

Supplement



Digital Standard ECMA-368 IEEE 802.15 3a (Ultra Wide Band)

R&S[®] AFQ100B-K264
1410.8504.02



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.

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 $\pm 10\%$ shall apply to the nominal voltage and of $\pm 5\%$ 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 $V_{\text{rms}} > 30 \text{ V}$, 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.

Grouped Safety Messages

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 electrostática

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

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 $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ 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 produjeran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.
 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. Muévelo 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.

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Digital Standard UWB MB-OFDM

Introduction - Digital Standard UWB MB-OFDM

The R&S Signal Generator provides you with the ability to generate UWB MB-OFDM signals in accordance with the WiMedia Alliance and MultiBand OFDM Alliance Unapproved Release Candidate Version 1.2.

A brief description of the standard is given in the following. For a detailed description see the corresponding WiMedia Alliance and MultiBand OFDM Alliance specifications.

The R&S Signal Generator simulates UWB MB-OFDM at the physical layer. A sequence of data packets with the frame structure defined by the standard is generated. A MAC header can be activated.

The following list gives an overview of the options provided by the R&S Signal Generator for generating a UWB MB-OFDM signal:

- ◆ Physical Layer mode MB-OFDM
- ◆ Data rates 53.3 Mbps, 80 Mbps, 106.7 Mbps, 160 Mbps, 200 Mbps, 320 Mbps, 400 Mbps, 480 Mbps
- ◆ Modulation according to the standard:
 - QPSK for data rates from 53.3 to 200 Mbps
 - DCM for data rates from 320 to 480 Mbps
- ◆ Support of all standard compliant Time-Frequency Codes (TFC1 to TFC10), as well as configuration of user-definable hopping sequences.
- ◆ Generation of frames for both standard frame and burst mode
- ◆ Standard compliant and user-definable cover synchronization sequence, minimum and short inter-frame spacing interval duration for both burst and standard mode
- ◆ Data scrambling, bit interleaving and convolutional encoding can be activated or deactivated.
- ◆ Clipping for reducing the crest factor.

Physical Layer MB-OFDM

In the MB-OFDM (Multiband Orthogonal Frequency Division Multiplexing) approach, the available spectrum of 7.5 GHz (3 100 .. 10 600 MHz) is divided into 14 bands, 528 MHz each. The information transmitted on each 528 MHz band is modulated using OFDM. OFDM distributes the data over 122 useful subcarriers with 4.125 MHz subcarrier spacing.

Band Groups

To achieve a MB-OFDM, the 528 MHz bands are grouped together into 6 band groups as shown on the figure below.

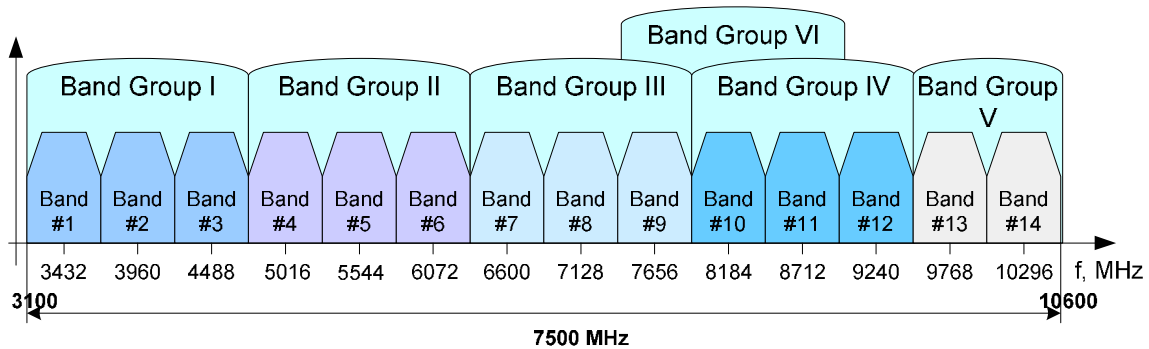


Figure 1 MB-OFDM Frequency Band Plan

Band Hopping

A total number of 49 logical channels are achieved with the help of TFCs (Time-Frequency Code). For each of the band group 1, 2, 3, 4 and 6, 10 TFCs are defined. However, only three TFCs are used in band group 5.

The combination for the band group and TFC defines the band hopping within the selected band group. The band switching time is 9.47 ns.

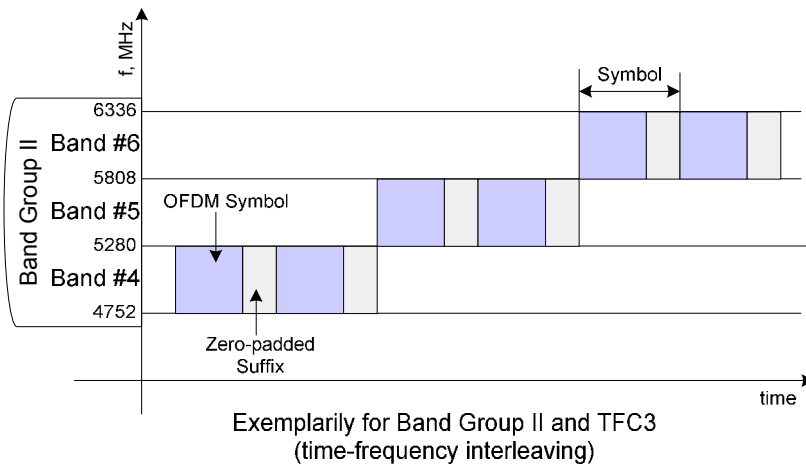


Figure 2 Band Hopping

UWB MB-OFDM Parameters

The table below gives an overview of the main UWB MB-OFDM parameters.

Table 1 Parameters of UWB MB-OFDM modulation

Parameters	Value
Number of data subcarriers	100
Number of pilot subcarriers	12
Total of subcarriers used	122
Subcarrier frequency spacing	4.125 MHz
IFFT/FFT period	242.42 ns
Zero padded suffix duration	70.08 ns
Symbol interval	312.5 ns
Number of samples per zero padding suffix	37
Total number of samples per symbol	165
Symbol rate	3.2 MHz
Subcarrier modulation	QPSK (for data rates \leq 200 Mbps) DCM (for data rates $>$ 200 Mbps)
Code rates	1/3, 1/2, 5/8, 3/4

A 128 point IFFT is used to generate the 122 subcarriers (12 pilot subcarrier, 110 data subcarriers and 10 guard subcarriers). Six of the 128 possible carriers are not used (null subcarrier). One is the carrier in the middle of the band, which would otherwise be impaired by the carrier leakage of the I/Q modulator, the others are the remaining carriers at the upper and lower end of the spectrum. The figure below shows an example of the Band #1 (3168 - 3696 MHz).

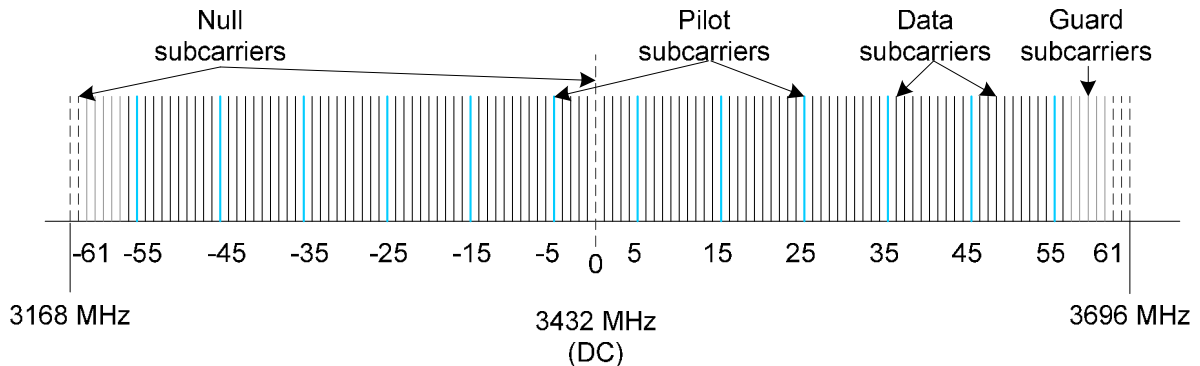


Figure 3 Structure of UWB MB-OFDM Signal

The required subcarrier spacing of 4.125 MHz is implicitly observed when the time signal generated by the IFFT with a sampling rate of 528 MHz is output. An OFDM symbol generated in this way would have a period of 242.42 ns. To compensate for multipath propagation, a so-called zero-padded suffix with a duration of 70.08 ns is attached to each symbol so that a total symbol interval of 312.5 ns is obtained.

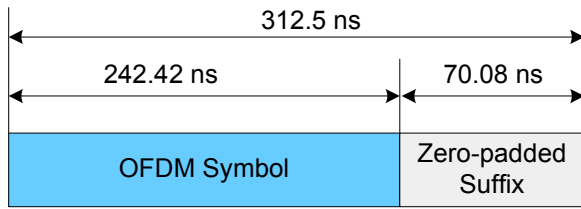


Figure 4 OFDM Symbol

Either QPSK or DCM (Dual-Carrier Modulation) modulation can be used on the subcarriers. Prior to the modulation, the raw data are convolutionally coded with code rates of 1/3, 1/2, 5/8 and 3/4 being possible.

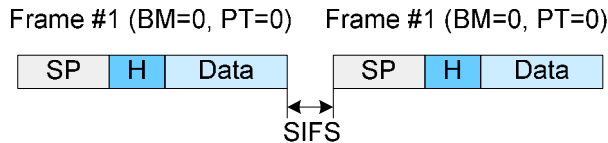
Transport Modes

At the physical level, the standard defines transmission of the frames in two modes, a standard (single frame) mode and a burst mode.

◆ **Standard mode**

In standard transport mode, a single frame will be transmitted.

In this mode, the frames are separated by a SIFS (Short Inter Frame Spacing) interval.



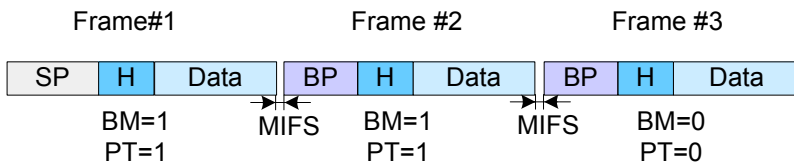
SP - Standard Preamble BM - Burst Mode
 BP - Burst Preamble PT - Preamble Type
 H - Header SIFS - Short Inter Frame Spacing

Figure 5 Standard Transport Mode

◆ **Burst mode**

A burst of frames from the same source will be transmitted.

The frames in the burst are separated by a minimum inter-frame separation interval (MIFS).



Exemplarily for Data Rate > 200Mbps, Burst Preamble Used
 and # Frames per Burst = 3

Figure 6 Burst Transport Mode

UWB MB-OFDM Frame Structure and PDU Format

The UWB MB-OFDM frame structure is very similar to the frame structure of other wireless formats, such as WLAN, etc.

The table below gives an overview of the UWB MB-OFDM physical parameters, related to the frame structure.

Table 2 Frame Structure of UWB MB-OFDM

Parameters	Value
PLCP Preamble Length	30 Symbols (standard preamble) 18 Symbols (burst preamble)
PLCP Preamble Duration	9.375 μ s (standard preamble) 5.625 μ s (burst preamble)
Packet/Frame Synchronization Length	24 Symbols (standard preamble) 12 Symbols (burst preamble)
Channel Estimation Sequence	6 Symbols (standard and burst preamble)
PLCP Header Duration	3.75 μ s
PLCP Header Rate	39.4 Mbps
PSDU Data Rate	53.3 Mbps, 80 Mbps, 106.7 Mbps, 160 Mbps, 200 Mbps, 320 Mbps, 400 Mbps, 480 Mbps
PSDU Frame Payload	0(standard preamble)/ 1(burst preamble) .. 4095 bytes

The data packet on the physical layer is referred to as PDU (PLCP Protocol Data Unit). A PDU consists of three components; the PLCP (Physical Layer Convergence Protocol) preamble, the PLCP header and the PSDU (PLCP Service Data Unit), which contains the actual information data (coming from higher layers).

The PLCP preamble and header are used for synchronization and signaling purposes, and are themselves divided into fields.

The figure below shows the frame structure (also indicated in the **PPDU Configuration** submenu).

