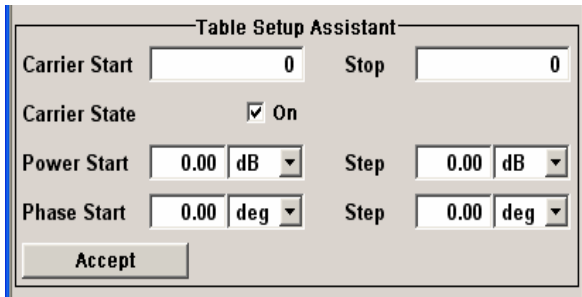
The **Table Setup Assistant** section can be used to set a selectable carrier range.
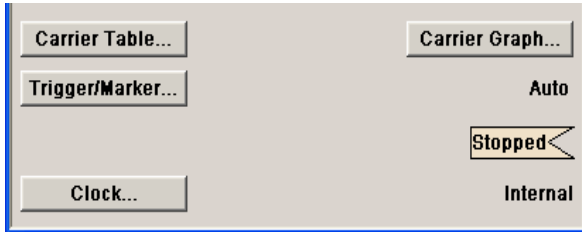
The buttons in the lower part of the menu open submenus for defining carrier tables and for configuring markers and, in case of two-path instruments, triggers and clocks. The carrier settings can be checked in the graphical **Carrier Graph** submenu.

General Settings for Multi Carrier CW

The upper part of the menu is used for powering up the Multi Carrier CW signal and calling the default settings.

State - Multi Carrier CW
Enables/disables the Multi Carrier CW.

Switching on this standard turns off all the other digital standards and digital modulation modes (in case of two-path instruments, this affects the same path).

Since Multi Carrier CW signals are computed in arbitrary waveform mode, changes to the settings of individual carriers are not adopted until the **Accept** button is pressed. This applies to the settings in the **Table Setup Assistant** menu section and the **Carrier Table** submenu.

Remote-control command:
SOUR:BB:MCCW:STAT ON

Set to Default - Multi Carrier CW
Calls default settings. The values are shown in the following table.

Remote-control command:
SOUR:BB:MCCW:PRES

Parameter	Value
State	Not affected by **Set to Default**
Carrier Setup	
Number of Carriers	64
Carrier Spacing	10 kHz
Optimize Crest Factor	Chirp
Desired Crest Factor	3 dB
Trigger	
Mode	Auto
Source	Internal
Ext. Delay	0
Ext. Inhibit	0

Parameter	Value
Marker	
Channel 1...4	Restart
Clock	
Source	Internal
Multi Channel Setup	
Start Carrier	0
Stop Carrier	0
State	ON
Power	0 dB
Power Step	0 dB
Initial Phase	0°
Phase Step	0°
Channel Setup	
State	ON
Power	0 dB
Phase	0°

The **Carrier Setup** section is used to configure the Multi Carrier CW.

Number of Carriers - Multi Carrier CW

Sets the number of carriers for the Multi Carrier CW signal.

By default the multi carrier table already lists 64 carriers that are preset to the settings State = ON, Power = 0 dB, Phase = 0°.

When entering fewer carriers than the table contains, the approach is generally to delete the superfluous entries from the table, and when entering more carriers than the table contains the missing entries are usually added at the end of the table.

Remote-control command:
SOUR:BB:MCCW:CARR:COUN 64

Carrier Spacing - Multi Carrier CW

Sets the spacing between carriers for the Multi Carrier CW signal.

The carriers are arranged symmetrically around the HF carrier.

The total bandwidth = *(Number of carriers - 1) * Carrier spacing*; the result must not exceed 80 MHz.

Remote-control command:
SOUR:BB:MCCW:CARR:SPAC 10 kHz

Clock Frequency - Multi Carrier CW

Displays the clock rate at which the multi carrier signal is output by the arbitrary waveform generator. The output clock rate depends on the number of carriers and the selected carrier offset.

The value indicates the resolution during the marker generation.

Remote-control command:
SOUR:BB:MCCW:CLOC?

Optimize Crest Factor - Multi Carrier CW

Selects the mode for automatically minimizing the crest factor.

The carrier start phases are automatically set to this.

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.

A very high crest factor arises when the carriers have an identical start phase, since the carriers are periodically superposed and very high peak voltages occur in relation to the rms voltage values.

Methods of reducing the crest factor differ with regard to both the optimization achievable and the time required for computation.

The following modes are available:

Off

There are no automatic settings for minimizing the crest factor. The **Phase** setting has an effect.

Remote-control command:
`SOUR:BB:MCCW:CFAC:MODE OFF`

Chirp

Very rapid crest factor optimization regardless of the number of carriers. A minimal crest factor of < 3 dB is only obtained for multi carrier signals in which all carriers are switched on and the power of the carriers is identical. In a configuration which differs from this, the achievable crest factor is worse.

Remote-control command:
`SOUR:BB:MCCW:CFAC:MODE CHIR`

Target Crest

Optimization of the crest factor to a desired value for all carrier configurations. The optimization time depends on the number of carriers and the desired crest factor. Computation time increases only when the number of carriers exceeds 256 and the crest factor is below 4 dB. The desired value can be entered in **Desired Crest Factor**.

Note:
Optimization can be cancelled at any time, and the current value being displayed at that moment is then used.

Remote-control command:
`SOUR:BB:MCCW:CFAC:MODE SLOW`

Desired Crest Factor - Multi Carrier CW

Enters the desired crest factor.

This is only possible when the optimization **Target Crest** has been selected.

Remote-control command:
`SOUR:BB:MCCW:CFAC 3 dB`

The **Table Setup Assistant** section can be used to set a selectable carrier range. The carrier table can be edited in the **Carrier Table** submenu.

