Supplement

Digital Standard IEEE 802.11 (a/b/c) WLAN

R&S® AMU-K48
1402.6706.02

R&S® AFQ-K248
1401.6602.02

R&S® SMATE-K48
1404.6703.02

R&S® AMU-K248
1402.8209.02

R&S® SMJ-K48
1404.1001.02

R&S® SMJ-K248
1409.1116.02

R&S® SMU-K48
1161.0266.02

R&S® SMU-K248
1408.6114.02

ROHDE&SCHWARZ
Test and Measurement Division

Dear Customer,

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

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.
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 ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed. The product may be opened only by authorized, specially trained personnel. Prior to performing any work on the product or opening the product, the product must be disconnected from the supply network. Any adjustments, replacements of parts, maintenance or repair must be carried out only by technical personnel authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test).

3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens, e.g. nickel) such as aluminum cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties), consult a physician immediately to determine the cause.

4. If products/components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled, e.g. for disposal purposes, by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.

5. If handling the product yields hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation.

6. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn life requires increased protection, pregnant women should be protected by appropriate measures. Persons with pacemakers may also be endangered by electromagnetic radiation. The employer/operator is required to assess workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the danger.

7. Operating the products requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to handle operating the products; otherwise injuries or material damage may occur. It is the responsibility of the employer to select suitable personnel for operating the products.

8. Prior to switching on the product, it must be ensured that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.

9. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with earthing contact and protective earth connection.

10. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.

11. If the product has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases, it must be ensured that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply. If products without power switches are integrated in racks or systems, a disconnecting device must be provided at the system level.

12. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by e.g. tripping over the cable or suffering an electric shock.

13. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).

14. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, this can result in sparks, fire and/or injuries.

15. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.

16. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.

17. Ensure that the connections with information technology equipment comply with IEC 950/EN 60950.

18. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

19. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a license electrician.

20. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that suitable protection is provided for users and products.

21. Do not insert any objects into the openings in the housing that are not designed for this purpose. Never pour any liquids onto or into the housing. This can cause short circuits inside the product and/or electric shocks, fire or injuries.

22. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a thunderstorm) can reach the product. Otherwise the operating personnel will be endangered by electric shocks.

23. Rohde & Schwarz products are not protected against penetration of liquids, unless otherwise specified (see also safety instruction 1.). If this is not taken into account, there exists the danger of electric shock for the user or damage to the product, which can also lead to personal injury.

24. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product was moved from a cold to a warm environment.

25. Do not close any slots or openings on the product, since they are necessary for ventilation and prevent the product from overheating. Do not place the product on soft surfaces such as sofas or rugs or inside a closed housing, unless this is well ventilated.

26. Do not place the product on heat-generating devices such as radiators or fan heaters. The temperature of the environment must not exceed the maximum temperature specified in the data sheet.

27. Batteries and storage batteries must not be exposed to high temperatures or fire. Keep batteries and storage batteries away from children. Do not short-circuit batteries and storage batteries.
If batteries or storage batteries are improperly replaced, this can cause an explosion (warning: lithium cells). Replace the battery or storage battery only with the matching Rohde & Schwarz type (see spare parts list). Batteries and storage batteries must be recycled and kept separate from residual waste. Batteries and storage batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

28. Please be aware that in the event of a fire, toxic substances (gases, liquids etc.) that may be hazardous to your health may escape from the product.

29. The product can be very heavy. Be careful when moving it to avoid back or other physical injuries.

30. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves).

31. Handles on the products are designed exclusively for personnel to hold or carry the product. It is therefore not permissible to use handles for fastening the product to or on means of transport such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport and for observing the safety regulations of the manufacturer of the means of transport. Noncompliance can result in personal injury or material damage.

32. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. The driver is always responsible for the safety of the vehicle. The manufacturer assumes no responsibility for accidents or collisions.

33. If a laser product (e.g. a CD/DVD drive) is integrated in a Rohde & Schwarz product, do not use any other settings or functions than those described in the product documentation. Otherwise this may be hazardous to your health, since the laser beam can cause irreversible damage to your eyes. Never try to take such products apart, and never look into the laser beam.

34. Prior to cleaning, disconnect the product from the AC supply. Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluent for cellulose lacquers.

Informaciones elementales de seguridad

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

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

Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o despreciando las informaciones de seguridad del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

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

Símbolos y definiciones de seguridad

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

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

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

Palabras de señal y su significado

PELIGRO	Identifica un peligro directo con riesgo elevado de provocar muerte o lesiones de gravedad si no se toman las medidas oportunas.
ADVERTENCIA	Identifica un posible peligro con riesgo medio de provocar muerte o lesiones (de gravedad) si no se toman las medidas oportunas.
ATENCIÓN	Identifica un peligro con riesgo reducido de provocar lesiones de gravedad media o leve si no se toman las medidas oportunas.
AVISO	Indica la posibilidad de utilizar mal el producto y a consecuencia dañarlo.
	En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

Informaciones de seguridad elementales

1. El producto solamente debe ser utilizado según lo indicado por el fabricante referente a la situación y posición de funcionamiento sin que se obstruya la ventilación. Si no se convino de otra manera, es para los productos R&S válido lo que sigue:
    como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, utilizar solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4.500 m sobre el nivel del mar.
    Se aplicará una tolerancia de ±10% sobre el voltaje nominal y de ±5% sobre la frecuencia nominal.

2. En todos los trabajos deberán ser tenidas en cuenta las normas locales de seguridad de trabajo y de prevención de accidentes. El producto solamente debe de ser abierto por personal especializado autorizado. Antes de efectuar trabajos en el producto o abrirlo deberá este ser desconectado de la corriente. El ajuste, el cambio de partes, la manutención y la reparación deberán ser solamente efectuadas por electricistas autorizados por R&S. Si se reponen partes con importancia para los aspectos de seguridad (por ejemplo el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada recambio de partes elementales para la seguridad deberá ser efectuado un control de seguridad (control a primera vista, control de conductor protector, medición de resistencia de aislamiento, medición de la corriente conductora, control de funcionamiento).

3. Como en todo producto de fabricación industrial no puede ser excluido en general de que se produzcan al usarlo elementos que puedan generar alergias, los llamados elementos alergénicos (por ejemplo el níquel). Si se producieran en el trato con productos R&S reacciones alérgicas, como por ejemplo urticaria, estornudos frecuentes, irritación de la conjuntiva o dificultades al respirar, se deberá consultar inmediatamente a un médico para averiguar los motivos de estas reacciones.

4. Si productos / elementos de construcción son tratados fuera del funcionamiento definido de forma mecánica o térmica, pueden generarse elementos peligrosos (polvos de sustancia de metales pesados como por ejemplo plomo, berilio, níquel). La partición elemental del producto, como por ejemplo sucede en el tratamiento de materias residuales, debe de ser efectuada solamente por personal especializado para estos tratamientos. La partición elemental efectuada inadecuadamente puede generar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes al tratamiento de materias residuales.

5. En el caso de que se produjeran agentes de peligro o combustibles en la aplicación del producto que debieran de ser transferidos a un tratamiento de materias residuales, como por ejemplo agentes refrigerantes que deben ser repuestos en periodos definidos, o aceites para motores, deberán ser tenidas en cuenta las prescripciones de seguridad del fabricante de estos agentes de peligro o combustibles y las regulaciones regionales para el tratamiento de materias residuales. Cuiden también de tener en cuenta en caso dado las prescripciones de seguridad especiales en la descripción del producto.

6. Ciertos productos, como por ejemplo las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. En vista a la protección de la vida en desarrollo deberían ser protegidas personas embarazadas debidamente. También las personas con un bypass pueden correr peligro a causa de la radiación electromagnética.

El empresario/usuario está comprometido a valorar y señalar áreas de trabajo en las que se corra un riesgo aumentado de exposición a radiaciones para evitar riesgos.

7. La utilización de los productos requiere instrucciones especiales y una alta concentración en el manejo. Debe de ponerse por seguro de que las personas que manejen los productos estén a la altura de los requerimientos necesarios referente a sus aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario lleva la responsabilidad de seleccionar el personal usuario apto para el manejo de los productos.

8. Antes de la puesta en marcha del producto se deberá tener por seguro de que la tensión preseleccionada en el producto equivalga a la del la red de distribución. Si es necesario cambiar la preselección de la tensión también se deberán en caso dabo cambiar los fusibles correspondientes del producto.

9. Productos de la clase de seguridad I con alimentación móvil y enchufe individual de producto solamente deberán ser conectados para el funcionamiento a tomas de corriente de contacto de seguridad y con conductor protector conectado.

10. Queda prohibida toda clase de interrupción intencionada del conductor protector, tanto en la toma de corriente como en el mismo producto. Puede tener como consecuencia el peligro de golpe de corriente por el producto. Si se utilizaran cables o enchufes de extensión se deberá poner al seguro que es controlado su estado técnico de seguridad.

11. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de distribución como interruptor. En estos casos deberá asegurar de que el enchufe sea de fácil acceso y nabejo (según la medida del cable de distribución, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá instalar el interruptor al nivel de la instalación.

12. No utilice nunca el producto si está dañado el cable eléctrico. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegure a través de las medidas de protección y de instalación adecuadas de que el cable de eléctrico no pueda ser dañado o de que nadie pueda ser dañado por él, por ejemplo al tropezar o por un golpe de corriente.

13. Solamente está permitido el funcionamiento en redes de distribución TN/TT aseguradas con fusibles de como máximo 16 A (utilización de fusibles de mayor amperaje sólo previa consulta con el grupo de empresas Rohde & Schwarz).

14. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. Si no tiene en consideración estas indicaciones se arriesga a que se originen chispas, fuego y/o heridas.

15. No sobrecargue las tomas de corriente, los cables de extensión o los enchufes de extensión ya que esto pudiera causar fuego o golpes de corriente.

16. En las mediciones en circuitos de corriente con una tensión de entrada de $U_{eff} > 30$ V se deberá tomar las precauciones debidas para impedir cualquier peligro (por ejemplo medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).

17. En caso de conexión con aparatos de la técnica informática se deberá tener en cuenta que estos cumplan los requisitos del estándar IEC950/EN60950.

18. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar heridas, fuego o daños en el producto.

19. Si un producto es instalado fijamente en un lugar, se deberá primero conectar el conductor protector fijo con el conductor protector del aparato antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.

20. En caso de que los productos que son instalados fijamente en un lugar sean sin protector implementado, autointerruptor o similares objetos de protección, el circuito de suministro de corriente deberá estar protegido de manera que usuarios y productos estén suficientemente protegidos.