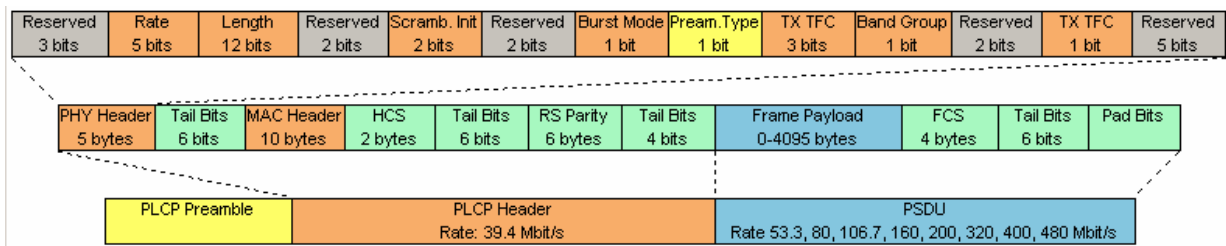


Figure 7 UWB MB-OFDM Frame Structure

PLCP Preamble

Each frame starts with the PLCP preamble for time synchronization and channel estimation purposes. There are two PLCP preambles defined, a standard preamble for frames in standard mode and a burst preamble for frames in burst mode respectively.

The standard PLCP preamble is 9.375 μ s long and thus corresponds to the duration of 30 OFDM symbols.

The burst PLCP preamble is 5.625 μ s long that corresponds to the duration of 18 OFDM symbols.

Both the standard and the burst preamble can be subdivided into two parts: a packet/frame synchronization sequence and a channel sequence each created by spreading an appropriate base sequence with a cover sequence.

PLCP Header

The PLCP Header is sent at 39.4 Mbps and carries information about the data rate, the data length, the transport mode and preamble type, as well as the MAC Header.

Prior to scrambling, the PLCP Header is protected with shortened Reed-Solomon code (23, 17) and Header Check Sequence ($x^{16}+x^{12}+x^5+1$). Tail bits are added to reset the convolutional encoder to zero.

PSDU

The user data in the data section of the frame is finally taken to the receiver. The data section can be transmitted with one of the defined data rates between 53.3 and 480 Mbps. The data section of the frame is subdivided into the fields Payload, FCS (Frame Check Sequence), tail and pad bits.

The 6 tail bits are used to reset the convolutional coder to zero. The data field must be filled with the full number of OFDM symbols and is therefore rounded up. Additional bits that may be available are set to 0 as pad bits.

Protection

The R&S Signal Generator simulates UWB MB-OFDM signals in accordance with ECMA 368 on the physical layer. In the standard, the MAC sublayer provides the input data for this layer. The following graph illustrates the signal generation process.

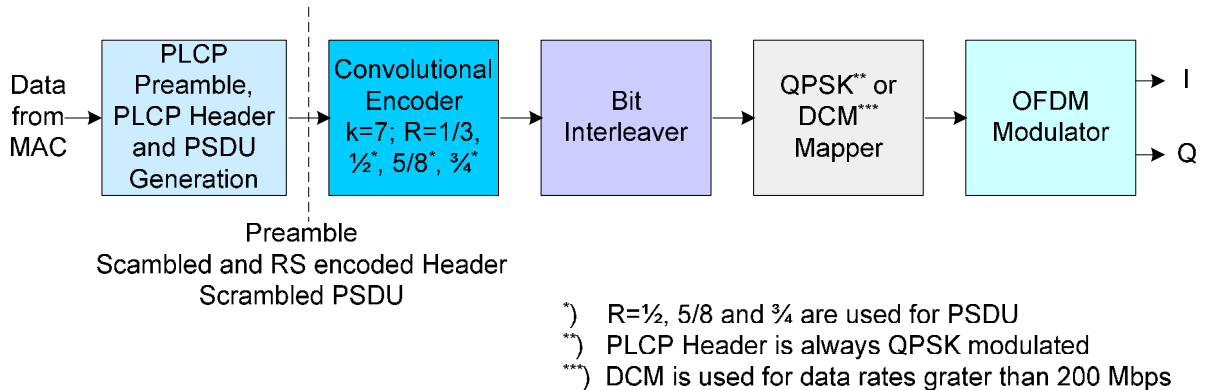


Figure 8 Principle of UWB MB-OFDM signal generation

The scrambled and RS encoded PLCP Header and the scrambled PSDU are subjected to usual signal processing consisting of convolutional coding, interleaving, subcarrier modulation, pilot carrier generation and OFDM modulation.

Data Scrambler

Data from the source (the next higher protocol layer, the MAC) must first be scrambled, i.e. multiplied with a PN sequence. The standard defines a side-stream scrambler. The scrambling sequence is given by the following generator polynomial:

$$g(D)=1+D^{14}+D^{15}$$

The start value of the register is determined from the seed identifier contained in the PLCP Header.

Convolutional Encoder

A subsequent convolutional coder adds redundancies to the bits. The coder uses the rate $R=1/3$, has 64 possible states ($k = 7$) and is described by the polynomials $g_0=133_8$, $g_1=165_8$ and $g_2=171_8$.

To obtain the data rates of 53.3 to 480 Mbps defined by the standard, different channel code rates are required. Bits generated by the convolutional coder are therefore punctured (i.e. omitted) depending on the setting so that $1/2$, $1/3$, $3/4$ or $5/8$ code rates are attained.

Increasing the redundancy by channel coding is generally mandatory in case of OFDM modulations since complete subcarriers may be eliminated by frequency selective fading so that the loss of bits on the transmission path is in many cases unavoidable.

The PLCP header always has a data rate of 39.4 Mbps, and is therefore always encoded with rate $R=1/3$.

Bit Interleaving

To increase the performance of the convolutional coder, the coded data are interleaved in the next step. Employing frequency diversity within a band and across subcarriers and time domain spreading, three interleaver stages ensure robustness against burst errors.

The adjacent bits of the convolutional coder are first symbol interleaved, i.e. the coded and padded bit stream is distributed across 6 consecutive OFDM symbols.

The second stage is the inter-symbol tone interleaving, which distributes the bits across the data subcarrier within one OFDM symbol.

Finally, the bits are cyclically shifted in successive OFDM symbols.

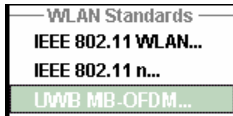
Constellation Mapping and OFDM Modulator

The coded and interleaved data sequence is mapped onto a complex constellation.

The PLCP header is always QPSK-modulated. Depending on the data rate, the useful carriers are subjected to a QPSK or DCM modulation. For data rate between 53.3 Mbps and 200 Mbps, the data sequence is mapped onto a QPSK constellation. A dual-carrier modulation (DCM) is employed for data with data rates between 320 Mbps and 480 Mbps.

UWB MB-OFDM Menu

The menu for setting the UWB MB-OFDM digital standard is either called from the baseband block or from the menu tree under Baseband.



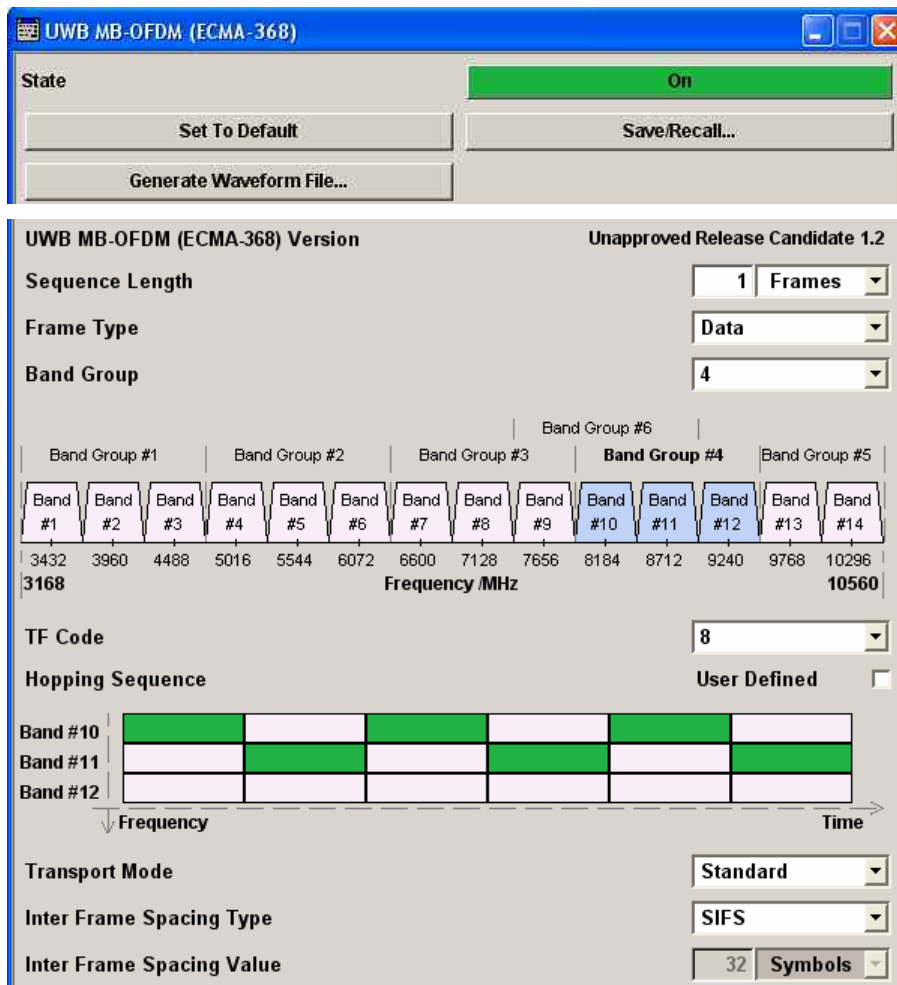
General Settings for UWB MB-OFDM Signals

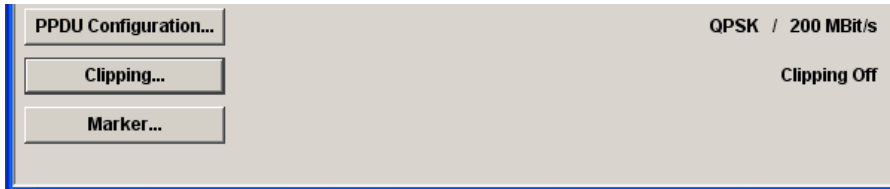
The menu is split into several sections for configuring the standard.

The upper section of the menu is where the UWB MB-OFDM digital standard is enabled and the default settings are called.

In the middle section the sequence length, the frame type, the band group, the time-frequency code and the transport mode are selected.

The buttons of the lower menu section lead to submenus for configuring the PPDU and for setting the filter, clipping and marker parameters.





State - UWB MB-OFDM

Enables/disables the UWB MB-OFDM standard.

Enabling this standard disables all the other digital standards and digital modulation modes (in case of two-path instruments, this affects the same path)

Remote-control command:
 SOUR:BB:UWBM:STAT ON

Set to default - UWB MB-OFDM

Calls the default settings. The following table gives an overview of the settings. The preset value for each parameter is specified in the description of the remote-control commands.

Remote-control command:
 SOUR:BB:UWBM:PRES

Parameter	Value
State	Not affected by Set to default
UWB MB-OFDM (ECMA-368) Version	Unapproved release Candidate 1.2
Sequence Length	1 Frame
Frame Type	Data
Band Group	1
TF Code	1
Hopping Sequence	User Defined Off
Transport Mode	Standard
Inter Frame Spacing Type	SIFS
Inter Frame Spacing Value	32 Symbols
Filter	Cosine
Clipping	Off
PPDU Configuration (QPSK, 200 Mbps)	
PDSU Data Rate	200 Mbps
PDSU Modulation	QPSK
PSDU Data Length	2048 bytes
PSDU Data Source	PN9
PLCP Cover Sequence	TF Code 1
PLCP Standard Preamble	++++ +++++ +++++ +++++ +----
Scrambler	On
Convolutional Encoder	On
Bit Interleaver	On
MAC Header	Off

Save/Recall - UWB MB-OFDM

Calls the **Save/Recall** menu.

From the **Save/Recall** menu the **File Select** windows for saving and recalling UWB MB-OFDM configurations and the **File Manager** can be called.



UWB MB-OFDM configurations are stored as files with the predefined file extension ***.uwb**. The file name and the directory they are stored in are user-definable.

The complete settings in the **UWB MB-OFDM** menu are saved and recalled.

Recall UWB MB-OFDM setting Opens the **File Select** window for loading a saved UWB MB-OFDM configuration.

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

Remote-control command:

```
MMEM:CDIR 'F:\gen_lists\uwb'
SOUR:BB:UWBM:SETT:CAT?
Response: 'uwb_1',uwb_2'
SOUR:BB:UWBM:SETT:LOAD "uwb_1"
```

Save UWB MB-OFDM setting Opens the **File Select** window for saving the current UWB MB-OFDM signal configuration.

The name of the file is specified in the **File name** entry field, the directory selected in the **save into** field. The file is saved by pressing the **Save** button.

Remote-control command:

```
MMEM:CDIR 'F:\gen_lists\uwb'
SOUR:BB:UWBM:SETT:STOR 'uwb_3'
```

File Manager Calls the **File Manager**.