Carrier Start - Multi Carrier CW
Defines the start index of the carrier range to which the following settings are intended to apply.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:STAR 2`

Carrier Stop - Multi Carrier CW
Defines the stop index of the carrier range to which the following settings are intended to apply.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:CARR:STOP 202`

Carrier State - Multi Carrier CW
Switches the carriers in the carrier range on/off.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:STAT ON`

Power Start - Multi Carrier CW
Sets the power of the starting carrier.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:POW 0 dB`

Power Step - Multi Carrier CW
Sets the width of the step with which the power will be changed from carrier to carrier.

The carrier power that is set with *Power + n* Power Step* must be within the valid value range -80 dB to 0 dB.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:POW:STEP -0.2 dB`

Phase Start - Multi Carrier CW
Sets the phase of the starting carrier. This setting is only available for Optimize Crest Factor Mode = Off.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:PHAS 0`

Phase Step - Multi Carrier CW
Sets the width of the step with which the phase will be changed from carrier to carrier.

The phase that is set with *Phase + n* Phase Step* must be within the valid value range 0° to 360°.

This setting is only available for Optimize Crest Factor Mode = Off.

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:PHAS:STEP 1DEG`

Accept - Multi Carrier CW
Adopts the carrier range setting into the table (Carrier Table).

Remote-control command:
`SOUR:BB:MCCW:EDIT:CARR:EXEC`

The lower part of the menu is used to open submenus for configuring carrier tables and for setting triggers, markers and clocks.

Note:
The trigger, clock, and marker delay functions are available for R&S SMx and R&S AMU instruments only.

Carrier Table - Multi Carrier CW   Calls the table for configuring individual carriers. This configuration can be checked with the aid of the **Carrier Graph**.

The table displays the settings of all available carriers. Carriers in the On state are highlighted. All carrier parameters can be edited in the table.

The Multi Carrier CW signal is only computed when the **Accept** button is pressed. Whenever the table contains settings that have not yet been adopted with the **Accept** button, the background is yellow.

Note:
  The phase/deg settings are only valid if optimization of the crest factor is disabled (Optimize Crest Factor = Off).

No.	This is the carrier index.
	Remote-control command: - (individual carriers can be set using the commands `SOUR:BB:MCCW:CARR:..` by specifying the index in the parameter. All the carriers in a multi carrier configuration can also be set using a value list with the commands `SOUR:BB:MCCW:CARR:LIST...`)
State	Switch a carrier on/off
	Remote-control command: `SOUR:BB:MCCW:CARR:LIST:STAT ON,OFF,..` `SOUR:BB:MCCW:CARR:STAT 2,ON`
Power	Sets the power of a carrier.
	Remote-control command: `SOUR:BB:MCCW:CARR:LIST:POW -3,-3,.` `SOUR:BB:MCCW:CARR:POW 2,-30dB`
Phase	Sets the starting phase of a carrier.
	Remote-control command: `SOUR:BB:MCCW:CARR:LIST:PHAS 0,0,..` `SOUR:BB:MCCW:CARR:PHAS 2, 0DEG`
Accept	Transfer the settings in the carrier table into the instrument.
	Remote-control command: n.a. (the values specified when the command is given are adopted immediately)

Carrier Graph - Multi Carrier CW

Calls a graphical representation of the chosen carrier configuration.

The carriers are on the X-axis and the colored bars represent those carriers which are in the On state. Power is on the Y-axis, and the height of the bars corresponds to the chosen power of each individual carrier.
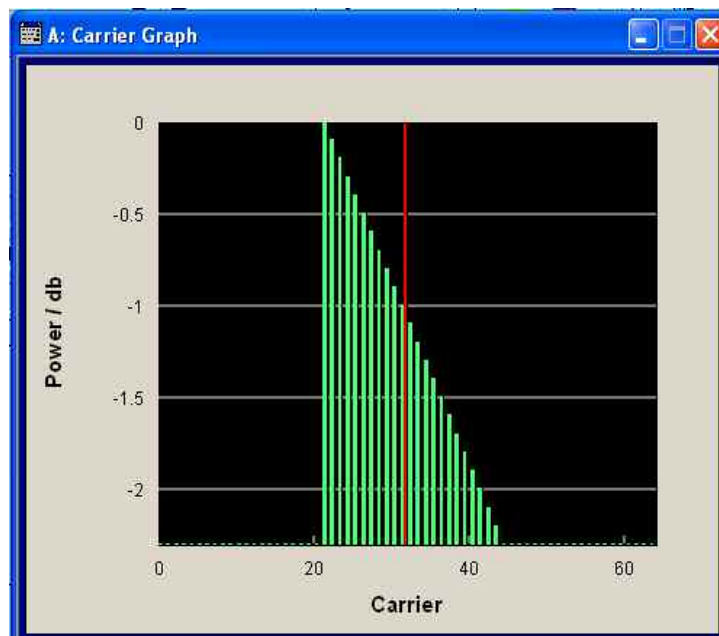
Trigger-Marker - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Calls the **Trigger/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 Menu - Multi Carrier CW", page 8).

Remote-control command: n.a.

Clock - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Calls the Clock menu. The Clock menu is used to select the clock source (see section "Trigger/Marker/Clock Menu - Multi Carrier CW", page 8).

Remote-control command: n.a.

Trigger/Marker/Clock Menu - Multi Carrier CW

Note:

The trigger, clock, and marker delay functions are available for R&S SMx and R&S AMU instruments only.

The Trigger menu is accessed via the **Multi Carrier CW** 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 generation (**Running** or **Stopped**) is indicated for all trigger modes.

The **Marker Settings** 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 Multi Carrier CW modulation. The current status of signal generation is indicated for all trigger modes.

Trigger Mode - Multi Carrier CW   **(R&S SMx and R&S AMU instruments only)**

Selects trigger mode.