21. Por favor, no introduzca ningún objeto que no esté destinado a ello en los orificios de la caja del aparato. No vierta nunca ninguna clase de líquidos sobre o en la caja. Esto puede producir cortocircuitos en el producto y/o puede causar golpes de corriente, fuego o heridas.

22. Asegúrese con la protección adecuada de que no pueda originarse en el producto una sobrecarga por ejemplo a causa de una tormenta. Si no se verá el personal que lo utilice expuesto al peligro de un golpe de corriente.

23. Los productos R&S no están protegidos contra líquidos si no es que exista otra indicación, ver también punto 1. Si no se tiene en cuenta esto se arriesga el peligro de golpe de corriente para el usuario o de daños en el producto lo cual también puede llevar al peligro de personas.

24. No utilice el producto bajo condiciones en las que pueda producirse y se hayan producido líquidos de condensación en o dentro del producto como por ejemplo cuando se desplaza el producto de un lugar frío a un lugar caliente.

25. Por favor no cierre ninguna ranura u orificio del producto, ya que estas son necesarias para la ventilación e impiden que el producto se caliente demasiado. No pongan el producto encima de materiales blandos como por ejemplo sofás o alfombras o dentro de una caja cerrada, si esta no está suficientemente ventilada.

26. No ponga el producto sobre aparatos que produzcan calor, como por ejemplo radiadores o calentadores. La temperatura ambiental no debe superar la temperatura máxima especificada en la hoja de datos.

27. Baterías y acumuladores no deben de ser expuestos a temperaturas altas o al fuego. Guardar baterías y acumuladores fuera del alcance de los niños. No cortocircuitar baterías ni acumuladores. Si las baterías o los acumuladores no son cambiados con la debida atención existirá peligro de explosión (atención células de litio). Cambiar las baterías o los acumuladores solamente por los del tipo R&S correspondiente (ver lista de piezas de recambio). Las baterías y acumuladores deben reutilizarse y no deben acceder a los vertederos. Las baterías y acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de evacuación y reciclaje.

28. Por favor tengan en cuenta que en caso de un incendio pueden desprenderse del producto agentes venenosos (gases, líquidos etc.) que pueden generar daños a la salud.

29. El producto puede poseer un peso elevado. Muévalo con cuidado para evitar lesiones en la espalda u otras partes corporales.

30. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptas para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (por ejemplo paredes y estantes).

31. Las asas instaladas en los productos sirven solamente de ayuda para el manejo que solamente está previsto para personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como por ejemplo grúas, carretillas elevadoras de horquilla, carros etc. El usuario es responsable de que los productos sean sujetados de forma segura a los medios de transporte y de que las prescripciones de seguridad del fabricante de los medios de transporte sean observadas. En caso de que no se tengan en cuenta pueden causarse daños en personas y objetos.

32. Si llega a utilizar el producto dentro de un vehículo, queda en la responsabilidad absoluta del conductor que conducir el vehículo de manera segura. Asegure el producto dentro del vehículo debidamente para evitar en caso de un accidente las lesiones u otra clase de daños. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Siempre queda en la responsabilidad absoluta del conductor la seguridad del vehículo. El fabricante no asumirá ninguna clase de responsabilidad por accidentes o colisiones.

33. Dado el caso de que esté integrado un producto de láser en un producto R&S (por ejemplo CD/DVD-ROM) no utilice otras instalaciones o funciones que las descritas en la documentación de producto. De otra manera pondrá en peligro su salud, ya que el rayo láser puede dañar irreversiblemente sus ojos. Nunca trate de descomponer estos productos. Nunca mire dentro del rayo láser.

34. Antes de proceder a la limpieza, desconecte el producto de la red. Realice la limpieza con un paño suave, que no se deshilache. No utilice de ninguna manera agentes limpiadores químicos como, por ejemplo, alcohol, acetona o nitrodiluyente.

Contents

Digital Standard IEEE 802.11a WLAN

Introduction - Digital Standard WLAN

The R&S Signal Generator provides you with the ability to generate signals in accordance with the Wireless LAN standards IEEE 802.11a, IEEE 802.11b and IEEE 802.11g. (IEEE 802.11) standard WLAN.

'IEEE 802.11' stands for a wireless LAN standard prepared by ANSI/IEEE Institute of Electrical and Electronics Engineers). A brief description of the standard is given in the following. For a detailed description see the corresponding ANSI/IEEE specifications.

In 1990, IEEE founded the work group 802.11 which issued a first version of the 802.11 standard in June 1997. This standard defines two transmission methods: an infrared interface and radio transmission in the ISM band around 2.4 GHz.

Radio transmission can alternatively be carried out via frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS).

Originally, two data transmission modes were defined for the DSSS method.

- 1 Mbps data rate with DBPSK modulation

- 2 Mbps data rate with DQPSK modulation

Both modes spread the information data sequence with an 11-chip Barker sequence, and operate with a chip rate of 11 Mcps.

In spring 1999, the standard was extended by an OFDM mode, 802.11a, in the 5 GHz band. Soon afterwards, in summer 1999, the DSSS mode was extended, too. This expansion to include the new data rates of 5.5 Mbps and 11 Mbps is defined in the 802.11b standard. A new modulation mode, complementary code keying (CCK), was introduced (see following sections).

Standard 802.11g issued in 2003 extends standard 802.11b with higher transmission rates. It includes the previous 802.11b standard and implements the OFDM transmission of standard 802.11a in the 2.4 GHz ISM band. In the physical layer, the packet structure and modulation format of the OFDM modes are identical in 802.11g and 802.11a, only different transmission frequencies are used.

The 802.11 wireless LAN standard is a packet-oriented method for data transfer. The data packets are transmitted and received on the same frequency in time division duplex (TDD), but without a fixed timeslot raster. An 802.11 component can only transmit or only receive packets at any particular time.

The R&S Signal Generator simulates IEEE 802.11a-g WLAN at the physical on the physical layer. Two simulation modes are offered:

In the framed mode a sequence of data packets with the frame structure defined by the standard is generated. A MAC header and a frame check sequence can be activated. In the unframed time mode a non-packet-oriented signal without frame structure is generated, with the modulation modes and data rates defined by the IEEE 802.11.

The following list gives an overview of the options provided by the R&S Signal Generator for generating a IEEE 802.11a-g WLAN signal:

- Physical Layer modes OFDM (IEEE.802.11a/g), and CCK/PBCC (IEEE.802.11b/g).

- Chip/Sample rate 20 Mcps (OFDM IEEE.802.11a/g), and 11 Mcps (CCK/PBCC IEEE.802.11b/g).

- PSDU bit rates 1Mbps, 2Mbps, 5.5Mbps and 11 Mbps (CCK/PBCC), 22Mbps (PBCC), 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24Mbps, 36 Mbps, 48 Mbps and 54 Mbps (OFDM).

- PSDU Modulation DBPSK,DQPSK and CCK/PBCC (CCK/PBCC) and BPSK,QPSK,16QAM or 64QAM (OFDM) (depending on specified PSDU bit rate).

- Data scrambling can be activated or deactivated (CCK/PBCC) and initial scrambler state can be set randomly or to a user-defined value (OFDM).

- Clipping for reducing the crest factor.

Physical Layer OFDM

The standard defines OFDM (orthogonal frequency division multiplex) with 52 carriers as transmission method. The symbol rate of the modulation on the individual carriers is 250 kHz. A user data rate of up to 54 Mbps at a channel bandwidth of 20 MHz can be obtained by combining 48 useful carriers for data transmission (4 carriers are used for pilots) and using 64QAM for subcarrier modulation. With OFDM, the individual carriers are superimposed mutually orthogonal, which, in the ideal case, does not cause any intercarrier interference (ICI).

Table 1   Parameters of 802.11a/g OFDM modulation

Parameters	Value
Number of data subcarriers	48
Number of pilot subcarriers	4
Total of subcarriers used	52
Subcarrier frequency spacing	0.3125 MHz (= 20 MHz/64)
IFFT/FFT period	3.2 µs
Guard interval duration	0.8 µs (T_{FFT} /4)
Symbol interval	4 µs (T_{GI} + T_{FFT})
PLCP preamble duration	16 µs
Subcarrier modulation	BPSK OFDM QPSK OFDM 16QAM OFDM 64QAM OFDM
Error correction code	K = 7 (64 states) convolutional code
Code rates	1/2, 2/3, 3/4
Occupied bandwidth	16.6 MHz
Channel spacing	20 MHz

The table shows the main parameters of OFDM. 64-point IFFT is used to generate the 52 subcarriers. 12 of the 64 possible carriers are not used. 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 required subcarrier offset of 312.5 kHz is implicitly observed when the time signal generated by the IFFT with a sampling rate of 20 MHz is output. These 20 MHz are also called 'kernel sample rate'. An OFDM symbol generated in this way would have a period of 3.2 µs. To compensate for multipath propagation, a so-called guard interval with a duration of 0.8 µs is attached to each symbol so that a total symbol interval of 4 µs is obtained.

Either BPSK, QPSK, 16QAM or 64QAM modulation can be used on the subcarriers. Prior to the modulation, the raw data are convolutionally coded with code rates of ½ to ¾ being possible.

The frame structure can be seen in the figure below (also indicated in the **PPDU Configuration** submenu):
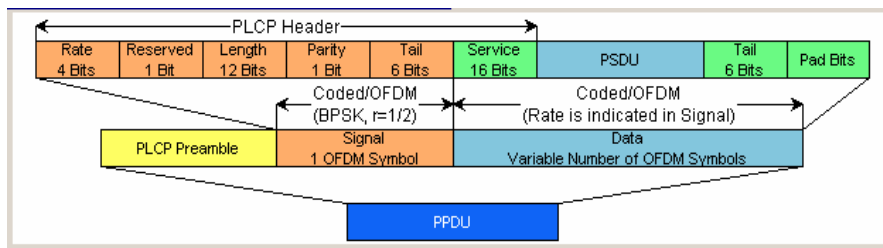
PLCP Format

The physical layer convergence protocol (PLCP) is a protocol layer between medium access control and the actual physical transmission layer (PHY). It is mainly used to adapt the different transmission formats of the 802.11 standards to the MAC layer which is identical for all transmission methods. Moreover, this protocol informs the receiver on the type of signal sent to allow for a correct demodulation.

The PLCP generates the PLCP protocol data unit (PPDU) frames which are physically transmitted.

PLCP Preamble

Each frame starts with the PLCP preamble made up of 10 short and 2 long symbols. The receiver uses the short symbols mainly for signal detection, AGC, coarse frequency adjustment and time synchronization. The long symbols are used to determine the transmission function of the channel and to set the equalizer of the receiver accordingly. The complete preamble is 16 µs long and thus corresponds to the duration of 4 normal OFDM symbols.