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

Remote-control commands:

```
MMEM:CDIR 'F:\gen_lists\uwb'
SOUR:BB:UWBM:SETT:DEL 'uwb_1'
```


Generate Waveform File... - UWB MB-OFDM	<p>Calls the Generate Waveform menu. This menu is used to store the current UWB MB-OFDM signal as ARB signal in a waveform file.</p> <p>This file can be loaded in the ARB menu and processed as multicarrier or multisegment signal.</p> <p>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.</p> <p>Remote-control commands: SOUR:BB:UWBM:STAT ON MMEM:CDIR 'D:\user\waveform' SOUR:BB:UWBM:WAV:CRE "uwb_1.wv"</p>
UWB MB-OFDM (ECMA-368) Version	<p>Displays the current version of the UWB MB-OFDM standard.</p> <p>The default settings and parameters provided are oriented towards the specifications of the version displayed.</p> <p>Remote-control command: SOUR:BB:UWBM:VERS? Response: Unapproved Release Candidate 1.2</p>
Sequence Length - UWB MB-OFDM	<p>Sets the sequence length of the signal in number of frames.</p> <p>Remote-control command: SOUR:BB:UWBM:SLEN 4</p>
Frame Type - UWB MB-OFDM	<p>Selects the frame type of the generated signal. The selection defines parameters of the MAC layer, e.g. the Frame Type and ACK Policy bit fields of the MAC Header.</p> <p>Data Frames containing useful data.</p> <p>Remote-control command: SOUR:BB:UWBM:FTYP DATA</p> <p>Beacon Beacon frames will be generated. Beacons are used for synchronization to a shared channel.</p> <p>Remote-control command: SOUR:BB:UWBM:FTYP BEAC</p> <p>Control Control frames will be generated.</p> <p>Remote-control command: SOUR:BB:UWBM:FTYP CONT</p> <p>Command Command frames will be generated.</p> <p>Remote-control command: SOUR:BB:UWBM:FTYP COMM</p> <p>Aggregated Aggregated frames will be generated. The payload of these frames contains an aggregation header and multiple MSDUs (MAC service data units).</p> <p>Remote-control command: SOUR:BB:UWBM:FTYP AGGR</p>

Band Group - UWB MB-OFDM

Selects the band group for which a signal will be generated.

The selection of band group defines the signal parameter Time-Frequency Code (**TF Code**). The combination for the parameters **Band Group** and **TF Code** defines the band hopping within the selected band group (see also "[Physical Layer MB-OFDM](#)"). The currently selected hopping sequence is displayed in the TFC Graph.

Remote-control command:
SOUR:BB:UWBM:BGR BG3

Band Group Graph - UWB MB-OFDM

In the band group graph, the currently selected band group is highlighted.

Remote-control command: n.a.

TF Code - UWB MB-OFDM

Selects the time-frequency code of the generated signal.

The value of the parameter **TF Code** depends on the selected **Band Group**.

For band groups 1, 2, 3, 4 and 6, one of 10 possible TF Codes can be selected.

For band group 5 only three TF Codes (TF Code 5, 6 and 8) are enabled.

Depending on the standard TF Code selected here, the parameter **Cover Sequence** will be set (see "[Cover Sequence \(Sync.\) - UWB MB-OFDM](#)").

The combination for the parameters **Band Group** and **TF Code** defines the band hopping within the selected band group (see also "[Physical Layer MB-OFDM](#)").

The currently selected hopping sequence is displayed in the TFC Graph.

However, the user is enabled to re-configure any standard TF Code hopping sequence by simply double click on a band in the TFC Graph.

This will automatically enable parameter **Hopping Sequence User Defined** and the configured user hopping sequence will be saved as the last used user hopping sequence.

Disabling the parameter **Hopping Sequence User Defined** restores the last used standard TF Code pattern.

Any further enabling of the parameter **Hopping Sequence User Defined** restores the last used user hopping sequence.

The configuration of used redined hopping sequence does not affect the selection made for the parameter **Cover Sequence**.

Remote-control command:
SOUR:BB:UWBM:BGR BG5
SOUR:BB:UWBM:TFC TFC5

Hopping Sequence User Defined - UWB MB-OFDM

Indicates a user definable hopping sequence. This parameter triggers the TFC Graph to display the last user defined hopping sequence.

The re-configuration of any standard TF Code hopping sequence by simply double click on a band in the TFC Graph automatically enables parameter **Hopping Sequence User Defined**.

The configured user hopping sequence is saved as the last used user hopping sequence.

Disabling the parameter **Hopping Sequence User Defined** restores the last used standard TF Code pattern.

Any further enabling of the parameter **Hopping Sequence User Defined** restores the last used user hopping sequence.

Remote-control command:

```
SOUR:BB:UWBM:BGR BG6
SOUR:BB:UWBM:HSEQ:USER:STAT ON
SOUR:BB:UWBM:HSEQ 11,11,11,10,9,10
```

TFC Graph - UWB MB-OFDM

The TFC graph indicates the selected band hopping mechanism, according to the selection made for the parameters **TF Code**, **Band Group** and **Hopping Sequence User Defined**.

The user is also enabled to re-configure any standard TF Code hopping sequence by simply double click on a band in the TFC Graph.

Remote-control command:

```
SOUR:BB:UWBM:BGR BG6
SOUR:BB:UWBM:HSEQ:USER:STAT ON
SOUR:BB:UWBM:HSEQ 11,11,11,10,9,10
```

Transport Mode - UWB MB-OFDM

Selects the transport mode of the signal.

The selection defines the values enabled for the parameters **PLCP Preamble** and **Data Length**.

Standard

In standard transport mode, a single frame will be transmitted. The frames are separated by a short inter-frame separation interval (SIFS).

According to the standard, the duration of the SIFS is 32 symbols but you can change it (see "[Inter Frame Spacing Value - UWB MB-OFDM](#)").

A frame in a standard mode uses always the **Standard Preamble** (see "[Standard Preamble - UWB MB-OFDM](#)").

Remote-control command:

```
SOUR:BB:UWBM:TMOD STAN
```

Burst

A burst of frames from the same source will be transmitted. The frames in the burst are separated by a minimum inter-frame separation time (MIFS). According to the standard, the duration of the MIFS is 6 symbols but you can change it.

For **Data Rates** \leq 200Mbps, all the frames will have a **Standard Preamble** (see "[Standard Preamble - UWB MB-OFDM](#)").

For **Data Rates** $>$ 200Mbps, only the first frame uses the Standard Preamble; the rest of the frame may use standard or burst preamble (see "[Burst Preamble - UWB MB-OFDM](#)" and "[Burst Preamble Used - UWB MB-OFDM](#)").

For burst transport mode the data length cannot be 0, i.e. the minimum **Data Length** is 1 byte (see "[Data Length - UWB MB-OFDM](#)").

Remote-control command:
SOUR:BB:UWBM:TMOD BURS

Inter Frame Spacing Type - UWB MB-OFDM - Selects the type of the Inter Frame Spacing Interval.

SIFS

Short Inter Frame Spacing Interval (SIFS) is the interval between two frames in standard transmission mode.

According to the standard, SIFS has duration of 32 Symbols.

Remote-control command:
SOUR:BB:UWBM:IFS:TYPE SIFS

MIFS

Minimum Inter Frame Spacing Interval (MIFS) is the interval between two frames in burst transmission mode.

According to the standard, MIFS has duration of 6 Symbols.

Remote-control command:
SOUR:BB:UWBM:IFS:TYPE MIFS

User

The duration of the Inter Frame Spacing interval can be defined by the user (see "[Inter Frame Spacing Value - UWB MB-OFDM](#)").

Remote-control command:
SOUR:BB:UWBM:IFS:TYPE USER

- Inter Frame Spacing Value - UWB MB-OFDM** Displays the duration in symbols of the Inter Frame Spacing interval, depending on the selection made for the parameter **Inter Frame Spacing Type**.
For **Inter Frame Spacing Type** set to SIFS or MIFS, the value is read-only.
For **Inter Frame Spacing Type** set to User, the duration can be defined by the user.

Remote-control command:
SOUR:BB:UWBM:IFS:TYPE USER
SOUR:BB:UWBM:IFS:VAL 10
- PPDU Configuration - UWB MB-OFDM** Calls the menu for configuration of the PPDU. The current setting is displayed next to the button.

The menu is described in Section "[PPDU Configuration - UWB MB-OFDM](#)", Page 16. Remote-control command: n.a.
- Clipping... - UWB MB-OFDM** Calls the menu for setting the filter parameters and the clipping. The current setting is displayed next to the button.

The menu is described in Section "[Clipping - UWB MB-OFDM](#)", Page 30.

Remote-control command: n.a.
- Marker... - UWB MB-OFDM** Calls the menu for configuring the marker signals (see Section "[Marker... - UWB MB-OFDM](#)", Page 28).

Remote-control command: n.a.

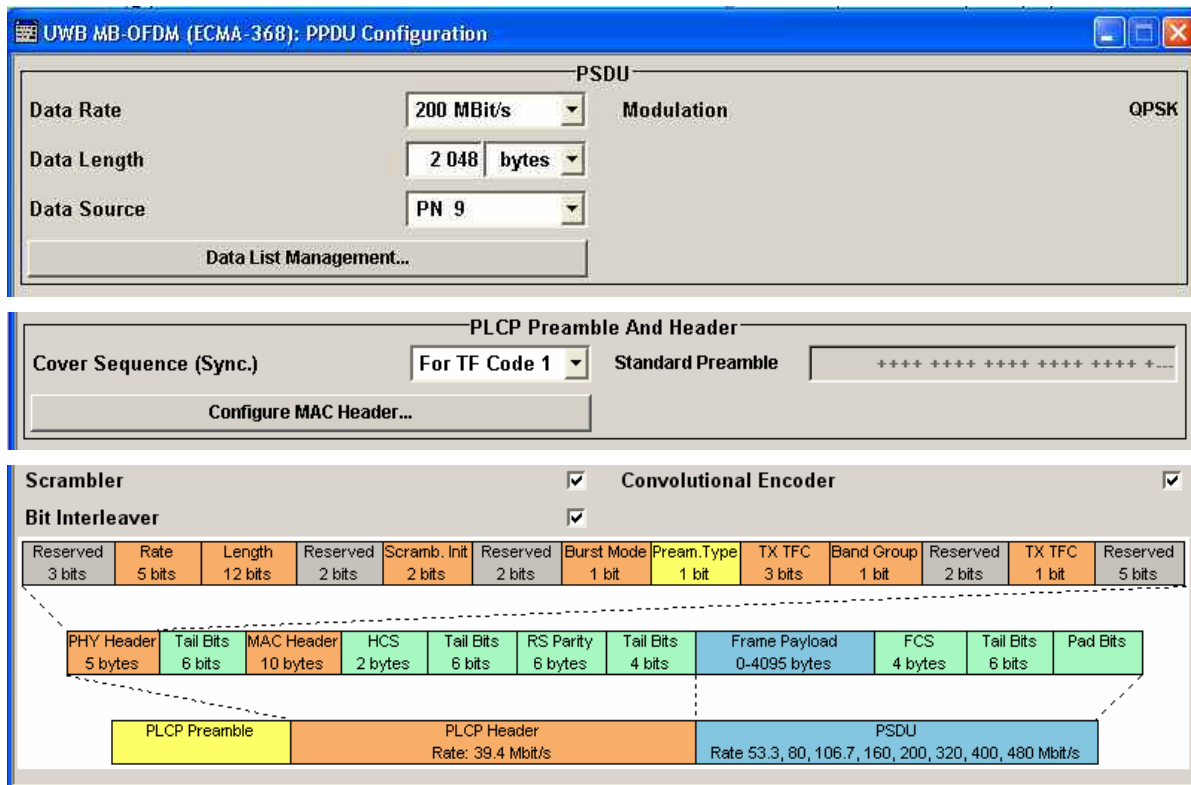
PPDU Configuration - UWB MB-OFDM

In the upper section of the menu, the parameters of the data part (PSDU) such as data rate, data length, and data source are set.

In the middle section, the PLCP Preamble and PLCP Header are configured.

In the lower section, enabling and disabling of the scrambler, bit interleaver and convolution encoder is possible.

A graph in the lower sections illustrates the structure of the PPDU.



Data Rate - UWB MB-OFDM Selects the data rate of the PSDU.

All data rates defined by the standard are supported. The selection of the PSDU bit rate automatically determines the code rate of the convolutional coder and the subcarrier modulation (see table below).

Data Rate, Mbps	Modulation	Coding Rate
53.3	QPSK	1/3
80	QPSK	1/2
106.7	QPSK	1/3
160	QPSK	1/2
200	QPSK	5/8
320	DCM	1/2
400	DCM	5/8
480	DCM	3/4

Remote-control command:

SOUR:BB:UWBM:PPDU:DRAT DR200M

Modulation - UWB MB-OFDM

Indicates the modulation type. The modulation mode depends on the selected **Data Rate** (see "[Data Rate - UWB MB-OFDM](#)").