Auto	The multi carrier signal is generated continuously. Remote-control command: `SOUR:BB:MCCW:SEQ AUTO`
Retrigger	The multi carrier signal is generated continuously. A trigger event (internal or external) causes a restart. Remote-control command: `SOUR:BB:MCCW:SEQ RETR`
Armed_Auto	The multi carrier signal is generated only when a trigger event occurs. Then the multi carrier signal is generated continuously. Pressing the button **Arm** stops the signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart. Remote-control command: `SOUR:BB:MCCW:SEQ AAUT`
Armed_Retrigger	The multi carrier signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart. Pressing the button **Arm** stops the signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart. Remote-control command: `SOUR:BB:MCCW:SEQ ARET`
Single	The multi carrier signal is generated only when a trigger event occurs. Then the signal 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:MCCW:SEQ SING`

Trigger Signal Duration - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**

Enters the length of the signal sequence to be output in the **Single** trigger mode.

The input is to be entered in sequence length (SL). The output can be just a defined part of the waveform, a sequence of the waveform or a defined number of repetitions of the wafveform.

Remote-control commands:
`SOUR:BB:MCCW:TRIG:SLEN 2`

Running - Stopped - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**

Displays the status of multi carrier signal generation for all trigger modes. This display appears only when Multi Carrier CW is enabled (**State On**).

Remote-control command:
`SOUR:BB:MCCW:TRIG:RMOD?`
Response: `RUN` or `STOP`

Running	The multi carrier 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 - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**

Stops multi carrier 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:MCCW:TRIG:ARM:EXEC`

Execute Trigger - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**

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 command:
`SOUR:BB:MCCW:TRIG:SOUR INT`
`SOUR:BB:MCCW:SEQ RETR`
`SOUR:BB:MCCW:TRIG:EXEC`

Trigger Source - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**
	Selects the trigger source.

<table>
<tr><td></td><td>**Internal**</td><td>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:MCCW:TRIG:SOUR INT`</td></tr>
<tr><td></td><td>**Internal (Baseband A/B)**</td><td>The trigger event is executed by the trigger signal from the second path (two-path instruments only).

Remote-control command:
`SOUR:BB:MCCW:TRIG:SOUR OBAS`</td></tr>
<tr><td></td><td>**External (TRIGGER 1|2)**</td><td>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 or TRIGGER 2 connector.

The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the **Global Trigger Settings** menu.

Remote-control command:
`SOUR:BB:MCCW:TRIG:SOUR EXT | BEXT`</td></tr>
</table>

Trigger Delay - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**
	Sets a trigger signal delay in samples by external triggering or, in case of two-path instruments, by internal triggering via the second path.
	This enables the R&S Signal Generator to be synchronized with the device under test or other external devices.

Note:
For two-path instruments, the delay can be set separately for each of the two paths.

Remote-control command:
```
SOUR:BB:MCCW:TRIG:EXT:DEL 0
SOUR:BB:MCCW:TRIG:OBAS:DEL 0
```

Trigger Inhibit - Multi Carrier CW	**(R&S SMx and R&S AMU instruments only)**
	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 generation to restart. This restart is inhibited for the specified number of samples:
	This parameter is only available on external triggering or, in case of two-path instruments, on internal triggering via the second path.

Note:
For two-path instruments, the trigger inhibit can be set separately for each of the two paths.

Remote-control command:
```
SOUR:BB:MCCW:TRIG:EXT:INH 0
SOUR:BB:MCCW:TRIG:OBAS:INH 0
```

The settings for the marker output signals are entered in the **Marker Mode** section.

Marker Channel x - Multi Carrier CW   Selects a marker signal for the associated MARKER output.

Restart   A brief marker signal is generated at the start of the waveform.

Remote-control command:
```
SOUR:BB:MCCW: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.

Divider	8.00
Frequency	33.854 17 kHz

Remote-control command:
```
SOUR:BB:MCCW:TRIG:OUTP1:MODE PULS
SOUR:BB:MCCW:TRIG:OUTP1:PULS:DIV 4
SOUR:BB:MCCW: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.

```
0000 0000
```

Remote-control command:
```
SOUR:BB:MCCW:TRIG:OUTP1:MODE PATT
SOUR:BB:MCCW:TRIG:OUTP1:PATT #H00,8
```

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.

Start of signal

ON time   OFF time   ON time   OFF time
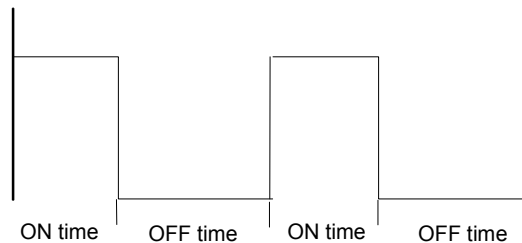
The ON time and OFF time are each expressed as a number of samples and are set in an input field which opens when **ON/OFF ratio** is selected.

On Time	1	Samples ▾
Off Time	1	Samples ▾

Remote-control command:
```
SOUR:BB:MCCW:TRIG:OUTP1:MODE RAT
SOUR:BB:MCCW:TRIG:OUTP1:OFFT 20
SOUR:BB:MCCW:TRIG:OUTP1:ONT  20
```

The delays for the marker output signals are entered in the **Marker Delay** section.

Marker x Delay - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

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 can be set without restarting the marker and signal.

Remote-control command:
SOUR:BB:MCCW:TRIG:OUTP2:DEL 2

Current Range without Recalculation - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

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:MCCW:TRIG:OUTP2:DEL:MAX?
SOUR:BB:MCCW:TRIG:OUTP2:DEL:MIN?

Fix marker delay to current range - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

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:MCCW:TRIG:OUTP:DEL:FIX ON

The **Clock Settings** section can be used to select the clock source.

Clock Source - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Selects the clock source.

Internal

The internal clock reference is used to generate the sample clock.

Remote-control command:
SOUR:BB:MCCW:CLOC:SOUR INT

External

The external clock reference is fed in as the sample clock or a multiple thereof via the CLOCK connector.

The polarity of the clock input can be changed with the aid of **Global Trigger/Clock Settings**.

In the case of two-path instruments, this selection applies to path A.

Remote-control command:
SOUR:BB:MCCW:CLOC:SOUR EXT

Clock Mode - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Enters the type of externally supplied clock.