Signal Field

The signal field directly follows the preamble and consists of 24 bits which are used as follows:

The first 4 bits inform on the data rate (RATE) of the following data section. This allows the receiver to correctly set its demodulator. Following a reserved bit, 12 LENGTH bits are sent. They contain the number of bytes transmitted in this frame. After a parity bit, 6 tail bits reset the convolutional coder to zero.

With settings for 6 Mbps, the 24 bits are subjected to usual signal processing consisting of convolutional coding, interleaving, BPSK subcarrier modulation, pilot carrier generation and OFDM modulation and thus form exactly one OFDM symbol of 4 µs duration. Thanks to the use of the lowest data rate (6 Mbps), each receiver has the best chance to obtain the information required for subsequent demodulation of the data section.

User Data

The user data in the data section of the frame is finally taken to the receiver. The data section may have a variable length of OFDM symbols and can be transmitted with one of the defined data rates between 6 and 54 Mbps. The data section of the frame is subdivided into the fields SERVICE, PSDU, TAIL and Pad bits.

SERVICE 16 Bits	PSDU	TAIL 6 Bits	Pad Bits

The service field consists of 16 bits, the 7 LSBs transmitted first being 0. The allows the receiver to draw conclusions as to the start value of the scrambler in the transmitter. The remaining 9 bits are reserved and, according to the current version of the standard, should also be set to 0.

The PSDU may have a user-selectable length of up to 2346 bytes. 6 tail bits follow 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.

A short description of the individual steps required to attain a valid 802.11a/g signal follows.

Data from the source (usually the next higher protocol layer, here MAC) must first be scrambled, i.e. multiplied with a PN sequence. A 127-bit code generated by the following generator polynomial is stipulated:

$$S(x) = x^7 + x^4 + 1$$

A feedback shift register generates the scrambling sequence. The start value of the register for the data section should be randomly selected.

A subsequent convolutional coder adds redundancies to the bits thus scrambled (factor of 2). The coder has 64 possible states (k = 7) and is described by the polynomials $g_0 = 133_8$ and $g_1 = 171_8$. To obtain the data rates of 6 to 54 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, 2/3 or 3/4 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.

To increase the performance of the convolutional coder, the coded data are interleaved in the next step. Two interleaver stages ensure that the adjacent bits of the convolutional coder are first distributed to different subcarriers and then to higher- or lower-significant bits of the constellation used for subcarrier modulation. Long sequences of defective bits can thus be avoided which significantly improves the faculties of the Viterbi decoder in the receiver for a correction.

The next stage performs the actual modulation of the individual OFDM carriers. Depending on the set data rate, the useful carriers are subjected to a uniform BPSK, QPSK, 16QAM or 64QAM modulation. This is done by first calculating the I and Q coefficients of each carrier. Gray coding is used to distribute the data bits to constellation points. All carriers from -26 to +26, except carriers -21, -7, 0, 7 and 21, are used for the transmission of user data. Carrier number 0 (directly at the center frequency later on) is not used and is always 0. The remaining 4 are BPSK-modulated pilots. The pilot carriers change their phase with each symbol. The phase variation is determined by the 127-bit PN sequence already defined as scrambling sequence.

The actual OFDM modulation is performed by inverse discrete Fourier transform (IFFT) in the next step. A 64-point IFFT is carried out with the I and Q coefficients of the subcarriers obtained before. To ensure sufficient spacing of aliasing products, only 52 of the 64 possible carriers are used. The result is a discrete complex time signal in the baseband with modulated OFDM carriers. A guard field which corresponds to a periodic continuation of the same symbol is then appended before each OFDM symbol. Multipath propagation can thus be easily compensated in the receiver.

Aliasing products are suppressed by oversampling, converting the discrete digital signal to an analog signal and subsequent filtering. In the last step, the baseband signal is modulated onto the selected RF carrier and the complete signal is sent to the receiver via the air interface.

Physical Layer CCK-PBCC

A distinction is made between the packet type (or PPDU format) with long or short PLCP (physical layer convergence protocol).

Long PLCP PPDU Format

In 802.11, the data packet on the physical layer is referred to as PPDU (PLCP protocol data units). A PPDU consists of three components; the PLCP 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 signalling purposes, and are themselves divided into fields.

The **PLCP preamble** consists of a synchronization field and a start frame delimiter field. The standard specifies a fixed data content for both fields.

The **PLCP header** consists of the signal, service, length and CRC fields.

The signal field determines the data rate used in the PSDU field. The rates 1 Mbps, 2 Mbps, 5.5 Mbps, and 11 Mbps can be selected; rates 22 MBps and 33 Mbps can be used in the optional PBCC modes.

The service field also helps to differentiate the modulation modes (CCK or PBCC) used for the higher data rates of 5.5 Mbps and 11 Mbps.

The length of the PSDU field is entered in μs in the Length field.

The CRC field contains a check sum of all the fields of the PLCP header.

The PLCP preamble and the PLCP header in the long PLCP PPDU format are both DBPSK-modulated and transmitted at a data rate of 1 Mbps. The data rate and the modulation of the PSDU component are defined by the signal and service fields in the PLCP header.

The frame structure can be seen in the figure below (also indicated in the **PPDU Configuration** submenu):
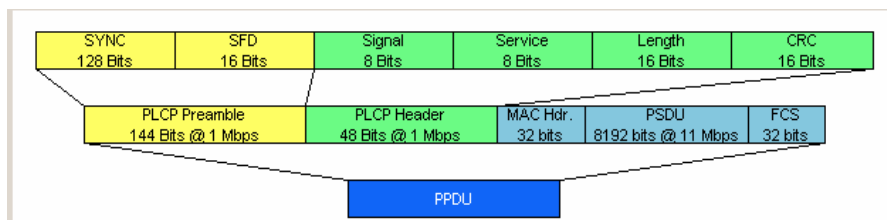
Short PLCP PPDU Format

The basic structure of the short PLCP PPDU format is identical to that of the long PLCP PPDU format. There is no difference in the PSDU component. The PLCP preamble and header are generated in an abbreviated form. In the short preamble, the number of bits transmitted in the SYNC field is reduced from 128 to 56. In the short header, however, the number of data bits transmitted remains unchanged, but the data rate is doubled (to 2 Mbps). These measures halve the transmission periods of preamble and header in the short PLCP format, as compared to the long PLCP format.

The frame structure can be seen in the figure below (also indicated in the **PPDU Configuration** submenu):
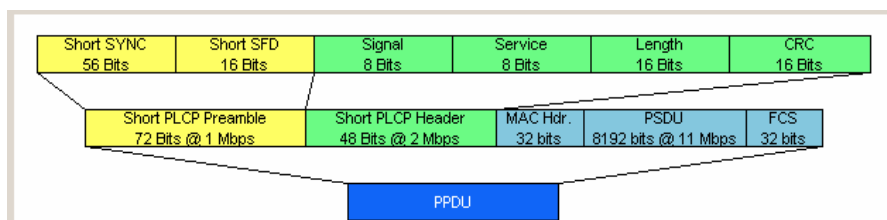
Data Spreading and Modulation CCK-PBCC

The R&S Signal Generator simulates signals in accordance with 802.11 on the physical layer. In the standard, the data link layer or, to be more precise, the MAC sublayer provides the input data for this layer The following graph illustrates the signal generation process.
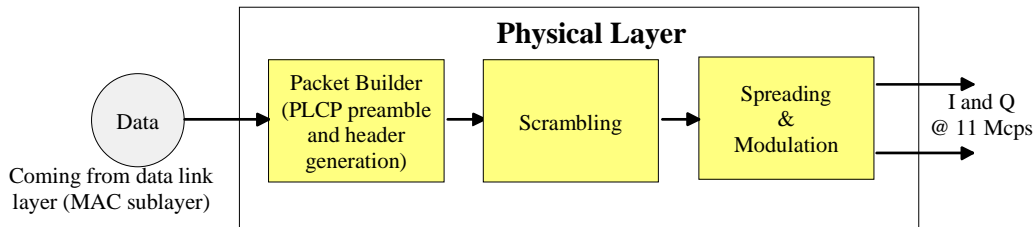
Fig. 1   Principle of 802.11b/g signal generation

Depending on the PLCP PPDU format used, the PLCP preamble and the PLCP header are combined in the packet builder. The PSDU field of the packet is filled with the input data of the physical layer block. In the next step, all the packet data is scrambled. The actual spreading and modulation of the data signal to the resulting chip rate of 11 Mcps comes next.

However, the data rates and modulations of the individual fields of a packet can differ. The PLCP preamble always has a data rate of 1 Mbps, and is DBPSK-modulated. Besides the actual modulation, spreading to the resulting chip rate occurs.

The PLCP header is either treated exactly like the preamble (long PLCP PPDU format), or DQPSK-modulated at a data rate of 2 Mbps (short PLCP PPDU format). Data rates (1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps, etc) with different modulations can be used for the data part of the packet, the PLCP service data unit (PSDU). The following table gives an overview of the different combinations of data rates, modulations and spreading/coding methods.

Packet field	Data rate	Chip rate	Spreading/coding methods	Modulation
Short PLCP preamble	1 Mbps	11 Mcps	11-chip Barker sequence	DBPSK
Long PLCP preamble	1 Mbps	11 Mcps	11-chip Barker sequence	DBPSK
Short PLCP header	2 Mbps	11 Mcps	11-chip Barker sequence	DQPSK
Long PLCP header	1 Mbps	11 Mcps	11-chip Barker sequence	DBPSK
PSDU	1 Mbps (long PPDU)	11 Mcps	11-chip Barker sequence	DBPSK
PSDU	2 Mbps	11 Mcps	11-chip Barker sequence	DQPSK
PSDU	5.5 Mbps	11 Mcps	CCK	DQPSK
PSDU	11 Mbps	11 Mcps	CCK	DQPSK
PSDU	5.5 Mbps	11 Mcps	PBCC	BPSK
PSDU	11 Mbps	11 Mcps	PBCC	QPSK
PSDU	22 Mbps	11 Mcps	PBCC	8PSK
PSDU	33 Mbps	16.5 Mcps	PBCC	8PSK

The individual combinations of spreading, coding and modulation are described below.

1 Mbps Data Rate with DBPSK Modulation

At a data rate of 1 Mbps, the already scrambled data stream is DBPSK-modulated according to the table below. The resulting symbol sequence is then spread using the 11-chip Barker sequence.

Bit input	Phase change (+jω)
0	0
1	π

2 Mbps Data Rate with DQPSK Modulation

At a data rate of 2 Mbps, the already scrambled data stream is DQPSK-modulated according to the table below. The resulting symbol sequence is then spread using the 11-chip Barker sequence.