Remote-control command:
 SOUR:BB:UWB:PPDU:DRAT DR80M
 BB:UWB:PPDU:MOD?
 Response: 'QPSK'

Data Length - UWB MB-OFDM

Sets the data length of the frame payload of PSDU.
 For standard transport mode (see "[Transport Mode - UWB MB-OFDM](#)"), the minimum data length is 0 bytes.
 For burst transport mode however, the data length cannot be 0, i.e. the minimum data length is 1 byte.

Remote-control command:
 SOUR:BB:UWB:PPDU:DLEN 256

Data Source - UWB MB-OFDM

Selects the data source for the data field.

**All 0
All 1**

0 data or 1 data is internally generated.

Remote-control command:
 SOUR:BB:UWB:PPDU:DATA ONE | ZERO

PNxx

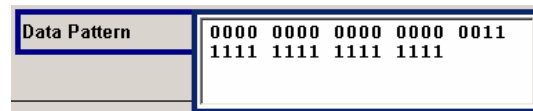
PRBS data in accordance with the IUT-T with period lengths between 2^9-1 and $2^{23}-1$ are internally generated.

Remote-control commands:
 SOUR:BB:UWB:PPDU:DATA PN11

**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:UWB:PPDU:DATA PATT
 SOUR:BB:UWB:PPDU:DATA:PATT #H3F,8

**Data List
...Select Data
List...**

Data lists will be used.

Data lists can be generated internally in the data editor or externally.

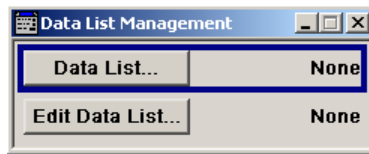
Data lists are selected in the **File Select** window, which is called by means of the **Data List Management** button.

The **File Manager** is used to transmit external data lists to the R&S Signal Generator, and can be called within every File Select window by means of the **File Manager** button.

Remote-control command:
 SOUR:BB:UWB:PPDU:DATA DLIS
 SOUR:BB:UWB:PPDU:DATA:DSEL
 'uwb_list1'

Data List Management... - UWB MB-OFDM

Calls the **Data List Management** menu. This menu is used to create and edit a data list.



All data lists are stored as files with the predefined file extension ***.dm_iqd**. The file name and the directory they are stored in are user-definable.

Remote-control commands:

Note:

*All data lists are generated and edited by means of the **SOURce:BB:DM** subsystem commands. Files containing data lists usually end with ***.dm_iqd**. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.*

Creating and editing the data list:

```
SOUR:BB:DM:DLIS:SEL "d_list1"
SOUR:BB:DM:DLIS:DATA #B1111010101000001111....
SOUR:BB:DM:DLIS:DATA:APP #B1111010101000001111....
```

Selecting the data list:

```
SOUR:BB:UWBM:PPDU:DATA DLIS
SOUR:BB:UWBM:PPDU:DATA:DSEL "uwb_list1"
```

Cover Sequence (Sync.) - UWB MB-OFDM

Selects which cover sequence will be used to spread the packet/frame synchronization sequence of the PLCP preamble. The parameter is automatically set depending on the selection made for the parameter **TF Code**. However, the Cover Sequence is always enabled for re-configuration.

For TF Code 1..10

Standard compliant cover sequence will be used to spread the synchronization sequence of the PLCP preamble (see tables below). Each of the cover sequences can be selected, irrespective of the selected **Band Group**.

The cover sequence for standard preamble is a 24 symbols long sequence. A "+" corresponds to 1 and a "-" to -1 respectively.

For TF Code 1, 2	++++ ++++++ ++++++ ++++++ ++++++ +---
For TF Code 3, 4	++++ ++++++ ++++++ ++++++ +---+ +--+
For TF Code 5,6,7	---- --+ --+ --+ --+ +--+ -+++
For TF Code 8,9,10	+--+ +--+ +--+ +--+ +++++ +---

Table 3 Cover Sequences for Standard Preamble

The cover sequence for burst preamble is a 12 symbols long sequence. A "+" corresponds to 1 and a "-" to -1 respectively.

For TF Code 1, 2	++++ +--- +---
For TF Code 3, 4	++++ +++- +-+
For TF Code 5,6,7	---+ +-+ -+++
For TF Code 8,9,10	++- +--- ++-

Table 4 Cover Sequences for Burst Preamble

If one of the standard compliant cover sequences is selected, the used sequence is displayed as **Standard Preamble** and/or **Burst Preamble**, depending on the selected **Transport Mode**.

Remote-control command:

SOUR:BB:UWBM:PPDU:CSS TFC3

User

The cover sequence can be defined by the user.

Depending on the selected **Transport Mode**, either the **Standard Preamble** and/or the **Burst Preamble** will be enabled for configuration.

Remote-control command:

SOUR:BB:UWBM:PPDU:CSS USER

Standard Preamble - UWB MB-OFDM

Displays the selected cover sequence used to spread the packet/frame synchronization sequence of the PLCP preamble. The standard preamble is a 24 symbols long sequence. A "+" corresponds to 1 and a "-" to -1 respectively. The displayed sequence depends on the selected **Cover Sequence** (see [Table 3](#)).

Note:

*This parameter is configurable only if the parameter **Cover Sequence (Sync.)** is set to User.*

Remote-control command:

SOUR:BB:UWBM:TMOD STAN

SOUR:BB:UWBM:PPDU:CSS USER

SOUR:BB:UWBM:PPDU:SPR "+-+-+-+-+--+--+--+--+--+--+--+--+--+--+"

Burst Preamble - UWB MB-OFDM	<p>Displays the selected cover sequence used to spread the packet/frame synchronization sequence of the PLCP preamble.</p> <hr/> <p>Note: <i>This parameter is enabled only for Burst Transport Mode, Data Rate grater than 200 Mbps and enabled Burst Preamble Used.</i></p> <hr/> <p>The burst preamble is a 12 symbols long sequence. A "+" corresponds to 1 and a "-" to -1 respectively. The displayed sequence depends on the selected Cover Sequence (see Table 4).</p> <hr/> <p>Note: <i>This parameter is configurable only if the parameter Cover Sequence (Sync.) is set to User.</i></p> <hr/> <p>According to the standard, applying a Burst preamble for data rates grater than 200 Mbps is optional. Whether the selected Burst Preamble or a Standard Preamble will be used, can be configured with parameter Burst Preamble Used.</p> <p>Remote-control command: SOUR:BB:UWB:TMOD BURS SOUR:BB:UWB:PPDU:CSS USER SOUR:BB:UWB:PPDU:DRAT DR320M SOUR:BB:UWB:PPDU:BPR:USED ON SOUR:BB:UWB:PPDU:BPR "+-+-+-+-+--"</p>
Burst Preamble Used - UWB MB-OFDM	<p>Enables/disables using of burst preamble.</p> <hr/> <p>Note: <i>This parameter is enabled only for Burst Transport Mode and Data Rate grater than 200 Mbps.</i></p> <hr/> <p>According to the standard, applying a Burst preamble for data rates grater than 200 Mbps is optional. Burst Preamble Used defines whether a burst preamble selected with a combination of the parameters Cover Sequence and Burst Preamble or a selected Standard Preamble will be used.</p> <p>Remote-control command: SOUR:BB:UWB:TMOD BURS SOUR:BB:UWB:PPDU:DRAT DR320M SOUR:BB:UWB:PPDU:BPR:USED OFF</p>
Configure MAC Header... - UWB MB-OFDM	<p>Calls the menu for configuration of the MAC Header.</p> <p>The menu is described in Section MAC Header - UWB MB-OFDM, page 22.</p> <p>Remote-control command: n.a.</p>
Scrambler - UWB MB-OFDM	<p>Activates/deactivates the scrambler.</p> <p>See section "Data Scrambler".</p> <p>Remote-control command: SOUR:BB:UWB:PPDU:SCR OFF</p>

Convolutional Encoder - UWB MB-OFDM

Activates/deactivates the coder.
See section ["Convolutional Encoder"](#).

Remote-control command:
SOUR:BB:UWBM:PPDU:ENC OFF

Bit Interleaver - UWB MB-OFDM

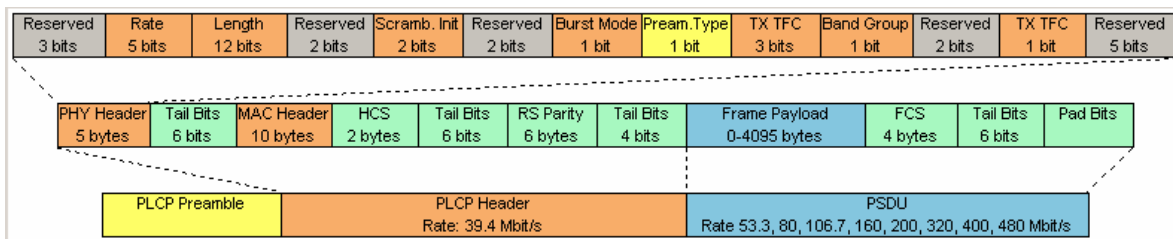
Activates/deactivates the interleaver.
See section ["Bit Interleaving"](#).

Remote-control command:
SOUR:BB:UWBM:PPDU:ILE OFF

PPDU Graph - UWB MB-OFDM

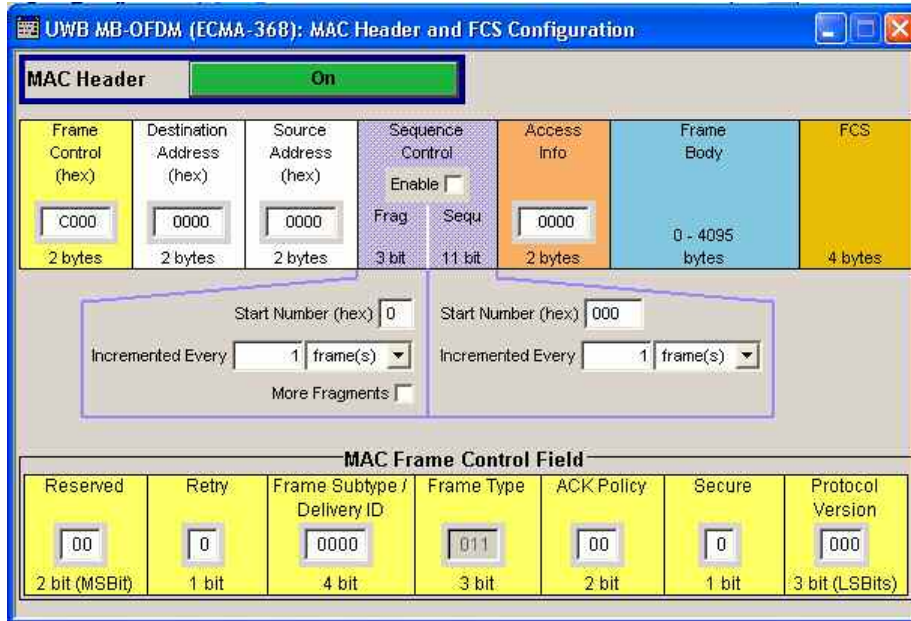
The frame graph in the lower part of the menu indicates the configuration of the PPDU.

A packet contains a PLCP Preamble, PLCP Header and PSDU payload. The general packet structure is described in section ["UWB MB-OFDM Frame Structure and PPDU Format"](#).



MAC Header - UWB MB-OFDM

In the real UWB system, a MAC (medium access control) header is transmitted in the PSDU prior to the actual data section. This header comprises control information of the MAC layer and checksum for protection of the PSDU. In the MAC Header menu, several MAC fields can be configured.



MAC Header - UWB MB-OFDM

Activates/deactivates the generation of the MAC Header for the PSDU.

If the MAC header is deactivated, all the MAC fields are set to 0. If the MAC header is activated, most of the MAC header fields are enabled for operation. Exceptions are the MAC Frame Control Fields. The values of these fields are set automatically depending on the selection made for the parameter **Frame Type** (see "[Frame Type - UWB MB-OFDM](#)").

The individual fields of the MAC header are described in the following.

All values of the MAC fields are entered in hexadecimal form with LSB in right notation. In the data stream, the values are output standard-conformal with the LSB coming first.

Remote-control command:

SOUR : BB : UWBM : PPDU : MAC : SCON : STAT ON

Frame Control (hex) - UWB MB-OFDM

Enters the value of the frame control field.

The Frame control field has a length of 2 bytes (16 bits) and is used to define the protocol version, the frame type, ACK policy, etc.

As an alternative, the individual bits can be set in the lower part of the graph.

MAC Frame Control Field						
Reserved	Retry	Frame Subtype / Delivery ID	Frame Type	ACK Policy	Secure	Protocol Version
00	0	0000	100	00	0	000
2 bit (MSBit)	1 bit	4 bit	3 bit	2 bit	1 bit	3 bit (LSBits)

The value of parameter **Frame Control** is automatically set according to the settings for the **MAC Frame Control Field** and vice versa.

Remote-control command:

```
SOUR:BB:UWB:PPDU:MAC:FCON #H100A,16
```

Reserved - UWB MB-OFDM

Sets the reserved bits.