    Sample

A sample clock is supplied via the CLOCK connector.

Remote-control command:
`SOUR:BB:MCCW:CLOC:MODE SAMP`

    Multiple

A multiple of the sample clock is supplied via the CLOCK connector; the sample clock is derived internally from this.

The **Multiplier** window provided allows the multiplication factor to be entered.

Remote-control command:
`SOUR:BB:MCCW:CLOC:MODE MSAM`

Sample Clock Multiplier - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Enters the multiplication factor for clock type **Multiple**.

Remote-control command
`SOUR:BB:MCCW:CLOC:MULT 4`

Measured External Clock - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Indicates of 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?`

Global Trigger-Clock-Input Settings - Multi Carrier CW

(R&S SMx and R&S AMU instruments only)

Calls the **Global Trigger/Clock/Input Settings** menu. The trigger threshold, the input impedance and the polarity of the clock and trigger inputs can be set in this menu.

In two-path instruments, these settings are valid for both paths.

The parameters in this menu affect all digital modulations and standards, and are described in the section
"*Global Trigger/Clock/Input Settings – Setup -Environment*".

SOURce:BB:MCCW Subsystem - Remote-Control Commands

This subsystem contains the commands for setting the Multi Carrier CW signals.

The numeric suffix to SOURce distinguishes between multi carrier generation for path A and path B in the case of two-path instruments:

SOURce<1> = path A

SOURce2 = path B

For two-path instruments, the keyword SOURce is optional in the case of commands for path A and can be omitted. For path B, the command must contain the keyword with suffix 2.

For one-path instruments, the keyword SOURce is optional and can be omitted.

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:MCCW:CARRier:COUNt	1 ... 8192	-	
[SOURce<[1]|2>]:BB:MCCW:CARRier:LIST:PHASe	0° ... 360°, 0° ... 360°, ...	RAD	
[SOURce<[1]|2>]:BB:MCCW:CARRier:LIST:POWer	-80 ... 0 dB , -80 ... 0 dB, ...	dB	
[SOURce<[1]|2>]:BB:MCCW:CARRier:LIST:STATe	ON	OFF, ON	OFF, ...		
[SOURce<[1]|2>]:BB:MCCW:CARRier:PHASe	<index>, 0 ... 360DEG	RAD	
[SOURce<[1]|2>]:BB:MCCW:CARRier:POWer	<index>, -80 ... 0 dB	dB	
[SOURce<[1]|2>]:BB:MCCW:CARRier:SPACing	0 Hz ... 50 MHz	Hz	
[SOURce<[1]	2>]:BB:MCCW:CARRier:STATe	<index>, ON	OFF		
[SOURce<[1]|2>]:BB:MCCW:CFACtor	0 ... 100 dB	dB	
[SOURce<[1]|2>]:BB:MCCW:CFACtor:MODE	OFF	CHIRp	SLOW		
[SOURce<[1]|2>]:BB:MCCW:CLOCk			Query only
[SOURce<[1]	2>]:BB:MCCW:CLOCk:MODE	SAMPle	MSAMple		
[SOURce<[1]|2>]:BB:MCCW:CLOCk:MULTiplier	1 ... 64		
[SOURce<[1]	2>]:BB:MCCW:CLOCk:SOURce	INTernal	EXTernal		
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:EXECute			No query
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:PHASe[:STARt]	0 ... 360DEG	RAD	
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:PHASe:STEP	-360 ... 360DEG	RAD	
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:POWer[:STARt]	-80 ... 0 dB	dB	
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:POWer:STEP	-80 ... 80 dB	dB	
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:STARt	<carrier_index>		
[SOURce<[1]	2>]:BB:MCCW:EDIT:CARRier:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:STOP	<carrier_index>		
[SOURce<[1]|2>]:BB:MCCW:PRESet	-		
[SOURce<[1]|2>]:BB:MCCW:SEQuence	AUTO / RETRigger / AAUTO / ARETrigger / SINGle		
[SOURce<[1]	2>]:BB:MCCW:STATe	ON	OFF		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:ARM:EXECute			No query

Command	Parameter	Default unit	Note
[SOURce<[1]|2>]:BB:MCCW:TRIGger:EXECute			No query
[SOURce<[1]|2>]:BB:MCCW:TRIGger[:EXTernal<[1]|2>]:DELay	0 ... 2^32-1 Samples	-	
[SOURce<[1]|2>]:BB:MCCW:TRIGger[:EXTernal<[1]|2>]:INHibit	0 ... 2^32-1 Samples	-	
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OBASeband:DELay	0 ... 2^32-1 Samples	-	
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OBASeband:INHibit	0 ... 2^32-1 Samples	-	
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:DELay	0 ... 2^20-1 Samples		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut:DELay:FIXed	ON | OFF		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:DELay:MAX?			Query only
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:DELay:MIN?			Query only
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:MODE	RESTart | PULSe | PATTern | RATio		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:OFFTime	1 ... max. wavelength - 1 sample		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:ONTime	1 ... max. wavelength - 1 sample		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:PATTern	#B0,1 ... #B111 ... 1,32		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 2^10		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:PULSe:FREQ			Query only
[SOURce<[1]|2>]:BB:MCCW:TRIGger:RMODe			Query only
[SOURce<[1]|2>]:BB:MCCW:TRIGger:SLENgth	1 … 2^32-1 Samples		
[SOURce<[1]|2>]:BB:MCCW:TRIGger:SOURce	INTernal | EXTernal | BEXTernal | OBASeband		

[SOURce<[1]|2>]:BB:MCCW:CARRier:COUNt　1 ... 8192

The command sets the number of carriers in the Multi Carrier CW signal. The total bandwidth *(Number of carriers - 1) * Carrier spacing* is 80 MHz. The number of carriers entered therefore defines the maximum carrier spacing (`:BB:MCCW:CARRier:SPACing`).

Example:　　　`":BB:MCCW:CARR:COUN 10"`
　　　　　　　　'sets 10 CW carriers for the multi carrier signal.