Dibit pattern (d0,d1) (d0 is first in time)	Phase change (+jω)
00	0
01	$\pi/2$
11	π
10	$3\pi/2$ $(-\pi/2)$

5.5 Mbps Data Rate with CCK Modulation

The standard specifies CCK modulation (complementary code keying) for a data rate of 5.5 Mbps. To this end, in each modulation step, four successive bits (d_0 to d_3) are taken from the data stream which is already scrambled. The phases $\varphi_1, \varphi_2, \varphi_3, \varphi_4$ are determined by these four bits. φ_1 is determined by the data bits d_0 and d_1 according to the following table, which specifies different phases for even and odd modulation steps:

Dibit pattern (d0, d1) (d0 is first in time)	Even symbols phase change (+jω)	Odd symbols phase change (+jω)
00	0	π
01	$\pi/2$	$3\pi/2$ $(-\pi/2)$
11	π	0
10	$3\pi/2$ $(-\pi/2)$	$\pi/2$

The phase φ_1 must be interpreted relative to the phase of the previous symbol.

The other three phases are determined as follows:

$$\varphi_2 = (d_2 \cdot \pi) + \pi/2$$

$$\varphi_3 = 0$$

$$\varphi_4 = d_3 \cdot \pi$$

By means of these four phases, the CCK code word can now be determined; it is:

$$c = \{e^{j(\varphi_1+\varphi_2+\varphi_3+\varphi_4)}, e^{j(\varphi_1+\varphi_3+\varphi_4)}, e^{j(\varphi_1+\varphi_2+\varphi_4)},$$
$$-e^{j(\varphi_1+\varphi_4)}, e^{j(\varphi_1+\varphi_2+\varphi_3)}, e^{j(\varphi_1+\varphi_3)}, -e^{j(\varphi_1+\varphi_2)}, e^{j\varphi_1}\}$$

Example:

$(d_0$ to $d_3) = (0110)$, the phase of the last symbol is 0, the current modulation step is even:

$$\varphi_1 = \pi/2$$

$$\varphi_2 = (1 \cdot \pi) + \pi/2 = 3\pi/2$$

$$\varphi_3 = 0$$

$$\varphi_4 = 0 \cdot \pi = 0$$

The CCK code word is consequently:

$$c = \left(e^{j(\pi/2+3\pi/2+0+0)}, e^{j(\pi/2+3\pi/2+0)}, e^{j(\pi/2+3\pi/2+0)}, -e^{j(\pi/2+0)}, e^{j(\pi/2+3\pi/2+0)}, e^{j(\pi/2+0)}, -e^{j(\pi/2+3\pi/2)}, e^{j\pi/2}, \right)$$

$$c = \left(e^{j0}, e^{j0}, e^{j0}, -e^{j\pi/2}, e^{j0}, e^{j\pi/2}, -e^{j0}, e^{j\pi/2}, \right) = (1,1,1,-j,1,j,1,j,)$$

The four data bits $(d_0$ to $d_3)$ thus become the eight complex output chips $(c_0$ to $c_7)$.

11 Mbps Data Rate with CCK Modulation

The standard also specifies CCK modulation (complementary code keying) for a data rate of 11 Mbps. The modulation is basically the same as described for the 5.5 Mbps data rate. In each modulation step, eight successive bits $(d_0$ to $d_7)$ are taken from the data stream, which is already scrambled. The phases $\varphi_1, \varphi_2, \varphi_3, \varphi_4$ are determined by these eight bits.

φ_1 is determined by the data bits d_0 and d_1 according to the following table, which specifies different phases for even and odd modulation steps:

Dibit pattern (d0, d1) (d0 is first in time)	Even symbols phase change (+jω)	Odd symbols phase change (+jω)
00	0	π
01	π/2	3π/2 (−π/2)
11	π	0
10	3π/2 (−π/2)	π/2

The phase φ_1 must be interpreted relative to the phase of the previous symbol.

φ_2 is determined by the data bits d_2, d_3, φ_3 from d_4, d_5 and φ_2 from d_6, d_7 according to the following table:

Dibit pattern [di, d(i+1)] (di is first in time)	Phase
00	0
01	π/2
10	π
11	3π/2 (−π/2)

5.5 Mbps and 11 Mbps Data Rates with PBCC Modulation

Packet binary convolutional coding (PBCC) can optionally be used instead of CCK modulation for the 5.5 Mbps and 11 Mbps data rates. The following illustration provides a schematic overview of this method. For details, refer to the standard.
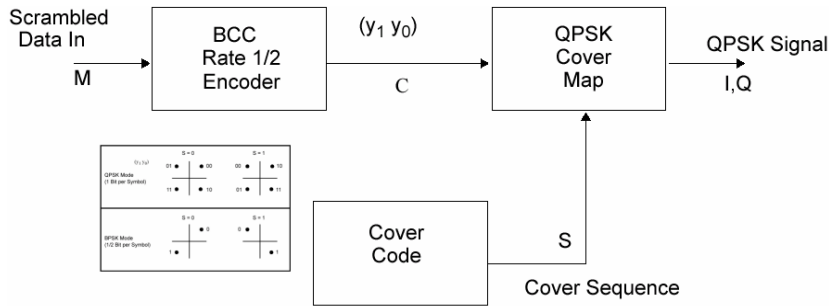
Fig. 2   Principle of PBCC modulation

22 Mbps and 33 Mbps Data Rates with PBCC Modulation

802.11g also defines the optional PBCC (ER-PBCC) modes using the extended 22 Mbps and 33 Mbps rates (see [3], 19.3.3.2). In contrast to the 5.5 Mbps und 11 Mbps PBCC modes, a rate 2/3 convolutional coder and 8PSK modulation are used. With 33 Mbps, also the clock rate in the data section of the packet is increased to 16.5 Mcps.

WLAN Menu

The menu for setting the IEEE 802.11a-g WLAN digital standard is either called from the baseband block or from the menu tree under Baseband.

```
------ TDMA standards ------
GSM/EDGE...
------ CDMA standards ------
3GPP FDD...
CDMA2000...
- OFDM/WLAN standards -
IEEE 802.11 WLAN...
IEEE 802.16 WiMAX...
```
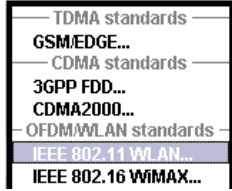
The menu is split into several sections for configuring the standard. The choice of simulation mode determines which displays and parameters are made available in the lower section.

The upper section of the menu is where the IEEE 802.11a-g WLAN digital standard is enabled, the default settings are called and the physical layer mode, the simulation mode and the frame type are selected. Additional parameters for defining the signal length and a graph outlining the signal structure are indicated.

A button leads to the submenu for loading and saving the IEEE 802.11a-g WLAN configuration.

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

IEEE 802.11g WLAN A	
State	On
Set To Default	**Save/Recall...**
Generate Waveform File	
Standard	802.11g
Physical Layer Mode	OFDM
Simulation Mode	Framed
Predefined Frames	Data

| PPDU | idle time | .... | PPDU | idle time |

| **Sequence Length** | 1 | Frames |
| **Idle Time (based on standard chiprate)** | 0.100 | ms |

PPDU Configuration...	64-QAM / 54 Mbps
Filter/Clipping...	Cosine / Clip Off
Trigger/Marker...	Single / Int
Execute Trigger	Running
Clock...	Internal

General Settings for WLAN Signals

The upper menu section is where the IEEE 802.11a-g WLAN digital standard is enabled and the basic signal structure is configured.

State - WLAN   Enables/disables the IEEE 802.11a-g WLAN 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:WLAN:STAT ON`

Set to default - WLAN   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:WLAN:PRES`

Parameter	Value
State	Not affected by Set to default
Standard	802.11g
Physical Layer Mode	CCK
Simulation Mode	Framed
Predefined Frames	Data
Sequence Length	1 frame
Idle Time	0.1 ms
Filter	Gauss (FSK), 0.50
Chip Rate Variation	11 Mcps
Clipping	Off
PPDU Configuration (CCK)	
PLCP P+H Format	Long PLPC
PSDU Bit Rate (CCK/PBCC)	11 Mbps
Data Length	1024 bytes
PSDU Data Source	PRBS 9
Scrambling	On
Service Field Clock Bits	Locked
MAC Header	Off
FCS (checksum)	Off

Save/Recall - WLAN   Calls the **Save/Recall** menu.

From the **Save/Recall** menu the **File Select** windows for saving and recalling IEEE 802.11a-g WLAN configurations and the **File Manager** can be called.

Recall WLAN Settings
Save WLAN Settings
File Manager...

IEEE 802.11a-g WLAN configurations are stored as files with the predefined file extension ***.wlan.** The file name and the directory they are stored in are user-definable.

The complete settings in the **IEEE 802.11a-g WLAN** menu are saved and recalled.

Recall IEEE   Opens the **File Select** window for loading a saved
802.11a-g   IEEE 802.11a-g WLAN configuration.
WLAN setting
                         The configuration of the selected (highlighted) file is loaded by pressing the **Select** button.

                         Remote-control command:
                         MMEM:CDIR 'F:\gen_lists\wlan'

                         SOUR:BB:WLAN:SETT:CAT?
                         Response: 'wlan_1',wlan_2'
                         SOUR:BB:WLAN:SETT:LOAD "wlan_1"

Save IEEE   Opens the **File Select** window for saving the
802.11a-g   current IEEE 802.11a-g WLAN signal
WLAN setting   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\wlan'

                         SOUR:BB:WLAN:SETT:STOR 'wlan_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\wlan'

                         SOUR:BB:WLAN:SETT:DEL 'wlan_1'

Generate Waveform File… -   Calls the **Generate Waveform** menu. This menu is used to store the
  WLAN   current WLAN signal as ARB signal in a waveform file.

                                   This file can be loaded in the **ARB** menu and processed as
                                   multicarrier or multisegment signal.

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

                                   Remote-control commands:
                                   SOUR:BB:WLAN:WAV:CRE "c:\temp\wlan.wv"

Standard - WLAN   Selects the 802.11 standard.

                                   The standard was expanded over the years adding additional
                                   features.

                   802.11a   The standard supports OFDM (orthogonal
                                   frequency division multiplexing). This modulation is
                                   defined by the IEEE 802.11a specification in the 5
                                   GHz frequency band.

                                   Remote-control command:
                                   SOUR:BB:WLAN:STAN STAN80211A

                   802.11b   The standard includes the modulation mode CCK
                                   (complementary code keying) and the data rates
                                   5.5 Mbps and 11 Mbps. PBCC (packet binary
                                   convolutional coding) can optionally be used
                                   instead of CCK modulation for the 5.5 Mbps and
                                   11 Mbps data rates.