Remote-control command:

```
SOUR:BB:UWB:PPDU:MAC:FCON:RES #H1,2
```

Retry - UWB MB-OFDM

Sets the Retry bit.

Note:

This parameter is enabled for data, aggregated data and command frames only.

A value of 1 indicates that the current frame is a retransmission of an earlier frame.

Remote-control command:

```
SOUR:BB:UWB:FTYP DATA
SOUR:BB:UWB:PPDU:MAC:FCON:RETR 1
```

Frame Subtype/ Delivery ID - UWB MB-OFDM

Sets the frame Subtype/ Delivery ID bits.

This field is used to assist a receiver in the proper processing of received frames.

Note:

This parameter is not enabled for bacon frames.

For data and aggregated data frames, this field is used as Delivery ID. For control and command frames, this field is used as Frame Subtype.

Value	Frame Subtype
0000	Imm-Ack (Immediate Acknowledgement)
0001	B-ACK (Block Acknowledgement)
0010	RTS (Request to Send)
0011	CTS (Clear to Send)
0100	UDA (Unused DRP Reservation Announcement)
0101	UDR (Unused DRP Reservation Response)
0110 .. 1101	Reserved
1110	Application-specific
1111	Reserved

Table 5 Control Frame Subtypes

Value	Frame Subtype
0000	DRP (Distributed Reservation Protocol) Reservation Request
0001	DRP reservation Response
0010	Probe
0011	Pair-wise Temporal Key (PTK)
0100	Group Temporal Key (GTK)
0101	Range Measurement
0110 .. 1101	Reserved
1110	Application-specific
1111	Reserved

Table 6 Command Frame Subtypes

The value of the Frame Subtype determines the allowed value of **Secure** bit.

Remote-control command:

SOUR:BB:UWB:FTYP CONT

SOUR:BB:UWB:PPDU:MAC:FCON:SUBT #H3,4

Frame Type - UWB MB-OFDM

Displays the value of the frame type bits. This parameter is automatically set depending on the selection made for the parameter **Frame Type**.

Value	Frame Type
000	Beacon Frame
001	Control Frame
010	Command Frame
011	Data Frame
100	Aggregated data frame
101, 110, 111	Reserved

Table 7 Frame Types

Remote-control command:

SOUR:BB:UWB:FTYP AGGR

SOUR:BB:UWB:PPDU:MAC:FCON:TYPE?

Response: '#H4,3'

ACK Policy - UWB MB-OFDM

Sets the ACK Policy bit, i.e. sets the type of acknowledgement requested by the transmitter. Acknowledgement policy is used if a verification of frame delivery is necessary.

Remote-control command:

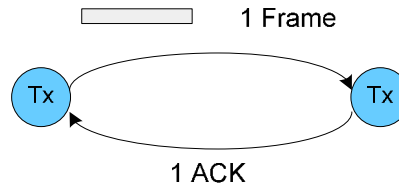
SOUR:BB:UWB:PPDU:MAC:FCON:APOL #H2,2

00

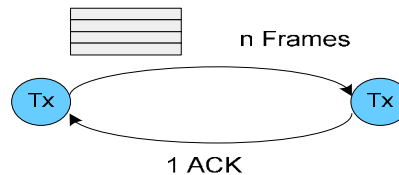
No-ACK Policy is a transmission without acknowledgement. The frames are considered as successfully transmitted. This policy can be used for frames that do not require guaranteed delivery or for delay sensitive frames.



01 Imm-ACK Policy is a transmission with an immediate individual acknowledgement of each frame after correct reception.



10 B(lock)-ACK Policy allows a single-frame acknowledgement of multiple frame transmission. The acknowledgement frame is send after receiving a request (B-ACK Request) from the transmitter.



11 B-ACK Request indicates the last frame of a multiple frame transmission with B-ACK Policy. Upon receiving such a frame, the receiver answers with single frame.

Secure - UWB MB-OFDM

Sets the secure bit.

A value of 1 indicates a secure frame. A Secure frame has special frame payload format and is protected with temporal keys.

The allowed value of the secure bit depends on the **Frame Type** and **Frame Subtype**.

Remote-control command:

SOUR:BB:UWBM:PPDU:MAC:FCON:SEC 1

Protocol Version - UWB MB-OFDM

Enters protocol version.

Protocol Version must be set to 0 to be standard compliant.

Remote-control command:

SOUR:BB:UWBM:PPDU:MAC:FCON:PVER #H0,3

Destination Address (hex) - UWB MB-OFDM

Enters the destination address of the intended receiver.

Receiver can be:

- a single device by unicast transmission
- a group of devices for a multicast transmission or
- all devices in case of broadcast.

The destination address is 2 bytes long. The value is in hexadecimal form.

Remote-control command:

SOUR:BB:UWBM:PPDU:MAC:DADD #H8F5A,16

Source Address (hex) - UWB MB-OFDM

Enters the address of the transmitter.

The source address is 2 bytes long. The value is in hexadecimal form.

Remote-control command:

SOUR:BB:UWBM:PPDU:MAC:SADD #H5A3B,16

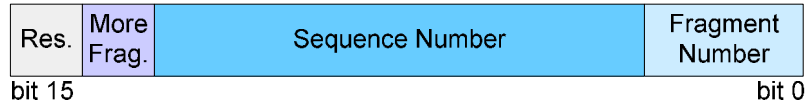
Sequence Control - UWB MB-OFDM

Activates/deactivates the sequence control field.

Note:

Sequence Control is not enabled for control frames.

The sequence control field has a length of 2 bytes and is divided in four parts, the fragment number field (3 bits), the sequence number field (11 bits), the more fragments bit (1 bit) and one reserved bit.



A long user data stream to be transmitted is first split up into MSDUs (MAC Service Data Units) which can either be transmitted as PSDU frames or further divided into fragments. The sequence number and the fragment number are then used to number the individual subpackets of the user data stream to be transmitted. Thus, all PSDUs are assigned a consecutive number. This allows the receiver to arrange the data packets in the correct order, to determine whether an incorrectly transmitted packet was retransmitted and to find out whether packets are missing.

If the receiver can detect a frame without an error and does not request a retransmission, the sequence number is incremented by 1 for each frame (the field is reset to 0 at the latest after a count of 1024). The fragment number field is incremented by 1 when another fragment of the current MPDU is transmitted. The start count for the transmission (normally 0) and the number of frames required to increment the corresponding counter can be defined for both numbers. This is done with the parameters **Start Number** and **Incremented every ... frame(s)** (see below).

Example:

An error-free transmission of 50 frames (no frame retransmission) is to be simulated. The sequence number should be incremented by 1 for each frame. Since no frame is fragmented, the fragment counter can always remain at 0. In this case the following values have to be set:

If it is to be simulated that some frames are received incorrectly or if the response of the receiver should be tested when the same frame arrives several times, the number of frames required to increment the sequence number can be set to 2, for example.

Remote-control command:

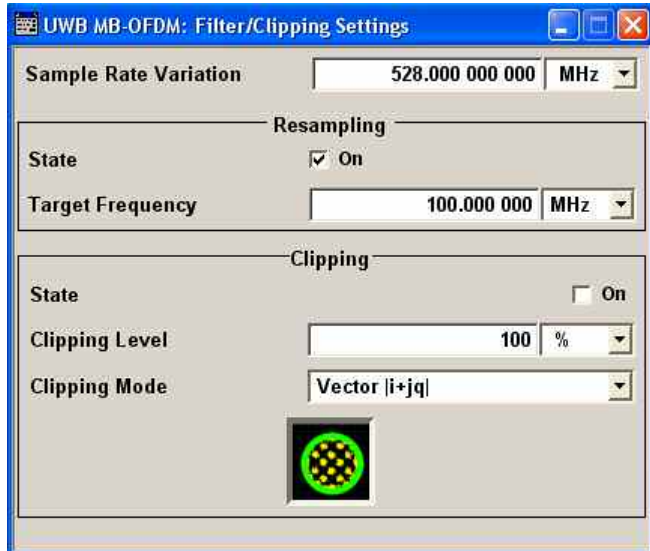
```
SOUR:BB:UWBM:PPDU:MAC:SCON:SEQ:STAT ON
SOUR:BB:UWBM:PPDU:MAC:SCON:FRAG:STAR #H0,1
SOUR:BB:UWBM:PPDU:MAC:SCON:FRAG:INCR 1024
SOUR:BB:UWBM:PPDU:MAC:SCON:FRAG:MORE 0
SOUR:BB:UWBM:PPDU:MAC:SCON:SEQ:STAR #H0,11
SOUR:BB:UWBM:PPDU:MAC:SCON:SEQ:INCR 1
```


Start Number - UWB MB-OFDM	<p>Sets the start number of the fragment bits or the sequence bits of the sequence control (see example above).</p> <p>Remote-control command: SOUR:BB:UWBM:PPDU:MAC:SCON:FRAG:STAR #H0,1 SOUR:BB:UWBM:PPDU:MAC:SCON:SEQ:STAR #HFF,11</p>
Increment Every - UWB MB-OFDM	<p>Defines the number of frames required to increment the counter of the fragment bits or the sequence bits of the sequence control (see example above).</p> <p>Remote-control command: SOUR:BB:UWBM:PPDU:MAC:SCON:FRAG:INCR 2 SOUR:BB:UWBM:PPDU:MAC:SCON:SEQ:INCR 2</p>
More Fragments - UWB MB-OFDM	<p>Enables/disables sending of More Fragments.</p> <p>Disabling of More Fragments sets the value of the bit to 0, i.e. the current fragment is the sole or the final fragment of the current MSDU or MCDU.</p> <p>Enabling of More Fragments sets the value of the More Fragments bit to 1.</p> <p>Remote-control command: SOUR:BB:UWBM:PPDU:MAC:SCON:FRAG:MORE 1</p>
Access Info - UWB MB-OFDM	<p>Sets the access information for the security functions.</p> <p>Remote-control command: SOUR:BB:UWBM:PPDU:MAC:AINF #H1FA5,16</p>
Frame Body - UWB MB-OFDM	<p>Indicates the length of the user data (frame body).</p> <p>Remote-control command: n.a.</p>
FCS - UWB MB-OFDM	<p>Indicates the length of the check sum. The FCS is 4 bytes long that corresponds to a CRC polynomial of degree 31.</p> <p>Remote-control command: n.a.</p>

Clipping - UWB MB-OFDM

The **Clipping...** menu is reached via the UWB MB-OFDM main menu.

The filter type and parameters, the sample rate variation (**Filter** section) and clipping (**Clipping** section) are defined in this menu.



Sample Rate Variation - UWB MB-OFDM

Sets the sample rate of the signal.

A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged.

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

The default sample rate of the UWB MB-OFDM signal is 528 MHz.

Remote-control command:

```
SOUR:BB:UWBM:SRAT:VAR 528 MHz
```

State Resampling - UWB MB-OFDM

Enables/disables resampling of the signal.

Resampling has to be performed to match the waveform's sample rate to the one supported by an instrument.

If the resampling is activated, the software resampler interpolates the waveform to a clock rate of the frequency selected with the parameter **Target Frequency**.

Remote-control command:

```
SOUR:BB:UWBM:RSEM:STAT ON
```

Target Frequency - UWB MB-OFDM

Sets the target frequency for the resampled signal.

The target frequency has to be lower or equal to the maximum clock frequency of the target instrument.

Remote-control command:

```
SOUR:BB:UWBM:RSEM:TF 600MHz
```

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

Clipping State - UWB MB-OFDM

Switches baseband clipping on and off.

Baseband clipping is a very simple and effective way of reducing the crest factor of the UWB MB-OFDM signal.

High crest factors entail two basic problems:

- The nonlinearity of the power amplifier (compression) causes intermodulation which expands the spectrum (spectral regrowth).
- Since the level in the D/A converter is relative to the maximum value, the average value is converted with a relatively low resolution. This results in a high quantization noise.

Both effects increase the adjacent-channel power.

With baseband clipping, all the levels are 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. Since clipping the signal not only changes the peak value but also the average value, the effect on the crest factor is unpredictable.

Remote-control command:

```
SOUR:BB:UWBM:CLIP:STAT ON
```

Clipping Level- UWB MB-OFDM

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:

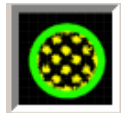
```
SOUR:BB:UWBM:CLIP:LEV 80PCT
SOUR:BB:UWBM:CLIP:STAT ON
```

Clipping Mode - UWB MB-OFDM

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 $|I + jQ|$. The I and Q components are mapped together, the angle is retained.

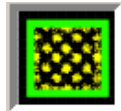


Remote-control command:

```
SOUR:BB:UWBM:CLIP:MODE VECT
```

Scalar $|i| + |q|$

The limit is related to the absolute maximum of all the $|I|$ and $|Q|$ values. The I and Q components are mapped separately, the angle changes.