*RST value	Resolution	Dependencies	SCPI
64	1	The carrier spacing (`:BB:MCCW:CARRier:SPACing`) is reduced if the total bandwidth of 80 MHz is not respected when entering the number of carriers.	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:LIST:PHASe　0 ... 360 DEG[, 0 ... 360 DEG].

The command sets the start phase of the carrier with the aid of a value list. The first value in the list is assigned to the carrier with index 0, the second value to the carrier with index 1, etc. The maximum length corresponds to the maximum number of multi carriers. There is no need to enter all the values every time. Values not set by the value list are set with the default values provided they have already been explicitly set by a previous command. If this is the case, the values continue to apply until overwritten.

If the query is expanded by using the two parameters <start> and <count>, the value list is read out in smaller sections. Start is expressed in position of bit, count in number of values. Without the parameters all values are always read out starting from the first value.

Example: ":BB:MCCW:CARR:LIST:PHAS 90 DEG, 90 DEG, 90 DEG, 80 DEG"
'sets a start phase for carriers 0, 1, 2 and 3.

":BB:MCCW:CARR:LIST:PHAS 2,3"
'queries the phase of carrier 1, 2 and 3.

Response: "90,90,80"

*RST value	Resolution	SCPI
0 DEG	0.01 DEG	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:LIST:POWer   - 80 dB ... 0 dB[, - 80 dB ... 0 dB]

The command sets the power of the carrier with the aid of a value list. The first value in the list is assigned to the carrier with index 0, the second value to the carrier with index 1, etc. The maximum length corresponds to the maximum number of multi carriers. There is no need to enter all the values every time. Values not set by the value list are set with the default values provided they have already been explicitly set by a previous command. If this is the case, the values continue to apply until overwritten.

If the query is expanded by using the two parameters <start> and <count>, the value list is read out in smaller sections. Start is expressed in position of bit, count in number of values. Without the parameters all values are always read out starting from the first value.

Example: ":BB:MCCW:CARR:LIST:POW -65 dB, -30 dB, -50 dB,..."
'sets the power of carrier 0 to -65 dB, carrier 1 to -30 dB and so on.

":BB:MCCW:CARR:LIST:POW 2,2"
'queries the power of carrier 1 and 2.

Response: "-30,-50"

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:LIST:STATe   ON | OFF, ON | OFF, ...

The command switches the carrier on or off with the aid of a value list. The first value in the list is assigned to the carrier with index 0, the second value to the carrier with index 1, etc. The maximum length corresponds to the maximum number of multi carriers. There is no need to enter all the values every time. Values not set by the value list are set with the default values provided they have already been explicitly set by a previous command. If this is the case, the values continue to apply until overwritten.

If the query is expanded by using the two parameters <start> and <count>, the value list is read out in smaller sections. Start is expressed in position of bit, count in number of values. Without the parameters all values are always read out starting from the first value.

Example: ":BB:MCCW:CARR:LIST:STAT ON, OFF, ON,...."
'switches carrier 0 on, carrier 1 off, etc.

":BB:MCCW:CARR:LIST:POW 2,2"
'queries the states of carrier 1 and 2.

Response: "0,1"

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:PHASe   <carrier_index>, 0 ... 360 DEG.

The command sets the start phase of the selected carrier. The carrier is selected by the numerical parameter <carrier_index>.

The phase settings are only valid if optimization of the crest factor is disabled (`:SOURce:BB:MCCW:CFACtor:MODE OFF`).

Example: `":BB:MCCW:CARR:PHAS 15, 90 DEG"`
                    'sets a start phase of 90° for carrier 15.

*RST value	Resolution	SCPI
0 DEG	0.01 DEG	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:POWer   <carrier_index>, 80 dB ... 0 dB

The command sets the power of the selected carrier. The carrier is selected by the numerical parameter <carrier_index>.

Example: `":BB:MCCW:CARR:POW 15, -50 dB"`
                    'sets the power of carrier 15 to -50 dB.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:SPACing   0 Hz ... 50 MHz

The command sets the carrier spacing. The carriers are generated symmetrically around the RF carrier. The total bandwidth *(Number of carriers - 1) * Carrier spacing* is 80 MHz. The maximum carrier spacing that can be set is dependent on the chosen number of carriers

Example: `":BB:MCCW: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 80 MHz is not exceeded on entering the number of carriers (`:BB:MCCW:CARRier:COUNt`).	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CARRier:STATe   <carrier_index>, ON | OFF

The command switches the selected carrier on or off. The carrier is selected by the numerical parameter <carrier_index>. The counting in remote control differs from the numbers in the carrier table. Index 0 corresponds to number 1 (first line) in the table. Therefore, switching the state of the channel via remote control always switches the state of channel index + 1 in the table.

Example: `":BB:MCCW:CARR:STAT 15, ON"`
                    'switches carrier 16 on.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CFACtor   0 ... 100 dB

The command sets the desired crest factor for the multi carrier signal on selection of the command
`SOURce:BB:MCCW:CFACtor:MODE SLOW`.

Example: `":BB:MCCW:CFAC:MODE SLOW"`
                  'sets the Target Crest optimization mode.

                  `":BB:MCCW:CFAC 10 dB"`
                  'sets the desired crest factor to 10 dB.

*RST value	Resolution	SCPI
3 dB	0.01 dB	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CFACtor:MODE   OFF | CHIRp | SLOW

The command sets the mode by which automatic settings will minimize the crest factor or hold it at a chosen value.

Parameter: **OFF**
                  Crest factor optimization is switched off. The carrier PHASE setting has an effect.

                  CHIRp
                  The crest factor is very rapidly optimized to < 3 dB for multi carrier signals so that all carriers are switched on and have the same amplitude. The computation time is independent of the number of carriers. In other carrier configurations the achievable crest factor is worse.