                                   Remote-control command:
                                   SOUR:BB:WLAN:STAN STAN80211B

                   802.11g   Standard 802.11g extends standard 802.11b with
                                   higher transmission rates. 802.11g contains the
                                   previous 802.11b modes and also integrates the
                                   OFDM method used in 802.11a for frequencies in
                                   the 2.4 GHz band.

                                   Remote-control command:
                                   SOUR:BB:WLAN:STAN STAN80211G

Physical Layer Mode - WLAN   Selects the physical layer mode.

OFDM   The OFDM (orthogonal frequency division multiplexing) physical layer supports a frame-based transmission. The OFDM signal is divided into 52 carriers. The symbol rate of the modulation on the individual carriers is 250 kHz. A user data rate of up to 54 Mbps at a channel bandwidth of 20 MHz can be obtained by combining 48 useful carriers for data transmission (4 carriers are used for pilots) and using 64QAM for subcarrier modulation. With OFDM, the individual carriers are superimposed mutually orthogonal, which, in the ideal case, does not cause any intercarrier interference (ICI).

Remote-control command:
SOUR:BB:WLAN:MODE OFDM

CCK   The CCK (complementary code keying) physical layer mode is used for the 5.5 Mbps and 11 Mbps data rates.

Remote-control command:
SOUR:BB:WLAN:MODE CCK

PBCC   The PBCC (packet binary convolutional coding) physical layer can optionally be used instead of CCK modulation and extents 802.11b to higher data rates (22 Mbps).
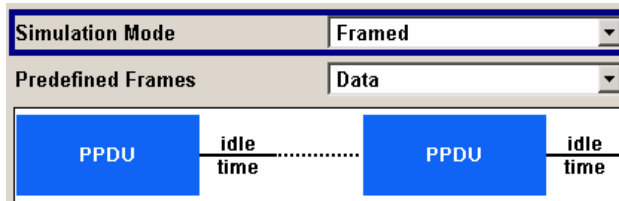
Remote-control command:
SOUR:BB:WLAN:MODE PBCC

Simulation Mode - WLAN Selects the simulation mode.

Framed The **framed mode** is the standard operating mode which is also used in the real system. Data packets with the frame structure defined by the standard are generated.


Signals representing a sequence of frames (PLCP protocol data units, referred to as PPDUs) and separated by a so-called idle time can be configured in the framed mode. The user data is continued in the consecutive frames, i.e. it is not repeated in each frame. Both the duration of the idle time and the number of frames to be sent can be user-selected.

Remote-control command:
SOUR:BB:WLAN:SMOD FRAM

Unframed The **unframed mode** is offered in addition. In this mode, a non-packet-oriented signal without a frame structure is generated with the modulations and data rates defined by 802.11a-g. This mode can be used for simple tests for which only modulation and spectrum of the test signal are of interest.
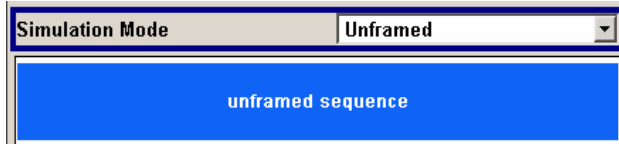
No PLCP preamble and no signal field are generated in the unframed mode. The idle time is also omitted. The data field is identical to that of the framed mode and also contains the service and tail bits. The length limitation stipulated by the standard to the maximum PSDU block length of 4095 bytes in the framed mode does not apply.

Operation is the same as in the framed mode, but only a limited number of setting parameters is available.

Remote-control command:
SOUR:BB:WLAN:MODE UNFRM

Predefined Frames - WLAN   (Framed Mode only) Selects the frame type. The selection defines parameters of the MAC layer, e.g. the type and sub-type bit fields of the MAC Header.

Data	Frames containing useful data.
	Remote-control command: `SOUR:BB:WLAN:FFOR   DATA`
RTS	Request to Send.
	Remote-control command: `SOUR:BB:WLAN:FFOR   RTS`
CTS	Clear to Send.
	Remote-control command: `SOUR:BB:WLAN:FFOR CTS`
ACK	Acknowledgement.
	Remote-control command: `SOUR:BB:WLAN:FFOR   ACK`

Sequence Length - WLAN   Sets the sequence length of the signal in number of frames. A (physical layer) frame consists of a PPDU burst including the subsequent idle time.

Remote-control command:
`SOUR:BB:WLAN:FCO 20`

Idle time - WLAN   (based on standard chip rate)

(This feature is available for Framed Mode only).

Sets the idle time, i.e. the time between two PPDU bursts. Idle time is given in µs; the packets can also be joined to each other directly with idle time 0. Please note that the idle time refers to the chip rate as defined in the standard (11 Mcps for 802.11b/g CCK/PBCC and 20 Mcps for 802.11a/g OFDM). Only at this chip rate does the idle period correspond exactly to the time set. If the chip rate is doubled, for instance, the real idle time is halved.

Remote-control command:
`SOUR:BB:WLAN:ITIM 10 ms`

PPDU Configuration - WLAN   **(This feature is available for Framed Mode only)**

Calls the menu for configuration of the PPDU. The menu differs for the physical layer modes.

The menu is described in Section "*PPDU/Sequence Configuration - WLAN*", Page 18.Remote-control command: n.a.

Sequence Configuration - WLAN

(This feature is available for Unframed Mode only).

Calls the menu for configuration of the signal in unframed mode modes.

The menu is described in Section "*PPDU/Sequence Configuration - WLAN*", Page 18.

Remote-control command: n.a.

Filter, Clipping - WLAN

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 "*Filter, Clipping - WLAN*", Page 33.

Remote-control command: n.a.

Trigger - Marker - WLAN

(Trigger for R&S SMx and R&S AMU instruments only)

Calls the menu for selecting the trigger source, for configuring the marker signals and for setting the time delay of an external trigger signal (see Section "*Trigger/Marker/Clock - WLAN*", Page 30).

The currently selected trigger source is displayed to the right of the button.

Remote-control command: n.a.

Execute Trigger - WLAN

(R&S SMx and R&S AMU instruments only)

This feature is available for Trigger Source Internal only.

Executes trigger manually.

A manual trigger can be executed only when an internal trigger source and a trigger mode other than **Auto** have been selected.

Remote-control commands:
```
SOUR:BB:WLAN:TRIG:SOUR INT
SOUR:BB:WLAN:SEQ RETR
SOUR:BB:WLAN:TRIG:EXEC
```

Clock - WLAN

(R&S SMx and R&S AMU instruments only)

Calls the menu for selecting the clock source (see Section "*Trigger/Marker/Clock - WLAN*", Page 30").

Remote-control command: n.a.

PPDU/Sequence Configuration - WLAN

In **framed mode**, a frame consists of a PPDU (PLCP protocol data unit) and the idle time. The data packet on the physical layer is referred to as PPDU. A PPDU consists of three components; the PLCP 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 details of the PPDU structure depend on the selected standard or, more precisely, on the physical layer mode (see below).

In **unframed mode**, the signal can be configured via the **PSDU bit rate** and **PSDU modulation** parameters, just as in the Framed mode. However, a preamble or header is not generated; only a continuous PSDU block is generated, the length of which can be varied by using the **Sequence Length** parameter. There is no restriction of the maximum PSDU block length to 4095 bytes as in the Framed mode. Moreover, the data stream can be scrambled prior to the modulation (**Scrambling Mode** parameter).
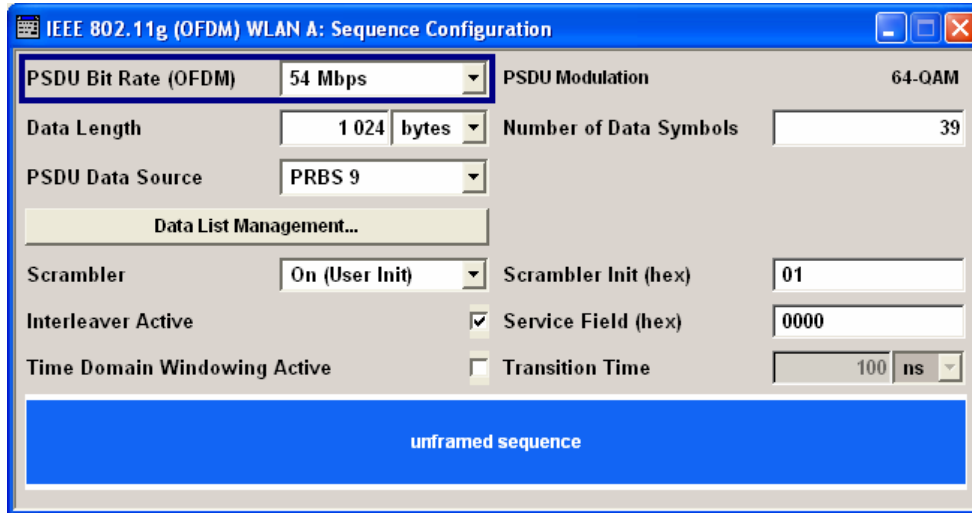
Standard 802.11a - OFDM

In the upper section of the menu, the parameters of the data part (PSDU) are set. In the middle section, the parameters of the scrambler and interleaver are set. A graph in the lower sections illustrates the structure of the PPDU (framed mode) or the unframed sequence (unframed mode).
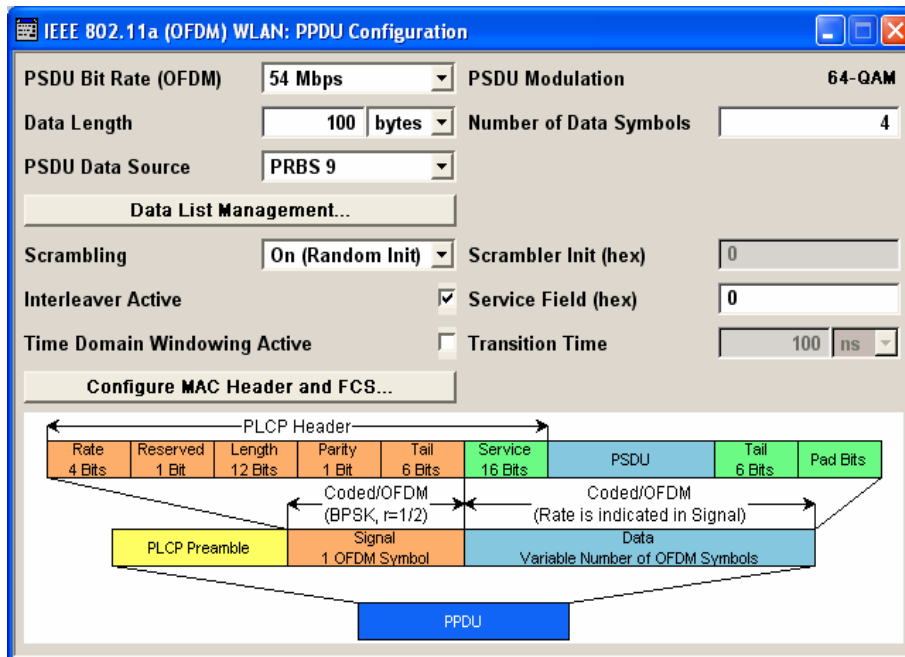
Framed mode:

Unframed mode:

Standard 802.11b/g - CCK - PBCC

In the upper section of the menu, the parameters of the data part (PSDU) are set. In framed mode, a distinction is made between the packet type (or PPDU format) with long or short PLCP (physical layer convergence protocol). A graph in the lower sections illustrates the structure of the PPDU (framed mode) or the unframed sequence (unframed mode).
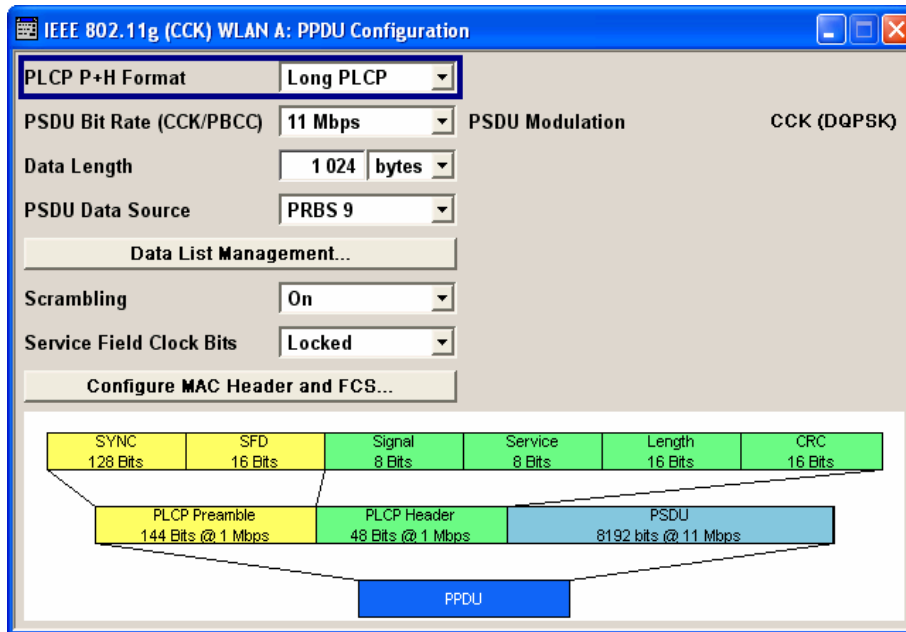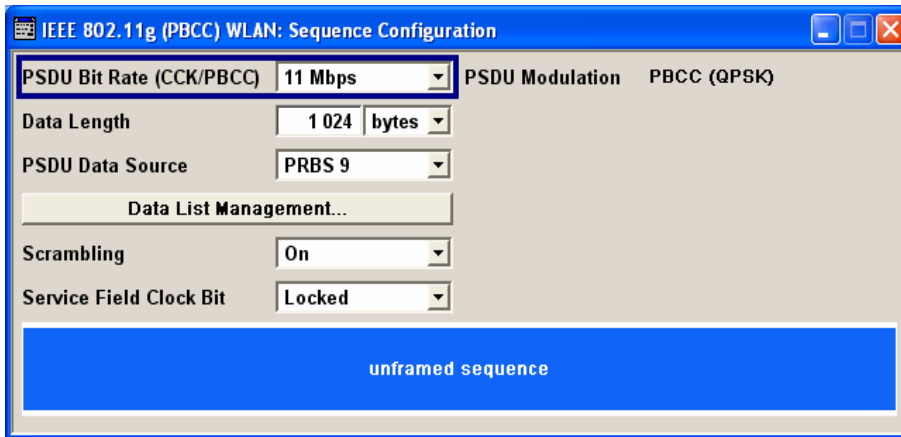
Framed Mode:

Unframed Mode:

IEEE 802.11g (PBCC) WLAN: Sequence Configuration

PSDU Bit Rate (CCK/PBCC)	11 Mbps	PSDU Modulation PBCC (QPSK)
Data Length	1 024 bytes	
PSDU Data Source	PRBS 9	
Data List Management...		
Scrambling	On	
Service Field Clock Bit	Locked	

unframed sequence

PLCP P+H Format (CCK,PBCC) - WLAN

(framed mode)

Selects the packet type (PPDU format) with long or short PLCP (physical layer convergence protocol). Depending on the format selected, the structure, modulation and data rate of the PLCP preamble and header are modified. The format currently set is shown in the graphic display in the lower part of the menu.

See section "*Physical Layer CCK-PBCC*", on page 5 for description of the long and short format.

Remote-control command:
SOUR:BB:WLAN:PLCP:FORM LONG

PSDU Bit Rate - WLAN

(OFDM) Selects the bit 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 of the OFDM.

PSDU Bit Rate

(CCK,PBCC) Selects the bit rate of the PSDU.

The data rates available are 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps and 22 Mbps. The 1 Mbps data rate is only available if the long PLCP format has been selected (framed mode only). The selection of the data rate also determines the possible modulation modes. The following table shows the correlation between data rate and modulation:

Remote-control command:
SOUR:BB:WLAN:PSDU:BRAT 18MBPS

Data rate	Possible modulation mode
1 Mbps	Barker Sequence (DBPSK) the information data sequence is spread with an 11-chip Barker sequence, chip rate is 11 Mcps
2 Mbps	Barker Sequence (DQPSK) the information data sequence is spread with an 11-chip Barker sequence, chip rate is 11 Mcps
5.5 Mbps	CCK (DQPSK) or PBCC (BPSK)
11 Mbps	CCK (DQPSK) or PBCC (QPSK)
22 Mbps	PBCC (8PSK)

PSDU Modulation - WLAN   Indicates the modulation type.

PSDU Modulation OFDM	(OFDM) Indicates the modulation type used on the OFDM subcarriers. The modulation mode depends on the selected PSDU bit rate.
	Remote-control command: `SOUR:BB:WLAN:PSDU:MOD QAM16`
PSDU Modulation CCK,PBCC	Indicates the modulation type. The modulation mode depends on the selected PSDU bit rate. The **Physical Layer Mode** parameter in the main menu can be used for switchover between CCK and PBCC.
	Remote-control command: `SOUR:BB:WLAN:PSDU:MOD DQPSK`

Data Length - WLAN   Sets the data length.

In the framed mode, data field lengths of up to 4095 bytes per frame packet are possible. This corresponds to the maximum data length. If the MAC Layer is activated, the MAC header (up to 30) and the (4) FCS bytes are added.

The unframed mode offers a data length of up to 100000 bytes.

OFDM:
If the data field length is changed, the generator calculates the number of OFDM data symbols as a function of the set PSDU bit rate and displays it in the field **Number of Data Symbols**. Data is always rounded up to complete symbols. Free data bits in the last symbol, the so-called pad bits, are filled with 0.

Remote-control command:
`SOUR:BB:WLAN:PSDU:DLEN 4095`

Number of Data Symbols (OFDM) - WLAN   Sets the number of data symbols per frame packet.

If the number of OFDM data symbols is changed, the generator calculates the data field length as a function of the set PSDU bit rate and displays it at **Data Length**.

Remote-control command:
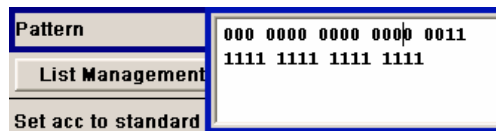`SOUR:BB:WLAN:PSDU:SCO 256`

PSDU Data SOURce - WLAN

Selects the data source for the data field.

The following data sources are available:

All 0

All 1

0 data or 1 data is internally generated.

Remote-control command:
SOUR:BB:WLAN:PSDU:DATA ONE │ ZERO

PRBS

  PRBS Type

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

The length is selected in the **PRBS Type** input box.

Remote-control commands:
SOUR:BB:WLAN:PSDU:DATA   PN9

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:WLAN:PSDU:DATA PATT
SOUR:BB:WLAN:PSDU:DATA:PATT
#H77550,17

Data List

...Select Data

Data lists will be used.

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

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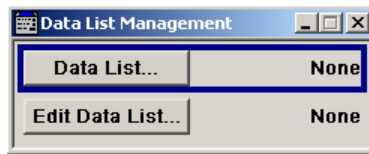

The **File Manager** is used to transmit external data lists to the R&S Signal Generator, and can be called within every File Select window by means of the **File Manager** button.

Remote-control command:
SOUR:BB:WLAN:PSDU:DATA DLIS
SOUR:BB:WLAN:PSDU:DATA:DLIS:SEL
"d_l1"

Data List Management… - WLAN	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. The data lists must be selected as a data source from the submenus under the individual function, e.g. in the channel table of the cells.