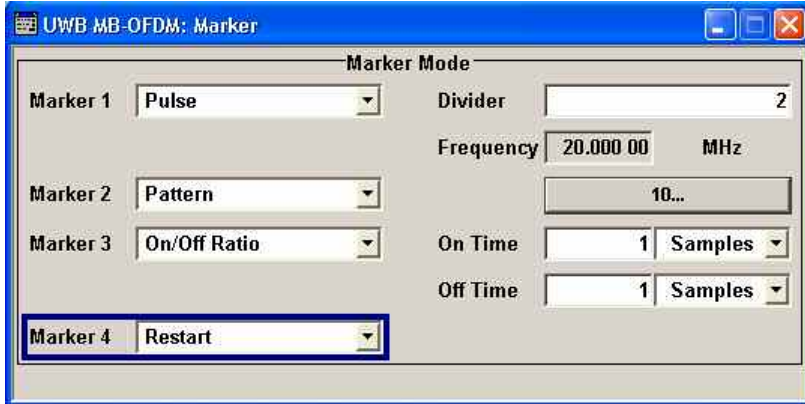
Remote-control command:

```
SOUR:BB:UWBM:CLIP:MODE SCAL
```

Marker... - UWB MB-OFDM

The **Marker...** menu can be reached via the UWB MB-OFDM main menu.

The **Marker Mode** section is where the marker signals at the MARKER output connectors are configured.



Marker x Mode - UWB MB-OFDM Selects a marker signal for the associated MARKER output.

Restart A marker signal is generated at the start of each signal sequence (period = selected number of frames).

Remote-control command:

```
SOUR:BB:UWBM:TRIG:OUTP1:MODE REST
```

Frame Start A marker signal is generated at the start of each frame (period = PPDU).

Remote-control command:

```
SOUR:BB:UWBM:TRIG:OUTP1:MODE FRAM
```

Pulse A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the chip 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:UWBM:TRIG:OUTP1:MODE PULS
SOUR:BB:UWBM:TRIG:OUTP1:PULS:DIV 10
SOUR:BB:UWBM:TRIG:OUTP1:PULS:FREQ?
Response: 4000000
```

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.

A screenshot of a text input field with a blue border. The field contains the text "10".

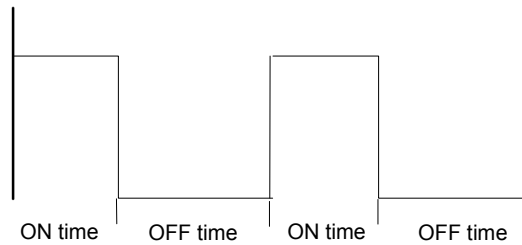
Remote-control commands:

```
SOUR:BB:UWBM:TRIG:OUTP1:MODE PATT
SOUR:BB:UWBM: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



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.

A screenshot of two control fields. The first field is labeled "On Time" and has a value of "1" and a dropdown menu set to "Samples". The second field is labeled "Off Time" and has a value of "1" and a dropdown menu set to "Samples".

Remote-control commands:

```
SOUR:BB:UWBM:TRIG:OUTP1:MODE RAT
SOUR:BB:UWBM:TRIG:OUTP1:OFFT 20
SOUR:BB:UWBM:TRIG:OUTP1:ONT 20
```


SOURce:BB:UWBMB Subsystem Remote-Control Commands

Introduction - UWB MB-OFDM - General Remote-Control Commands

This subsystem contains commands for the primary and general settings of the UWB MB-OFDM standard. These settings concern activation and deactivation of the standard, filter, clipping and marker settings, defining the frame type, the band group and the sequence length, as well as the preset setting.

The commands for defining the frame configuration are described in the next section. The commands are divided up in this way to make the comprehensive SOURce:BB:UWBMB subsystem clearer.

The numerical suffix at SOURce distinguishes between path A and path B for 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.

Command Table - UWBMB

Command	Parameters	Default unit	Comments
Primary commands			
[SOURce<[1]]2>:BB:UWBMB:CLIPping:LEVel	1...100	PCT	
[SOURce<[1]]2>:BB:UWBMB:CLIPping:MODE	VECTor SCALar		
[SOURce<[1]]2>:BB:UWBMB:CLIPping:STATe	ON OFF		
[SOURce<[1]]2>:BB:UWBMB:PRESet			No query
[SOURce<[1]]2>:BB:UWBMB:SETTing:CATalog?			Query only
[SOURce<[1]]2>:BB:UWBMB:SETTing:DELeTe	<file_name>		
[SOURce<[1]]2>:BB:UWBMB:SETTing:LOAD	<file_name>		
[SOURce<[1]]2>:BB:UWBMB:SETTing:STORe	<file_name>		
[SOURce<[1]]2>:BB:UWBMB:SRATe:VARiAtion	400 Hz .. 40 MHz		
[SOURce<[1]]2>:BB:UWBMB:STATe	ON OFF		
[SOURce<[1]]2>:BB:UWBMB:TRIGger:OUTPut<[1]...4>:MODE	REStArT FRAMe PULSe PATTern RATio		
[SOURce<[1]]2>:BB:UWBMB:TRIGger:OUTPut<[1]...4>:OFFTime	2 ... (2 ²⁴ - 1) chips		
[SOURce<[1]]2>:BB:UWBMB:TRIGger:OUTPut<[1]...4>:ONTIME	2 ... (2 ²⁴ - 1) chips		
[SOURce<[1]]2>:BB:UWBMB:TRIGger:OUTPut<[1]...4>:PATTern	#B0,1...#B111...1,32		
[SOURce<[1]]2>:BB:UWBMB:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 1024		
[SOURce<[1]]2>:BB:UWBMB:TRIGger:OUTPut<[1]...4>:PULSe:FREQUency			Query only
[SOURce<[1]]2>:BB:UWBMB:WAVeform:CREate			No query
General Commands			

Command	Parameters	Default unit	Comments
[SOURCE<[1]]2>:BB:UWBMb:BGRoup	BG1 BG2 BG3 BG4 BG5 BG6		
[SOURCE<[1]]2>:BB:UWBMb:FTYPE	DATA BEACon CONTrol COMMand AGGRegated		
[SOURCE<[1]]2>:BB:UWBMb:HSEQUence	<sequence of 6 integer values>		
[SOURCE<[1]]2>:BB:UWBMb:HSEQUence:USER[STATE]	ON OFF		
[SOURCE<[1]]2>:BB:UWBMb:IFS:TYPE	SIFS MIFS USER		
[SOURCE<[1]]2>:BB:UWBMb:IFS:VALue	0 ... 99	Symbols	
[SOURCE<[1]]2>:BB:UWBMb:SLENgth	1... 1000	Frames	
[SOURCE<[1]]2>:BB:UWBMb:TFCCode	TFC1 TFC2 TFC3 TFC4 TFC5 TFC6 TFC7 TFC8 TFC9 TFC10		
[SOURCE<[1]]2>:BB:UWBMb:TMODE	BURSt STANdard		
[SOURCE<[1]]2>:BB:UWBMb:Version			Query only
PPDU Settings			
[SOURCE<[1]]2>:BB:UWBM:PPDU:BPREamble	<pattern>		
[SOURCE<[1]]2>:BB:UWBM:PPDU:BPREamble:USED	ON OFF		
[SOURCE<[1]]2>:BB:UWBM:PPDU:CSSync	TFC1 TFC2 TFC3 TFC4 TFC5 TFC6 TFC7 TFC8 TFC9 TFC10 USER		
[SOURCE<[1]]2>:BB:UWBM:PPDU:DATA	PN9 PN11 PN15 PN16 PN20 PN21 PN23 DLISt ZERO ONE PATtern		
[SOURCE<[1]]2>:BB:UWBM:PPDU:DATA:DSElect	<dlist_name>		
[SOURCE<[1]]2>:BB:UWBM:PPDU:DATA:PATtern	<bit pattern>		
[SOURCE<[1]]2>:BB:UWBM:PPDU:DLENgth	0 (standard transport mode) / 1 (burst transport mode) ... 4095	bytes	
[SOURCE<[1]]2>:BB:UWBM:PPDU:DRAtE	DR53M3 DR80M DR106M7 DR160M DR200M DR320M DR400M DR480M		
[SOURCE<[1]]2>:BB:UWBM:PPDU:ENCOder:STATe	ON OFF		
[SOURCE<[1]]2>:BB:UWBM:PPDU:ILEAver:STATe	ON OFF		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:AINFO>	#H0000,16 #HFFFF,16		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:DADdress	#H0000,16 #HFFFF,16		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol	#H0000,16 ... #HFFFF,16		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol:APOLicy	#H0,2 ... #H3,2		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol:PVERsion	#H0,3 ... #H7,3		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol:RETRy	0 1		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol:SECure	0 1		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol:SUBType	#H0,4 ... #HF,4		
[SOURCE<[1]]2>:BB:UWBM:PPDU:MAC:FCONtrol:TYPE	#H0,3 ... #H7,3		

Command	Parameters	Default unit	Comments
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:SADDRESS	#H0000,16 #HFFFF,16		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:SCONTROL:FRAGMENT:INCREMENT	0 ... 1024		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:SCONTROL:FRAGMENT:MORE	0 1		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:SCONTROL:FRAGMENT:START	#H0,1 ... #H7,1		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:SCONTROL:SEQUENCE:INCREMENT	0 ... 1024		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:SCONTROL:SEQUENCE:START	#H0,11 ... #H7FF,11		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:STATE	ON OFF		
[SOURCE<[1]>:]BB:UWBM:PPDU:MAC:STATE	ON OFF		
[SOURCE<[1]>:]BB:UWBM:PPDU:MODULATION	QPSK DCM		Query only
[SOURCE<[1]>:]BB:UWBM:PPDU:SCRAMBLERR:STATE	ON OFF		
[SOURCE<[1]>:]BB:UWBM:PPDU:SPREAMBLE	<pattern>		

[SOURCE<[1]>:]BB:UWBMb:BGRoup BG1 | BG2 | BG3 | BG4 | BG5 | BG6

Selects the band group for which a signal will be generated.

Example: BB:UWBM:BGR BG2
'sets the band group 2.

*RST value	Resolution	SCPI
BG1	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:CLIPping:LEVel 0 ... 100 PCT

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 SOUR:BB:UWBM:CLIP:STAT ON

Example: BB:UWBM:CLIP:LEV 80PCT
'sets the limit for level clipping to 80% of the maximum level.
BB:UWBM:CLIP:STAT ON
'activates level clipping.

*RST value	Resolution	SCPI
100 PCT	1	Device-specific

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

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:UWBMB:CLIP:MODE SCAL
'selects the absolute maximum of all the I and Q values as the reference level.

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

BB:UWBMB:CLIP:STAT ON
'activates level clipping.

*RST value	Resolution	SCPI
VECTor	-	Device-specific

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

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

Example: BB:UWBMB:CLIP:STAT ON
'activates level clipping.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:UWBMB:FTYPe DATA | BEACon | CONTrol | COMMand | AGGRegate

Selects the frame type of the generated signal.

Parameters: **DATA**

Frames containing useful data.

BEACon

Beacons are used for synchronization to a shared channel.

CONTrol

Control frames will be generated.

COMMand

Command frames will be generated.

AGGRegate

Aggregated frames will be generated. The payload of these frames contains an aggregation header and multiple MSDUs (MAC service data units).

Example: BB:UWBMB:FTYP CONTR
'sets the frame type to control.

*RST value	Resolution	SCPI
DATA	-	Device-specific

[SOURCE<[1]|2>:]BB:UWBMb:HSEQuence <sequence of 6 integer values>

Sets a user defined hopping sequencel.

Example:

```
BB:UWBM:HSEQ:USER:STAT ON
    'enables deffining of user hopping sequence.

BB:UWBM:BGR BG1
    'selects the band group the hopping sequene will be deffined for.

BB:UWBM:HSEQ 1,2,3,1,2,3
    'enables deffining of user hopping sequence.
```

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]|2>:]BB:UWBMb:HSEQuence:USER[:STATe] ON | OFF

Enables/disables defining of user hopping sequencel.

Example:

```
BB:UWBM:HSEQ:USER:STAT ON
    'enables deffining of user hopping sequence.

BB:UWBM:BGR BG1
    'selects the band group the hopping sequene will be deffined for.

BB:UWBM:HSEQ 1,2,3,1,2,3
    'enables deffining of user hopping sequence.
```

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]|2>:]BB:UWBMb:IFS:TYPE SIFS | MIFS | USER

Selects the frame type of the inter frame spacing interval.

Example:

```
BB:UWBM:TMOD BURS
    'sets the transmission mode to burst.

BB:UWBM:IFS:TYPE MIFS
    'sets the inter frame spacing type to MIFS.

BB:UWBM:IFS:VAL?
    'queries the duration of the inter frame spacing interval.

Response: '6'
```

*RST value	Resolution	SCPI
SIFS	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:IFS:VALue 0..99

Sets the duration in symbols of the inter frame spacing interval.