                  SLOW
                  The crest factor entered using `SOURce:BB:MCCW:CFACtor` is maintained for all carrier configurations by means of automatic settings. The computation time depends on the number of carriers and on the crest factor that has been set. Computation time increases only when the number of carriers exceeds 256 and the crest factor is above 4 dB.

Example: `":BB:MCCW:CFAC:MODE OFF"`
                  'switches off automatic crest factor optimization. The setting
                  `SOUR:BB:MCCW:CARR:PHAS` has an effect.

*RST value	Resolution	SCPI
FAST	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CLOCk?

Note:
    This command is available for R&S SMx and R&S AMU instruments only.

The command queries the output clock rate. The output clock rate depends on the number of carriers an the selected carrier spacing.

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

Example: `":BB:MCCW:CLOC?"`
                  'queries the output clock rate.

                  Response: `"256 000 000"`
                  'the output clock rate is 256 MHz.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CLOCk:MODE   SAMPle | MSAMple

Note:
   This command is available for R&S SMx and R&S AMU instruments only.

The command enters the type of externally supplied clock (`:BB:MCCW: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. The multiplier is entered with the command `BB:MCCW:CLOCk:MULTiplier`.

For two path instruments, the only numerical suffix allowed for SOURce is 1, since the external clock source is permanently allocated to path A.

Example: `":BB:MCCW:CLOC:MODE SAMP"`
           'selects clock type **Sample**, i.e. the supplied clock is a sample clock.

*RST value	Resolution	SCPI
SAMPle	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CLOCk:MULTiplier   1 ... 64

The command specifies the multiplier for clock type **Multiple Samples** (`:BB:MCCW:CLOCk:MODE MSAM`) in the case of an external clock source.

For two-path instruments, the only numerical suffix allowed for SOURce is 1, since the external clock source is permanently allocated to path A.

Example: `":BB:MCCW:CLOC:SOUR EXT"`
           'selects the external clock source. The clock is supplied via the CLOCK connector.
           `":BB:MCCW:CLOC:MODE MSAM"`
           'selects clock type **Multiple Samples**, , i.e. the supplied clock has a rate which is a multiple of the sample rate.
           `":BB:MCCW:CLOC:MULT 12"`
           'the multiplier for the external clock rate is 12.

*RST value	Resolution	SCPI
4	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:CLOCk:SOURce   INTernal | EXTernal

Note:
   This command is available for R&S SMx and R&S AMU instruments only.

The command selects the source for the digital modulation clock.

For two-path instruments, selecting EXTernal is only possible for path A, since the external clock source is permanently allocated to path A.

Parameter: **INTernal**
           The internal clock reference is used.
           EXTernal
           The external clock reference is supplied to the CLOCK connector.

Example: `":BB:MCCW:CLOC:SOUR EXT"`
           'selects an external clock reference. The clock is supplied via the CLOCK connector.

*RST value	Resolution	SCPI
INTernal		Device-specific

[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:EXECute

The command adopts the settings for the carrier range which has been defined using the
`:BB:MCCW:EDIT:CARR:` commands.

Example: `":BB:MCCW:EDIT:CARR:STAR 4"`
                    'the carrier range starts at carrier 4.

                    `":BB:MCCW:EDIT:CARR:STOP 400"`
                    'the carrier range stops at carrier 400.

                    `":BB:MCCW:EDIT:CARR:STAT ON"`
                    'sets all the carriers in the carrier range to ON.

                    `":BB:MCCW:EDIT:CARR:EXEC"`
                    'adopts the settings for all the carriers in the carrier range.

                    `":BB:MCCW:STAT"`
                    'starts generation of the multi carrier signal. Carriers 4 to 400 are in the ON
                    state.

*RST value	Resolution	SCPI
		Device-specific

[SOURce<[1]|2>]:BB:MCCW: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:MCCW: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:MCCW:EDIT:CARR:PHAS:STEP` command.

The phase settings are only valid if optimization of the crest factor is disabled
(`:SOURce:BB:MCCW:CFACtor:MODE OFF`).

Example: `":BB:MCCW: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<[1]|2>]:BB:MCCW: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:MCCW:CFACtor:MODE OFF`).

Example: `":BB:MCCW:EDIT:CARR:PHAS 90 DEG"`
                    'sets a start phase of 90° for the carriers in the carrier range.

                    `":BB:MCCW: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<[1]|2>]:BB:MCCW: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:MCCW: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:MCCW:EDIT:CARR:POW:STEP` command.

Example: `":BB:MCCW:EDIT:CARR:POW -50 dB"`
                      'sets the power of the carrier to -50 dB.

*RST value	Resolution	SCPI
0 dB	0.01 dB	Device-specific

[SOURce<[1]|2>]:BB:MCCW: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:MCCW:EDIT:CARR:POW -80dB"`
                      'sets a power of -80 dB for the carriers in the carrier range.

                      `":BB:MCCW:EDIT:CARR:POW:STEP 1 dB"`
                      'the power phase 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<[1]|2>]:BB:MCCW:EDIT:CARRier:STARt   <carrier_index>

The command selects the first carrier in the carrier range to which the settings with the
`:BB:MCCW:EDIT:CARR:..` commands shall apply.

Example: `":BB:MCCW:EDIT:CARR:STAR 4"`
                      'the carrier range starts at carrier 4.

*RST value	Resolution	SCPI
0		Device-specific

[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:STATe   ON | OFF

The command switches all the carriers in the selected carrier range on or off.

Example: `":BB:MCCW:EDIT:CARR:STAT ON"`
                      'sets all the carriers in the carrier range to ON.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:EDIT:CARRier:STOP   <carrier_index>

The command selects the last carrier in the carrier range to which the settings with the
`:BB:MCCW:EDIT:CARR:..` commands shall apply.

Example: `":BB:MCCW:EDIT:CARR:STOP 40"`
                      'the carrier range stops at carrier 40.

*RST value	Resolution	SCPI
0		Device-specific

[SOURce<[1]|2>]:BB:MCCW:PRESet

The command sets all multi carrier signal parameters to their default values

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

Example: `":BB:MCCW:PRESet"`
        'resets the Multi Carrier settings to default values.