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:WLAN:PSDU:DATA DLIS
SOUR:BB:WLAN:PSDU:DATA:DLIS:SEL "d_l1"
```

Scrambler - WLAN	(OFDM) Activates/deactivates the scrambler and selects the mode of determining the initialization value.	
	OFF	The scrambler is deactivated.
		Remote-control command: `SOUR:BB:WLAN:SCR:MODE OFF`
	Random	The scrambler is activated.
		The initialization value of the scrambler is selected at random. Each frame has a different random initialization value. This value is also different in case of successive recalculations with the same setting parameters so that different signals are generated for each calculation.
		Remote-control command: `SOUR:BB:WLAN:SCR:MODE RAND`
	User	The scrambler is activated.
		The initialization value of the scrambler is set to a fixed value that is entered at **Scrambler Init (hex)** . This value is then identical in each generated frame.
		Remote-control command: `SOUR:BB:WLAN:SCR:MODE USER`

Scrambler (CCK,PBCC)   Activates or deactivates the scrambler. Some tests require a test
signal without scrambling (e.g. for the RF carrier suppression
measurement).

             OFF   The scrambler is deactivated.

                 Remote-control command:
`SOUR:BB:WLAN:SCR:MODE OFF`

             ON   The scrambler is activated.

                 Remote-control command:
`SOUR:BB:WLAN:SCR:MODE ON`

             Preamble Only   The scrambler is activated.

                 Only the preamble is scrambled.

                 Remote-control command:
`SOUR:BB:WLAN:SCR:MODE PRE`

Service Field Clock Bit   Sets the Locked Clock Bit in Service Field of the PLCP Header.
(CCK,PBCC) - WLAN
Via this flag (bit), the 802.11b/g transmitter indicates whether
transmission frequency and symbol rate have been derived from the
same oscillator. If this is the case (locked), the bit is set to 1, otherwise
(not locked) to 0.

Remote-control command:
`SOUR:BB:WLAN:PLCP:LCB:STAT ON`

Disable Barker Spreading -   (CCK,PBCC) Activates/deactivates barker spreading (bit rates 1 Mbps
WLAN   or 2 Mbps only).

Remote-control command:
`SOUR:BB:WLAN:PLCP:LCB:STAT ON`

Scrambler Init (hex)   Enters the initialization value for scrambling mode User. This value is
(OFDM) - WLAN   then identical in each generated frame.

Remote-control command:
`SOUR:BB:WLAN:SCR:PATT #H3F,8`

Interleaver Active (OFDM) - WLAN

Activates/deactivates the interleaver.

Remote-control command:
SOUR:BB:WLAN:ILE ON

Service field (hex) - WLAN

Enters the value of the service field. The standard specifies a default value of 0. Other values can be entered in hexadecimal form for test purposes or future extensions.

Remote-control command:
SOUR:BB:WLAN:SERV:PATT #H3F,8

Time Domain Windowing Active - WLAN

Activates/deactivates the time domain windowing. Time domain windowing is a method to influence the spectral characteristics of the signal, which is not stipulated by the standard. However, it does not replace oversampling and subsequent signal filtering.

Remote-control command:
SOUR:BB:WLAN:TDW:STAT OFF

Transition Time - WLAN

Sets the transition time when time domain windowing is active.

The transition time defines the overlap range of two OFDM symbols. At a setting of 100 ns, one sample overlaps.

Remote-control command:
SOUR:BB:WLAN:OFDM:TTIM 0.0005ms

Configure MAC Header and FCS... - WLAN

Calls the menu for configuration of the MAC Header and FSC.

The menu is described in Section *MAC Header and FCS Configuration - WLAN*, page 26.

Remote-control command: n.a.

MAC Header and FCS Configuration - WLAN

In the real IEEE 802.11 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. It is also possible to protect the PSDU by a frame checksum. These two functions can be controlled in the menu.

FCS (checksum) - WLAN   Activates/deactivates the calculation of the FCS (frame check sequence). The standard defines a 32-bit (4-byte) check sum to protect the MAC header and the user data (frame body).

Remote-control command:
SOUR:BB:WLAN:PSDU:MAC:FCS:STAT ON

MAC Header - WLAN   Activates/deactivates the generation of the MAC Header for the PSDU. If the MAC header is activated, all MAC header fields are enabled for operation.

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

All values of the MAC fields (except addresses) 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:WLAN:PSDU:MAC:STAT ON

Frame Control - WLAN   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, sub type and its function, etc.. As an alternative, the individual bits can be set in the lower part of the graph.

Remote-control command:
```
SOUR:BB:WLAN:PSDU:MAC:FCON #H100A,16
SOUR:BB:WLAN:PSDU:MAC:FCON:PVER #H8,2
SOUR:BB:WLAN:PSDU:MAC:FCON:TYPE  #H8,2
SOUR:BB:WLAN:PSDU:MAC:FCON:SUBType  #H5,4
SOUR:BB:WLAN:PSDU:MAC:FCON:TDS  #H8,1
SOUR:BB:WLAN:PSDU:MAC:FCON:FDS  #H0,1
SOUR:BB:WLAN:PSDU:MAC:FCON:MFRagments  #H8,1
SOUR:BB:WLAN:PSDU:MAC:FCON:RETR  #H0,1
SOUR:BB:WLAN:PSDU:MAC:FCON:PMAN  #H0,1
SOUR:BB:WLAN:PSDU:MAC:FCON:MDAT  #H8,1
SOUR:BB:WLAN:PSDU:MAC:FCON:WEP  #H0,1
SOUR:BB:WLAN:PSDU:MAC:FCON:ORD  #H8,1
```

802.11 MAC Frame Control Field										
Protocol Version	Type	Subtype	To DS	From DS	More Frag	Retry	Pwr Mgt	More Data	WEP	Order
00	00	0000	0	0	0	0	0	0	0	0
2 bit (LSBits)	2 bit	4 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit (MSBit)

Duration Id - WLAN   Enters the value of the duration Id field.

Depending on the frame type, the 2-byte field Duration/ID is used to transmit the association identity of the station transmitting the frame or it indicates the duration assigned to the frame type.

Remote-control command:
```
SOUR:BB:WLAN:PSDU:MAC:DID #HA5A5,16
```

MAC Address - WLAN   Enters the value of the address fields 1 ... 4.

The MAC header may contain up to four address fields, but not all of them must be available. Each of the 4 address fields can be activated or deactivated. The fields are used for transmitting the basic service set identifier, the destination address, the source address, the receiver address and the transmitter address. Each address is 6 bytes (48 bit) long. The addresses can be entered in hexadecimal form in the entry field of each address field. The least significant byte (LSB) is in left notation.

Remote-control command:
```
SOUR:BB:WLAN:PSDU:MAC:ADDR2:STAT ON
SOUR:BB:WLAN:PSDU:MAC:ADDR2 #H124836C7EA54,48
```

Sequence Control - WLAN   Activates/deactivates the sequence control field.

The sequence control field has a length of 2 bytes and is divided in two parts, the fragment number (4 bits) and the sequence number (12 bits) field. 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 packet without an error and does not request a retransmission, the sequence number is incremented by 1 for each packet (the field is reset to 0 at the latest after a count of 4095). 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 packets required to increment the corresponding counter can be defined for both numbers. This is done with the parameters **Start Number** and **Incremented every ... packet(s)** (see below).

Example:

An error-free transmission of 50 packets (no packet retransmission) is to be simulated. The sequence number should be incremented by 1 for each packet. Since no packet 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 packets are received incorrectly or if the response of the receiver should be tested when the same packet arrives several times, the number of packets required to increment the sequence number can be set to 2, for example. Each packet will then automatically be sent twice (with identical data).

Remote-control command:
```
SOUR:BB:WLAN:PSDU:MAC:SCON:STAT ON
SOUR:BB:WLAN:PSDU:MAC:SCON:FRAG:STAR  #H0,4
SOUR:BB:WLAN:PSDU:MAC:SCON:SEQ:STAR   #H0,4
SOUR:BB:WLAN:PSDU:MAC:SCON:FRAG:INCR  2
SOUR:BB:WLAN:PSDU:MAC:SCON:SEQ:INCR   4
```

Start Number - WLAN   Sets the start number of the fragment bits or the sequence bits of the sequence control (see example above).

Remote-control command:
```
SOUR:BB:WLAN:PSDU:MAC:SCON:FRAG:STAR   #H0,4
SOUR:BB:WLAN:PSDU:MAC:SCON:SEQ:STAR    #H0,4
```

Increment Every - WLAN   Defines the number of packets required to increment the counter of the fragment bits or the sequence bits of the sequence control (see example above).

Remote-control command:
```
SOUR:BB:WLAN:PSDU:MAC:SCON:FRAG:INCR   2
SOUR:BB:WLAN:PSDU:MAC:SCON:SEQ:INCR    4
```

Frame Body - WLAN   Indicates the length of the user data (frame body).

Remote-control command: n.a.

FCS - WLAN   Indicates the length of the check sum.

Remote-control command:n.a.

PPDU Graph - WLAN

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

The frame structure for the different physical layer modes is described in section "*Physical Layer CCK-PBCC*", on page 5.