Example: BB:UWBM:IFS:TYPE MIFS
 'sets the inter frame spacing type to MIFS.
 BB:UWBM:IFS:VAL?
 'queries the duration of MIFS.
 Response: '6'
 BB:UWBM:IFS:TYPE SIFS
 'sets the inter frame spacing type to SIFS.
 BB:UWBM:IFS:VAL?
 'queries the duration of SIFS.
 Response: '32'
 BB:UWBM:IFS:TYPE USER
 'sets the inter frame spacing type to User.
 BB:UWBM:IFS:VAL 10
 'sets the inter frame spacing duration to 10 symbols.

*RST value	Resolution	SCPI
32 (for SIFS) 6 (for MIFS)	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:PRESet

Produces a standardized default for the UWB MB-OFDM standard. The settings correspond to the *RST values specified for the commands.

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

Example: BB:UWBM:PRESet
 'resets all the UWB MB-OFDM settings to default values.

*RST value	Resolution	Dependencies	SCPI
-	-	All UWB MB-OFDM settings are preset. An overview is provided by Table in section "General Settings for UWB MB-OFDM"	Device-specific

[SOURCE<[1]>:]BB:UWBMb:SETTING:CATalog?

Reads out the files with UWB MB-OFDM settings 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 read. Only files with the file extension *.uwb will be listed.

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

Example: MMEM:CDIR 'D:\user\uwb'
 'sets the default directory to D:\user\uwb.
 BB:UWBM:SETT:CAT?
 'reads out all the files with UWB MB-OFDM settings in the default directory.
 Response: 'uwb_1', 'uwb_2'
 'the files 'uwb_1' and 'uwb_2' are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:SETTING:DELETE <file_name>

Deletes the selected file with UWB MB-OFDM 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 `*.uwb` will be deleted.

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

Example: `BB:UWBMB:SETT:DEL 'uwb_2'`
`'deletes file 'uwb_3'.`

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:SETTING:LOAD <file_name>

Loads the selected file with UWB MB-OFDM 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 `*.uwb` will be loaded.

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

Example: `BB:UWBMB:SETT:LOAD 'uwb_1'`
`'loads file 'uwb_1'.`

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:SETTING:STORE <file_name>

Stores the current UWB MB-OFDM 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. UWB MB-OFDM settings are stored as files with the specific file extensions `*.uwb`.

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

Example: `BB:UWBMB:SETT:STOR 'uwb_3'`
`'stores the current settings into file 'uwb_3'.`

*RST value	Resolution	SCPI
	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:SLENGTH 1 ... 1000 frames

Selects the number of frames.

Example: `BB:UWBMB:SLEN 4`
`'selects the generation of 4 frames.`

*RST value	Resolution	SCPI
1	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:SRATe:VARiation 400 Hz .. 40 MHz

Sets the sample rate of the signal.

A variation of this parameter only affects the ARB clock rate; all other signal parameters remain unchanged.

Example: BB:UWBM:SRAT:VAR 4 MHz
 'sets the sample rate of the signal to 4 MHz.

*RST value	Resolution	SCPI
40 MHz	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:STATe ON | OFF

Activates modulation in accordance with the UWB MB-OFDM standard. Activating this standard deactivates all the other digital standards and digital modulation modes (in case of two-path instruments, this affects the same path).

Example: BB:UWBM:STAT ON
 'activates modulation in accordance with the UBW MB-OFDM standard.

*RST value	Resolution	Dependencies	SCPI
OFF	-	BB:UWBM:STAT ON deactivates the other standards and digital modulation.	Device-specific

[SOURCE<[1]>:]BB:UWBMb:TFCCode TFC1 | TFC2 | TFC3 | TFC4 | TFC5 | TFC6 | TFC7| TFC8 | TFC9 | TFC10

Selects the time-frequency code (TF Code) of the generated signal.

Note:

For band group 5 (BB:UWBM:BGR BG5) only TFC5, TFC6, TFC8 and User are allowed.

Example: BB:UWBM:BGR BG5
 'sets the band group of the generated signal to 5.
 BB:UWBM:TFC TFC5
 'sets the time-frequency code of the generated signal to TF Code 5.

*RST value	Resolution	SCPI
TFC1	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:TMODE BURSt | STANdard

Selects the transport mode of the signal.

Example: BB:UWBM:TMOD BURS
 'sets the transport mode of the generated signal to Burst.

*RST value	Resolution	SCPI
STAN	-	Device-specific

[SOURce<[1]|2>:]BB:UWBMB:TRIGger:OUTPut<[1]...4>:MODE
 REStart | FRAMe | PULSe | PATTern | RATio

Defines the signal for the selected marker output.

Parameters: **REStart**

A marker signal is generated at the start of each signal sequence (period = selected number of frames; the sequence length is set with command `SOUR:BB:UWBMB:SLen`).

FRAMe

A marker signal is generated at the start of each frame (period = PPDU).

PATTern

A marker signal is generated according to the user defined pattern (command `SOURce:BB:UWBMB:TRIGger:OUTPut:PATTern`).

PULSe

A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:BB:UWBMB:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:UWBMB:TRIG:OUTP:PULSe:FREQuency?` command.

RATio

A marker signal corresponding to the Time Off / Time On specifications in the commands `SOURce:BB:UWBMB:TRIGger:OUTPut:OFFT` and `SOURce:BB:UWBMB:TRIGger:OUTPut:ONT` is generated.

Example:

```
BB:UWBMB:TRIG:OUTP2:MODE FRAM
'selects the frame marker signal on output MARKER 2.
```

*RST value	Resolution	SCPI
REStart	-	Device-specific

[SOURce<[1]|2>:]BB:UWBMB:TRIGger:OUTPut<[1]...4>:OFFTime 1.. 2²⁴ - 1 (1..16 777 215)
 chips

Sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:UWBMB:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example:

```
BB:UWBMB:TRIG:OUTP2:MODE FRAM
'selects a ratio marker signal on output MARKER 2.

BB:UWBMB:TRIG:OUTP2:OFFT 200
'sets an OFF time of 200 samples for marker signal 2.
```

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>:]BB:UWBMB:TRIGger:OUTPut<[1]...4>:ONTime 1.. 2²⁴ - 1 (1..16 777 215) chips

Sets the number of samples in a period (ON time + OFF time) during which the marker signal in setting SOURce:BB:UWBMB:TRIGger:OUTPut:MODE RATio on the marker outputs is ON.

Example:
 BB:UWBMB:TRIG:OUTP2:MODE FRAM
 'selects a ratio marker signal on output MARKER 2.
 BB:UWBMB:TRIG:OUTP2:ONT 200
 'sets an ON time of 200 chips for marker 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>:]BB:UWBMB:TRIGger:OUTPut<[1]...4>:PATtern #B0,1 ... #B111...1, 2

Defines the bit pattern used to generate the marker signal in the setting SOURce:BB:UWBMB:TRIGger:OUTPut:MODE PATtern. 0 is marker off, 1 is marker on.

Example:
 BB:UWBMB:TRIG:OUTP2:PATT #B000000011111111,15
 'sets a bit pattern.
 BB:UWBMB: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:UWBMB:TRIGger:OUTPut<[1]...4>:PULSe:DIVider 2 ... 2¹⁰

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

Example:
 BB:UWBMB:TRIG:OUTP2:PULS:DIV 10
 'sets the divider to 2 for the marker signal on output MARKER 2.
 BB:UWBMB:TRIG:OUTP2:FREQ?
 'queries the resulting pulse frequency of the marker signal.
 Response: '4 000 000'
 'the resulting pulse frequency is 4 MHz.

*RST value	Resolution	SCPI
2	1	Device-specific

[SOURce<[1]2>:]BB:UWBMb:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency?

Queries the pulse frequency of the pulsed marker signal in the setting SOURce:BB:UWBMb: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:UWBM:TRIG:OUTP2:PULS:DIV 2
 'sets the divider marker signal on output MARKER 2 to the value 2.
 BB:UWBM:TRIG:OUTP2:MODE PULS
 'enables the pulsed marker signal.
 BB:UWBM:TRIG:OUTP2:PULS:FREQ?
 'queries the pulse frequency of the marker signal.
 Response: '20 000 000'
 'the resulting pulse frequency is 20 MHz.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]2>:]BB:UWBMb:VERSion?

The command queries the version of the WB MB-OFDM standard underlying the definitions

The command is a query command and therefore does not have an *RST value. The numerical suffix at SOURce has no significance for this command and should not be specified.

Example:
 BB:UWBM:VERS?
 'queries the UWB MB-OFDM version.
 Response: '1st Edition, Dec. 2005'
 'The version used is the 1st Edition, Dec. 2005

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]2>:]BB:UWBMb:WAVeform:CREate <file_name>

Creates a waveform using the current settings of the **UWV MB-OFDM** 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:
 BB:UWBM:STAT ON
 'activates modulation in accordance with the UBW MB-OFDM standard.
 MMEM:CDIR 'D:\user\waveform'
 'sets the default directory to D:\user\waveform.
 BB:UWBM:WAV:CRE 'uwb_1'
 'creates the waveform file uwv_1.wv in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

SOURce-UWBMB – PPDU Settings

The SOURce:BB:UWBMB:PPDU system contains commands for setting the characteristics of the data packet on the physical layer (PPDU).

Command	Parameters	Default unit	Comments
[SOURce<[1]]2>:]BB:UWBMB:PPDU:BPRamble	<pattern>		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:BPRamble:USED	ON OFF		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:CSSync	TFC1 TFC2 TFC3 TFC4 TFC5 TFC6 TFC7 USER		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:DATA	PN9 PN11 PN15 PN16 PN20 PN21 PN23 DLISt ZERO ONE PATtern		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:DATA:DSElect	<dlist_name>		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:DATA:PATtern	<bit pattern>		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:DLEngh	0 (standard transport mode) / 1 (burst transport mode) ... 4095	bytes	
[SOURce<[1]]2>:]BB:UWBMB:PPDU:DRate	DR53M3 DR80M DR106M7 DR160M DR200M DR320M DR400M DR480M		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:ENCOder:STATe	ON OFF		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:ILEaver:STATe	ON OFF		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:AINFO>	#H0000,16 #HFFFF,16		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:DADDRESS	#H0000,16 #HFFFF,16		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol	#H0000,16 ... #HFFFF,16		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol:APOLicy	#H0,2 ... #H3,2		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol:PVERsion	#H0,3 ... #H7,3		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol:RETRy	0 1		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol:SECure	0 1		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol:SUBType	#H0,4 ... #HF,4		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:FCONtrol:TYPE	#H0,3 ... #H7,3		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SADDRESS	#H0000,16 #HFFFF,16		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SCONtrol:FRAGment:INCRement	0 ... 1024		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SCONtrol:FRAGment:MORE	0 1		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SCONtrol:FRAGment:STARt	#H0,1 ... #H7,1		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SCONtrol:SEQUence:INCRement	0 ... 1024		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SCONtrol:SEQUence:STARt	#H0,11 ... #H7FF,11		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:SCONtrol:STATe	ON OFF		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MAC:STATe	ON OFF		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:MODulation	QPSK DCM		Query only
[SOURce<[1]]2>:]BB:UWBMB:PPDU:SCRambler:STATe	ON OFF		
[SOURce<[1]]2>:]BB:UWBMB:PPDU:SPRamble	<pattern>		

[SOURCE<[1]2>:]BB:UWBMb:PPDU:BPRreamble <pattern>

Selects the burst preamble. The burst preamble is a 12 symbols long sequence. A "+" corresponds to 1 and a "-" to -1 respectively.

Note:

This parameter is enabled for configuration only for Cover Sequence set to User, Burst Transport Mode, Data Rate greater than 200 Mbps and enabled Burst Preamble. For Cover Sequence set to one of the standard compliant sequences, burst preamble is read-only.

Example:

```
BB:UWBM:TMOD BURS
'selects burst transport mode.

BB:UWBM:PPDU:CSS TFC3
'sets the packet/frame synchronization cover sequence to TFC3.

BB:UWBM:PPDU:BPR?
'queries the burst preamble.

Response: '+++++++--+-'

BB:UWBM:PPDU:CSS USER
'sets the packet/frame synchronization cover sequence to user-defined.

BB:UWBM:PPDU:DRAT DR320M
'sets the data rate to 320 Mbps.

BB:UWBM:PPDU:BPR:USED ON
'enables using the burst preamble.

BB:UWBM:PPDU:BPR "+-+-+-+-+-"
'sets the burst preamble to '+-+-+-+-'.
```

*RST value	Resolution	SCPI
+++++++--	-	Device-specific

[SOURCE<[1]2>:]BB:UWBMb:PPDU:BPRreamble:USED ON | OFF

Enables/disables using of burst preamble.

Note:

This parameter is enabled only for Burst Transport Mode and Data Rate greater than 200 Mbps.