*RST value	Dependencies			SCPI
-	`:BB:MCCW:CARR:COUN`		64	Device-specific
	`:BB:MCCW:CARR:PHAS`		0	
	`:BB:MCCW:CARR:POW`		0	
	`:BB:MCCW:CARR:SPAC`	10	kHz	
	`:BB:MCCW:CARR:STAT`		ON	
	`:BB:MCCW:CLOC:SOUR`		INT	
	`:BB:MCCW:CFAC`	3	dB	
	`:BB:MCCW:CFAC:MODE`		FAST	
	`:BB:MCCW:STAT`		OFF	
	`:BB:MCCW:TRIG:EXT:DEL`		0	
	`:BB:MCCW:TRIG:EXT:INH`		0	
	`:BB:MCCW:TRIG:OBAS:DEL`	0	(two-path instruments	
			only)	
	`:BB:MCCW:TRIG:OBAS:INH`	0	(two-path instruments	
			only)	
	`:BB:MCCW:TRIG:OUTP<[1]|2|3|4>:MODE`		REST	
	`:BB:MCCW:TRIG:OUTP<[1]|2|3|4>:PFR`		1MHz	
	`:BB:MCCW:TRIG:OUTP<[1]|2|3|4>:PATT`		#H0,1	
	`:BB:MCCW:TRIG:OUTP<[1]|2|3|4>:OFFT`		0	
	`:BB:MCCW:TRIG:OUTP<[1]|2|3|4>:ONT`		0	
	`:BB:MCCW:TRIG:SEQ`		AUTO	
	`:BB:MCCW:TRIG:SOUR INT`			

[SOURce<[1]|2>]:BB:MCCW:SEQuence   AUTO | RETRigger | AAUTo | ARETrigger | SINGle

Note:
This command is available for R&S SMx and R&S AMU instruments only.

The command selects the trigger mode.

Parameter: **AUTO**
      The multi carrier signal is generated continuously.

    RETRigger
      The multi carrier signal is generated continuously. A trigger event (internal or external) causes a restart.

    AAUTo
      The multi carrier 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:MCCW:TRIG:ARM:EXEC` and started again when a trigger event occurs.

    ARETrigger
      The multi carrier 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:MCCW:TRIG:ARM:EXEC` and started again when a trigger event occurs.

    SINGle
      The multi carrier signal is output only when a trigger event occurs. After the trigger event the signal is output once to the set sequence length (`SOUR:BB:MCCW:TRIG:SLEN`). Every subsequent trigger event causes a restart.

Example: `":BB:MCCW: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<[1]|2>]:BB:MCCW:STATe   ON | OFF

The command turns on the Multi Carrier CW signal. Any other digital standards or digital modulation that may be in the ON state will be automatically turned OFF.

Example: `":BB:MCCW:STAT ON"`
              'switches on generation of the Multi Carrier CW signal.

*RST value	Resolution	Dependencies	SCPI
OFF	-	`:BB:MCCW:STAT ON` switches off all the digital standards and digital modulationon (in case of two-path instruments, this affects the same path.	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:ARM:EXECute

Note:
   This command is available for R&S SMx and R&S AMU instruments only.

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:MCCW:TRIG:SOUR INT"`
              'sets internal triggering.

              `":BB:MCCW:TRIG:SEQ ARET"`
              'sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.

              `":BB:MCCW:TRIG:EXEC"`
              'executes a trigger, signal generation is started.

              `":BB:MCCW:TRIG:ARM:EXEC"`
              'signal generation is stopped.

              `":BB:MCCW:TRIG:EXEC"`
              'executes a trigger, signal generation is started again.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:EXECute

Note:
This command is available for R&S SMx and R&S AMU instruments only.

The command executes a trigger. The internal trigger source must be selected using the command `MCCW:TRIGger:SOURce INTernal` and a trigger mode other than `AUTO` must be selected using the command `:BB:MCCW:TRIGger:MODE`.

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

Example: `":BB:MCCW:TRIG:SOUR INT"`
                          'sets internal triggering.

                    `":BB:MCCW:TRIG:SEQ RETR"`
                          'sets Retrigger mode, i.e. every trigger event causes signal generation to restart.

                    `":BB:MCCW:TRIG:EXEC"`
                          'executes a trigger.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger[:EXTernal<[1]|2>]:DELay 0 ... 2^32-1 samples

Note:
This command is available for R&S SMx and R&S AMU instruments only.

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:MCCW:TRIG:SOUR EXT"`
                          'selects an external trigger via the TRIGGER 1 connector

                    `":BB:MCCW:TRIG:DEL 200"`
                          'sets a delay of 200 samples for the trigger.

*RST value	Resolution	SCPI
0	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger[:EXTernal<[1]|2>]:INHibit 0 ... 2^26-1 samples

Note:
This command is available for R&S SMx and R&S AMU instruments only.

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:MCCW:TRIG:SOUR EXT"`
                          'selects an external trigger via the TRIGGER 1 connector.

                    `":BB:MCCW:TRIG:INH 200"`
                          'sets a restart inhibit for 200 samples following a trigger event.

*RST value	Resolution	SCPI
0	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OBASeband:DELay   0 ... 2^32-1 samples

Note:
   This command is available for SMx and AMU two-path instruments only.

The command specifies the trigger delay (expressed as a number of samples) for triggering by the signal from the second path (two-path instruments only).

Example: `":BB:MCCW:TRIG:SOUR OBAS"`
               'sets for path A the internal trigger executed by the signal from the second path (path B).

               `":BB:MCCW:TRIG:DEL 200"`
               'sets a delay of 200 samples for the trigger.

*RST value	Resolution	SCPI
0	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OBASeband:INHibit   0 ... 2^32-1 samples

Note:
   This command is available for SMx and AMU two-path instruments only.

The command specifies the number of samples by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path (two-path instruments only).