Example:

```
BB:UWBM:TMOD BURSt
'selects burst transport mode.

BB:UWBM:PPDU:DRAT DR320M
'sets the data rate to 320 Mbps.

BB:UWBM:PPDU:BPR:USED OFF
'enables using the burst preamble.
```

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:CSSync TFC1 | TFC2 | TFC3 | TFC4 | TFC5 | TFC6 | TFC7 | TFC8 | TFC9 | TFC10 | USER

Selects which cover sequence will be used to spread the packet/frame synchronization sequence of the PLCP preamble.

Example: BB:UWBMB:PPDU:CSSync TFC3
'sets the packet/frame synchronization cover sequence to TFC3.

*RST value	Resolution	SCPI
TFC1	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:DATA PN9 | PN11 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | ZERO | ONE | PATtern

Determines the data source for the data field.

Parameters: **PNxx** The pseudo-random sequence generator is used as the data source. Different random sequence lengths can be selected.

DLISt A data list is used. The data list is selected with the command BB:UWBMB:PPDU:DATA:DSElect.

ZERO | ONE Internal 0 and 1 data is used.

PATtern Internal data is used. The bit pattern for the data is defined by the command BB:UWBMB:PPDU:DATA:PATtern.

Example: BB:UWBMB:PPDU:DATA PATT
'selects as the data source for the data fields of burst 0, the bit pattern defined with the following command.
BB:UWBMB:PPDU:DATA:PATT #H3F,8
'defines the bit pattern.

*RST value	Resolution	SCPI
PN9	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:DATA:DSElect <data list name>

Selects the data list for the DLISt data source selection.

The lists are stored as files with the fixed file extensions *.dm_iqd in a directory of the user's choice. The directory applicable to the following commands is defined with the command MMEMoRY:CDIR. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Example: BB:UWBMB:PPDU:DATA DLIS
'selects the Data Lists data source.
MMEMoRY:CDIR 'D:\Lists\DM\IqData'
'selects the directory for the data lists.
BB:UWBMB:PPDU:MAC:DATA:DSEL 'uwb_list1'
'selects file 'uwb_list1' as the data source. This file must be in the directory D:\Lists\DM\IqData and have the file extension *.dm_iqd.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:DATA:PATTERN <bit pattern>

Determines the bit pattern for the PATTERN selection. The maximum length is 64 bits.

Example: BB:UWBMB:PPDU:DATA PATT
'selects as the data source for the data fields of burst 0, the bit pattern defined with the following command.

BB:UWBMB:PPDU:MAC:DATA:PATT #H3F,8
'defines the bit pattern.

*RST value	Resolution	SCPI
0	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:DLENGTH 0 (standard transport mode) / 1 (burst transport mode) ... 4095 Bytes

Sets the data length in bytes.

Example: BB:UWBMB:PPDU:DLEN 256
'sets a data length of 256.

*RST value	Resolution	SCPI
2048	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:DRATE DR53M3 | DR80M | DR106M7 | DR160M | DR200M | DR320M | DR400M | DR480M

Selects the data rate of the PSDU. The selection of the PSDU bit rate automatically determines the code rate of the convolutional coder and the subcarrier modulation.

Example: BB:UWBMB:PPDU:DRAT DR320M
'sets a data rate to 320 Mbps.

*RST value	Resolution	SCPI
200	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:ENCODER:STATE ON | OFF

Activates/deactivates the coder.

Example: BB:UWBMB:PPDU:ENC OFF
'deactivates the coder.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:ILEaver:STATE ON | OFF

Activates/deactivates the interleaver.

Example: BB:UWBMB:PPDU:ILE OFF
'deactivates the interleaver.'

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:AINFO #H0000,16 #HFFFF,16

Sets the access information for security functions.

The destination address is 2 bytes long.

Example: BB:UWBMB:PPDU:MAC:AINFO #H1FA5,16
'set the access information to 'H1FA5,16.'

*RST value	Resolution	SCPI
#H0000,16		Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:DADDRESS #H0000,16 #HFFFF,16

Enters the destination address of the intended receiver.

The destination address is 2 bytes long. The value is in hexadecimal form.

Example: BB:UWBMB:PPDU:MAC:DADDRESS #H8F5A,16
'set the value for the destination address.'

*RST value	Resolution	SCPI
#H0000,16		Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:FCONTROL #H0000,16 ... #HFFFF,16

Enters the value of the frame control field. The Frame control field has a length of 2 bytes (16 bits) and is used to define the protocol version, the frame type, etc.. As an alternative, the individual bits can be set.

Example: BB:UWBMB:PPDU:MAC:FCONTROL #H100A,16
'sets the value of the frame control field.'

*RST value	Resolution	SCPI
#HC000,16		Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:FCONTROL:APOLICY #H0,2 ... #H3,2

Sets the ACK Policy bit, i.e. sets the type of acknowledgement requested by the transmitter.

Acknowledgement policy is used if a verification of frame delivery is necessary.

The ACK Policy field has a length of 2 bits.

Example: BB:UWBMB:PPDU:MAC:FCONTROL:APOLICY #H2,2
'sets the acknowledgement type to Block-ACK.'

*RST value	Resolution	SCPI
#H0,2		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:FCONtrol:PVERsion #H0,3 ... #H7,3

Enters protocol version.
 The Protocol Version field has a length of 3 bits. Protocol Version must be set to 0 to be standard compliant.

Example: BB:UWBM:PPDU:MAC:FCON:PVER #H1,3
 'sets the value of the Protocol Version field.

*RST value	Resolution	SCPI
#H0,3		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:FCONtrol:REServed #H0,2 ... #H3,2

Sets the reserved bits.
 The Reserved field has a length of 2 bits.

Example: BB:UWBM:PPDU:MAC:FCON:RES #H1,2
 'sets the value of the Reserved field.

*RST value	Resolution	SCPI
#H0,2		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:FCONtrol:RETRY 0 | 1

Sets the Retry bit.

Note:
This parameter is enabled for data, aggregated data and command frames only.

A value of 1 indicates that the current frame is a retransmission of an earlier frame.

The Retry field has a length of 1 bit.

Example: BB:UWBM:FTYP DATA
 'sets the frame type to data.
 BB:UWBM:PPDU:MAC:FCON:RETR 1
 'sets the value of the Retry field to 1, i.e. the current frame is a retransmission of an earlier frame.

*RST value	Resolution	SCPI
0		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:FCONtrol:SECure 0 | 1

Sets the secure bit.

A value of 1 indicates a secure frame. The Secure field has a length of 1 bit.

Example: BB:UWBM:PPDU:MAC:FCON:SEC 1
 'sets the value of the Secure field to 1, i.e. the current frame is a secure frame.

*RST value	Resolution	SCPI
0		Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:FCONTROL:SUBTYPE #H0,4 .. #HF,4

Sets the frame Subtype/ Delivery ID bits.
 This field is used to assist a receiver in the proper processing of received frames.

Note:
This parameter is not enabled for bacon frames.

For data and aggregated data frames, this field is used as Delivery ID.
 For control and command frames, this field is used as Frame Subtype.

The Frame Subtype/ Delivery ID field has a length of 4 bits.

Example:
 BB:UWBMB:FTYP CONT
 'sets the frame type to control.
 BB:UWBMB:PPDU:MAC:FCON:SUBT #H3,4
 'sets the frame subtype to CTS (Clear to Send).

BB:UWBMB:FTYP COMM
 'sets the frame type to control.
 BB:UWBMB:PPDU:MAC:FCON:SUBT #H3,4
 'sets the frame subtype to PTK (Pair-wise Temporal Key).

*RST value	Resolution	SCPI
#H0,4	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:FCONTROL:TYPE?

Queries the frame type set with the command BB:UWBMB:FTYPE.

The Frame Type (Frame Control) field has a length of 3 bits.

Example:
 BB:UWBMB:FTYP AGGR
 'sets the frame type to aggregated.
 BB:UWBMB:PPDU:MAC:FCON:TYPE?
 'queries the frame type.
 Response: '#H4,3'

*RST value	Resolution	SCPI
#H3,3	-	Device-specific

[SOURCE<[1]>:]BB:UWBMB:PPDU:MAC:SADDRESS #H0000,16 #HFFFF,16

Enters the address of the transmitter.

The source address is 2 bytes long. The value is in hexadecimal form.

Example:
 BB:UWBMB:PPDU:MAC:SADD #H5A3B,16
 'set the value for the destination address.

*RST value	Resolution	SCPI
#H0000,16		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:SCONtrol:FRAGment:INCRement 0 ... 1024

Defines the number of packets required to increment the counter of the fragment bits of the sequence control.

Example: BB:UWBM:PPDU:MAC:SCON:FRAG:INCR 2
 'two packets are required to increment the counter of the fragment bits.

*RST value	Resolution	SCPI
1		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:SCONtrol:FRAGment:MORE 0 | 1

Enables/disables sending of More Fragments.

Example: BB:UWBM:PPDU:MAC:SCON:FRAG:MORE 0
 'current fragment is the sole or the final fragment of the current MSDU or MCDU.

*RST value	Resolution	SCPI
0		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:SCONtrol:FRAGment:STARt #H0,1 ... #H7,1

Enters the start number of the fragment bits of the sequence control.

Example: BB:UWBM:PPDU:MAC:SCON:FRAG:STAR #H4,1
 'sets the start value of the fragment bits of the sequence control.

*RST value	Resolution	SCPI
#H0,1		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:SCONtrol:SEQuence:INCRement 0 ... 1024

Defines the number of packets required to increment the counter of the sequence bits of the sequence control.

Example: BB:UWBM:PPDU:MAC:SCON:SEQ:INCR 2
 'two packets are required to increment the counter of the sequence bits.

*RST value	Resolution	SCPI
1		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:SCONtrol:SEQuence:STARt #H0,11 ... #HFFF,11

Enters the start number of the fragment bits of the sequence control.

Example: BB:UWBM:PPDU:MAC:SCON:SEQ:STAR #HFF,11
 'sets the start value of the sequence bits of the sequence control.

*RST value	Resolution	SCPI
#H0,12		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:SCONtrol:SEQuence:STATe ON | OFF

Activates/deactivates the sequence control field.

Note:

Sequence Control is not enabled for control frames.

Example:

BB:UWBM:PPDU:MAC:SCON:SEQ:STAT ON
'activates sequence control field.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:MAC:STATe ON | OFF

Activates/deactivates the generation of the MAC Header.

Example:

BB:UWBM:PPDU:MAC:SCON:STAT ON
'activates the generation of the MAC Header.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURCE<[1]>:]BB:UWBM:PPDU:MODulation?

Queries the modulation type. The modulation mode depends on the selected PSDU data rate. (SOURCE:BB:UWBM:PPDU:DRAT).

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

Example:

BB:UWBM:PPDU:DRAT DR80M
'sets a data rate to 80 Mbps

BB:UWBM:PPDU:MOD?
'queries the modulation mode.

Response: "QPSK"

BB:UWBM:PPDU:DRAT DR320M
'sets a data rate to 320 Mbps

BB:UWBM:PPDU:MOD?
'queries the modulation mode.

Response: "DCM"

*RST value	Resolution	SCPI
-		Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:SCRamble:STATe ON | OFF

Activates/deactivates the scrambler.

Example: BB:UWBM:PPDU:SCR OFF
 'deactivates the scrambler.'

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURCE<[1]>:]BB:UWBMb:PPDU:SPReamble <pattern>

Selects the standards preamble. The standard preamble is a 24 symbols long sequence. A "+" corresponds to 1 and a "-" to -1 respectively.

Note:

*This parameter is enabled for configuration only for Cover Sequence set to User.
 For Cover Sequence set to one of the standard compliant sequences, standard preamble is read-only.*

Example:

BB:UWBM:TMOD STAN
 'selects standard transport mode.'

BB:UWBM:PPDU:CSS TFC3
 'sets the packet/frame synchronization cover sequence to TFC3.'

BB:UWBM:PPDU:SPR?
 'queries the standard preamble.'

Response: '+++++++-----+-'

BB:UWBM:PPDU:CSS USER
 'sets the packet/frame synchronization cover sequence to user-defined.'

BB:UWBM:PPDU:SPR "++++-----"
 'sets the standard preamble to '++++-----'.'

*RST value	Resolution	SCPI
+++++++-----	-	Device-specific

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

Enables/disables resampling of the signal.

Resampling has to be performed to match the waveform's sample rate to the one supported by an instrument.

If the resampling is activated, the software resampler interpolates the waveform to a clock rate of the frequency selected with the command `BB:UWBM:RES:TF`.

Example: `BB:UWBM:RES:STAT ON`
'enables resampling.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>:]BB:UWBMb:RESampling:TF 100 MHz .. 600 MHz

Sets the target frequency for the resampled signal.

The target frequency has to be lower or equal to the maximum clock frequency of the target instrument.

Example: `BB:UWBM:RES:TF 300`
'sets the target frequency to 300 MHz.

*RST value	Resolution	SCPI
100 MHz	-	Device-specific

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