Example: `":BB:MCCW:TRIG:SOUR OBAS"`
               'sets for path A the internal trigger executed by the signal from the second path (path B).

               `":BB:MCCW:TRIG:INH 200"`
               'sets a restart inhibit for 200 samples following a trigger event.

*RST value	Resolution	SCPI
0	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:DELay   0 ... 2^20-1 Symbols

Note:
   This command is available for R&S SMx and R&S AMU instruments only.

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:MCCW: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:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:OUTPut:DELay:FIXed   ON | OFF

Note:
    This command is available for R&S SMx and R&S AMU instruments only.

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:MCCW:TRIG:OUTP:DEL:FIX ON"`
           'restricts the marker signal delay setting range to the dynamic range.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:DELay:MAXimum

Note:
    This command is available for R&S SMx and R&S AMU instruments only.

The command queries the maximum marker delay for setting `:BB:MCCW:TRIGger:OUTPut:DELay:FIXed ON`.

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

Example: `":BB:MCCW:TRIG:OUTP:DEL:FIX ON"`
           'restricts the marker signal delay setting range to the dynamic range.
           `":BB:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:DELay:MINimum

Note:
    This command is available for R&S SMx and R&S AMU instruments only.

The command queries the minimum marker delay for setting `:BB:MCCW:TRIGger:OUTPut:DELay:FIXed ON`.

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

Example: `":BB:MCCW:TRIG:OUTP:DEL:FIX ON"`
           'restricts the marker signal delay setting range to the dynamic range.
           `":BB:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:MODE   RESTart | PULSe | PATTern | RATio

The command defines the signal for the selected marker output.

Parameter: **RESTart**
                        A marker signal is generated at every signal start.

                        PULSe
                        A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the
                        `SOUR:BB:MCCW:TRIG:OUTP:PULS:DIVider` command and can be queried with the `SOUR:BB:MCCW: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
                        `SOURce:BB:MCCW:TRIGger: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:MCCW:TRIGger:OFFT` and
                        `SOURce:BB:MCCW:TRIGger:ONT` is generated.

Example: `":BB:MCCW:TRIG:OUTP2:MODE PULS"`
                        'selects the pulsed marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RESTart	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:OFFTime   1 ... max. wave length -1 sample

The command sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:MCCW:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example: `":BB:MCCW:TRIG:OUTP2:OFFT 20"`
                        'sets an OFF time of 20 samples for marker signal 2.

*RST value	Resolution	SCPI
1 Sample	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>: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 `SOURce:BB:MCCW:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Example: `":BB:MCCW:TRIG:OUTP2:ONT 20"`
                        'sets an ON time of 20 samples for marker 2.

*RST value	Resolution	SCPI
1 Sample	1	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:PATTern #B0,1 ... #B111...1,32

The command defines the bit pattern used to generate the marker signal in the setting
`SOURce:BB:MCCW:TRIGger:OUTPut:MODE PATTern` 0 is marker off, 1 is marker on.

Example: `":BB:MCCW:TRIG:OUTP2:PATT #HE0F52,20"`
                                'sets a bit pattern.

                       `":BB:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:PULSe:DIVider 2 ... 2^10

The command sets the divider for Pulse marker mode (`SOUR:BB:MCCW:TRIG:OUTP:MODE PULSe`). The resulting pulse frequency is derived by dividing the symbol rate by the divider.

Example: `":BB:MCCW:TRIG:OUTP2:PULS:DIV 2"`
                                'sets the divider for the marker signal on output MARKER 2 to the value 2.

                       `":BB:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency?

The command queries the pulse frequency of the pulsed marker signal in the setting
`SOUR:BB:MCCW:TRIG:OUTP:MODE PULS`. The pulse frequency is derived by dividing the symbol rate by the divider. The divider is defined with command `SOUR:BB:MCCW:TRIG:OUTP:PULS:DIV`.

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

Example: `":BB:MCCW:TRIG:OUTP2:PULS:DIV 4"`
                                'sets the divider for the marker signal on output MARKER 2 to the value 4.

                       `":BB:MCCW:TRIG:OUTP2:MODE PULS"`
                                'enables the pulsed marker signal

                       `":BB:MCCW:TRIG:OUTP2:PULS:FREQ?"`
                                'queries the pulse frequency for the marker signal.

                       Response: `"33 000"`
                                'the resulting pulse frequency is 33 kHz.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>]:BB:MCCW:TRIGger:RMODe

Note:
    This command is available for R&S SMx and R&S AMU instruments only.

The command queries the current status of signal generation for all trigger modes with Multi Carrier CW 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:MCCW:TRIG:ARM:EXECute` (armed trigger modes only).

Example: `"SOUR:BB:MCCW:TRIG:SOUR EXT"`
                    'sets external triggering via the TRIGGER 1 connector.

                    `"SOUR:BB:MCCW:TRIG:MODE ARET"`
                    'selects the Armed_Retrigger mode

                    `"SOUR:BB:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:SLENgth   1 … (2^32-1) Samples

Note:
    This command is available for R&S SMx and R&S AMU instruments only.

The command defines the length of the signal sequence to be output in the **Single** trigger mode. The input is to be expressed in samples. It is then 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:MCCW:SEQ SING"`
                    'sets trigger mode Single.

                    `"SOUR:BB:MCCW: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<[1]|2>]:BB:MCCW:TRIGger:SOURce   INTernal | EXTernal | BEXTernal | OBASeband

Note:
   This command is available for R&S SMx and R&S AMU instruments only.

The command selects the trigger source.

Parameter: **INTernal**
                        Triggering is executed by means of the Trigger command
                        `:BB:MCCW:TRIG:EXECute` 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.

                        BEXTernal
                        Triggering is executed by means of the signal on the TRIGGER 2 connector.

                        OBASeband
                        Triggering is executed by means of the signal from the second path (two-path
                        instruments only).

Example: `":BB:MCCW:TRIG:SOUR INT"`
                        'sets internal triggering.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

Alphabetical List of Commands

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