Physical layer Mode OFDM
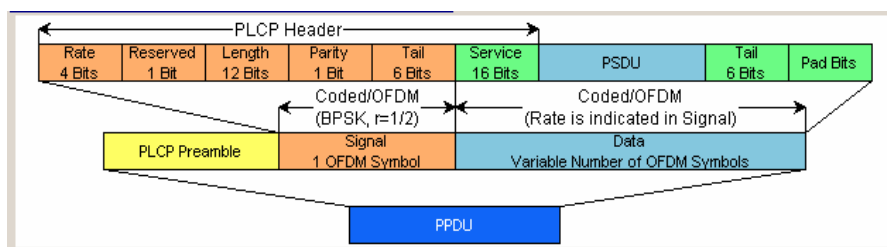
Physical layer Mode CCK, Long PLCP
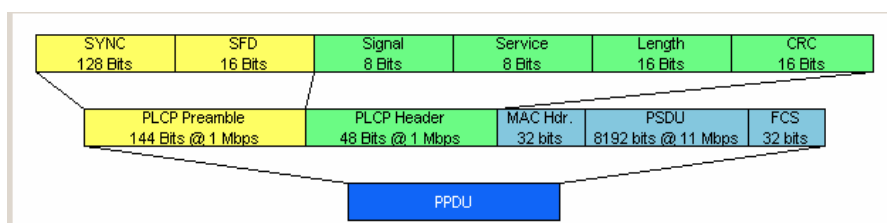
Filter, Clipping - WLAN

The **Filter, Clipping...** menu is reached via the WLAN main menu.

The filter type and parameters, the chip rate variation (**Filter** section) and clipping (**Clipping** section) are defined in this menu.
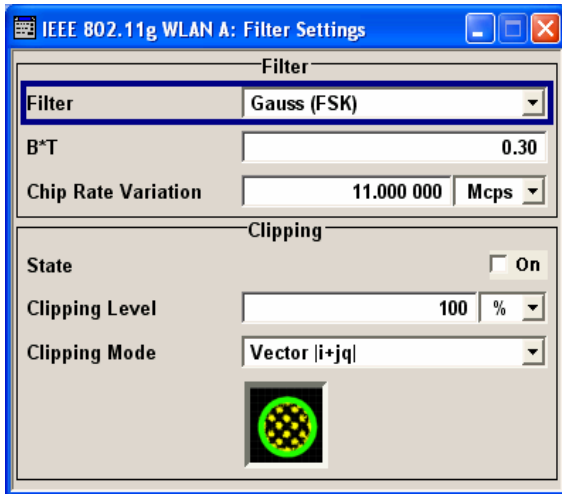
In the **Filter** section, the settings are made for the baseband filter.

Filter - WLAN	Selects baseband filter.
	This opens a selection window containing all the filters available to the instrument.
	In 802.11a/g OFDM mode, a cosine filter with roll-off factor 0.1 is used by default to achieve the spectrum masks requirement.
	In 802.11b/g CCK/PBCC mode, a gauss (FSK) filter with B*T 0.5 is used by default to achieve the spectrum masks requirement.
	The filter types are described in Section "*Baseband Filter - Custom Digital Mod*".
	Remote-control command: `SOUR:BB:WLAN:FILT:TYPE RCOS`
Roll Off Factor or BxT - WLAN	Enters the filter parameters.
	The filter parameter offered (Roll Off factor or B*T) depends on the currently selected filter type. This parameter is always set to the default for each of the predefined filters.

	Remote-control commands:
	`SOUR:BB:WLAN:FILT:PAR:APCO25 0.2`
	`SOUR:BB:WLAN:FILT:PAR:COS 0.35`
	`SOUR:BB:WLAN:FILT:PAR:GAUS 0.5`
	`SOUR:BB:WLAN:FILT:PAR:PGA 0.5`
	`SOUR:BB:WLAN:FILT:PAR:RCOS 0.35`
	`SOUR:BB:WLAN:FILT:PAR:SPH 2`

Cut Off Frequency Factor - WLAN

(This feature is available for filter parameter Lowpass only.)

Sets the value for the cut off frequency factor. The cut off frequency of the lowpass filter can be adjusted to reach spectrum mask requirements.

Remote-control command:
SOUR:BB:WLAN:FILT:PAR:LPAS 0.5

Chip Rate Variation - WLAN

Enters the chip rate. For each physical layer mode an own parameter is defined. Which parameter is affected depends on the currently selected mode.

The chip rate entry changes the output clock and the modulation bandwidth, as well as the synchronization signals that are output. It does not affect the calculated chip sequence.

Remote-control command:
SOUR:BB:WLAN:CRAT:VAR 11MCPS

Impulse Length - WLAN

(For R&S WinIQSIM2 only)

Displays the number of filter tabs. If the check box is activated, the most sensible parameter values are selected. The value depends on the coherence check. If the check box is deactivated, the values can be changed manually.

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

Oversampling - WLAN

(For R&S WinIQSIM2 only)

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

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

The settings for clipping are collected in the Clipping section.

Clipping State - WLAN   Switches baseband clipping on and off.

Baseband clipping is a very simple and effective way of reducing the crest factor of the WLAN signal.

WLAN signals may have high crest factors particularly in the 802.11a/g OFDM mode. 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:WLAN:CLIP:STAT ON

Clipping Level- WLAN   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:WLAN:CLIP:LEV 50

Clipping Mode - WLAN   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.
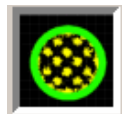
Remote-control command:
SOUR:BB:WLAN:CLIP:MODE VECT

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.
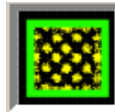
Remote-control command:
```
SOUR:BB:WLAN:CLIP:MODE SCAL
```

Trigger/Marker/Clock - WLAN

Note:
   The trigger, clock, and marker delay functions are available for SMx and AMU instruments only.

The **Trigger/Marker/Clock** menu can be reached via the IEEE 802.11a-g WLAN main menu.

The **Trigger In** section is where the trigger for the WLAN signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation (**Running** or **Stopped**) is indicated for all trigger modes.

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

The **Marker Delay** section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.

The **Clock Settings** section is where the clock source is selected and - in the case of an external source - the clock type.

The **Global Trigger/Clock Settings** button leads to a submenu for general trigger and clock settings.
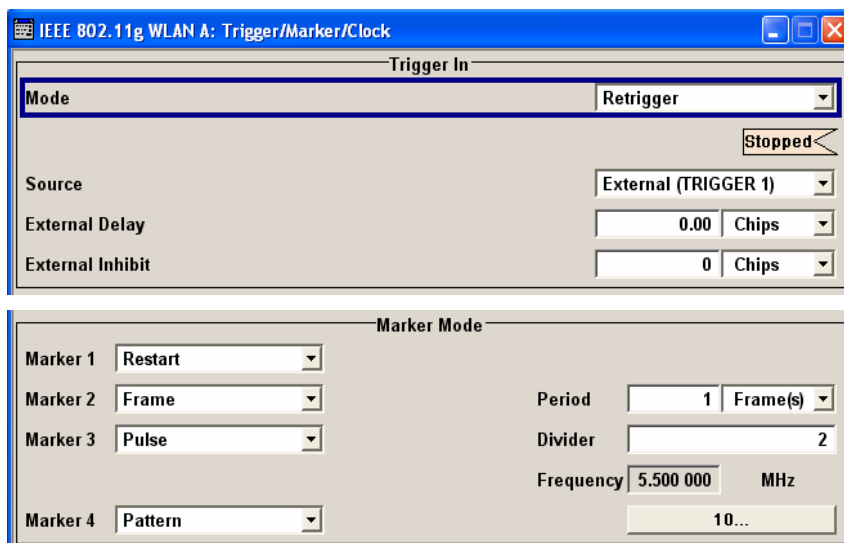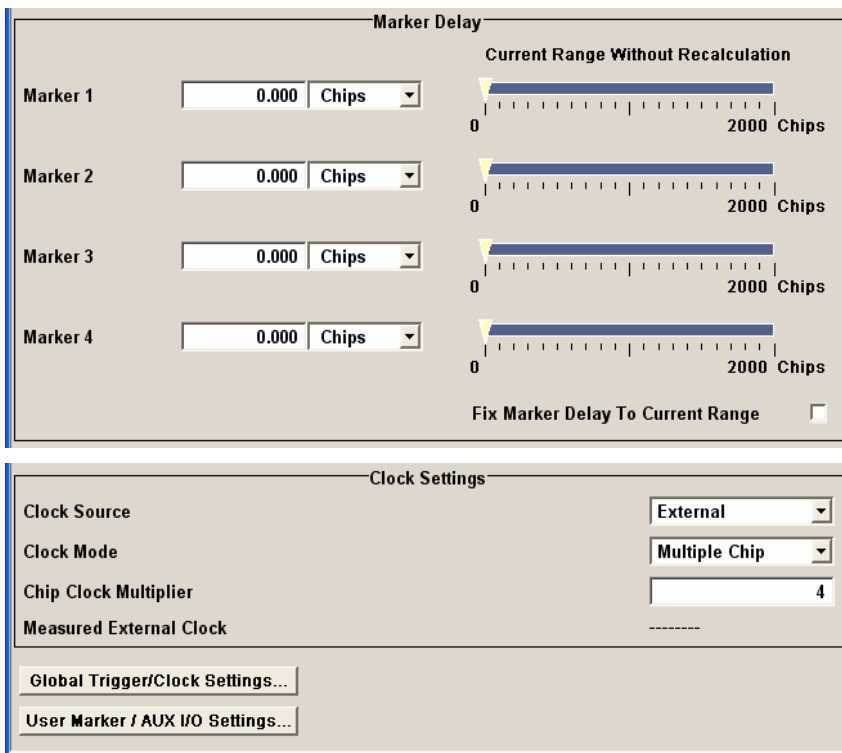
The Trigger In section is where the trigger for the IEEE 802.11a-g WLAN signal is set. The current status of the signal generation is displayed for all trigger modes.

Trigger Mode - WLAN   **(R&S SMx and R&S AMU instruments only)**

Selects trigger mode.

The trigger mode determines the effect of a trigger on the signal generation.

            Auto   The IEEE 802.11a-g WLAN signal is generated continuously.

                                  Remote-control command:
                                  `SOUR:BB:WLAN:SEQ   AUTO`

            Retrigger   The IEEE 802.11a-g WLAN signal is generated continuously. A trigger event (internal or external) causes a restart.

                                  Remote-control command:
                                  `SOUR:BB:WLAN:SEQ   RETR`

Armed_Auto   The IEEE 802.11a-g WLAN-Signal signal is generated only when a trigger event occurs. Then the signal is generated continuously.

Button **Arm** stops signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
SOUR:BB:WLAN:SEQ AAUT

Armed_Retrigger The IEEE 802.11a-g WLAN-Signal signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

Button **Arm** stops signal generation. A subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
SOUR:BB:WLAN:SEQ ARET

Single   The IEEE 802.11a-g WLAN signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at **Sequence Length**. Every subsequent trigger event (internal with **Execute Trigger** or external) causes a restart.

Remote-control command:
SOUR:BB:WLAN:SEQ SING

Signal Duration - WLAN   **(R&S SMx and R&S AMU instruments only)**

Defines the length of the signal sequence to be output in the **Single** trigger mode. The input is to be expressed in chips. It is then possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Remote-control commands:
SOUR:BB:WLAN:TRIG:SLEN 2000

Signal Duration Unit - WLAN   **(R&S SMx and R&S AMU instruments only)**

Defines the unit for the entry of the length of the signal sequence to be output in the **Single** trigger mode. Available units are frame, chip or sequence length (SL).

Remote-control commands:
SOUR:BB:WLAN:TRIG:SLUN FRAM

Running - Stopped - WLAN **(R&S SMx and R&S AMU instruments only)**

Displays the status of signal generation for all trigger modes. This display appears only when IEEE 802.11a-g WLAN is enabled (**State On**).

Remote-control command:
```
SOUR:BB:WLAN:TRIG:RMOD?
```
Response: `RUN or STOP`

Running	The IEEE 802.11a-g WLAN modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode.
	If Armed_Auto and Armed_Retrigger have been selected, generation of signals can be stopped with the Arm button. A new trigger (internally with Execute Trigger or externally) causes a restart.
Stopped	The signal is not generated, and the instrument waits for a trigger event (internal or external).

Arm - WLAN **(R&S SMx and R&S AMU instruments only)**

Stops signal generation. This button appears only with **Running** signal generation in the **Armed_Auto** and **Armed_Retrigger** trigger modes.

Signal generation can be restarted by a new trigger (internally with **Execute Trigger** or externally).

Remote-control command:
```
SOUR:BB:WLAN:TRIG:ARM:EXEC
```

Execute Trigger - WLAN **(R&S SMx and R&S AMU instruments only)**

(Trigger Source Internal only)

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than Auto have been selected.

Remote-control commands:
```
SOUR:BB:WLAN:TRIG:SOUR INT
SOUR:BB:WLAN:SEQ RETR
SOUR:BB:WLAN:TRIG:EXEC
```

Trigger Source - WLAN   **(R&S SMx and R&S AMU instruments only)**

Selects trigger source. This setting is effective only when a trigger mode other than **Auto** has been selected.

Internal	The trigger event is executed by **Execute Trigger**.
	Remote-control command: `SOUR:BB:W3GP:TRIG:SOUR INT`
Internal (Baseband A/B)	The trigger event is executed by the trigger signal from the second path (two-path instruments only).
	Remote-control command: `SOUR:BB:W3GP:TRIG:SOUR OBAS`
External (TRIGGER 1 / 2)	The trigger event is executed with the aid of the active edge of an external trigger signal. The trigger signal is supplied via the TRIGGER 1 or TRIGGER 2 connector.
	The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the **Global Trigger/Clock Settings** menu.
	Remote-control command: `SOUR:BB:W3GP:TRIG:SOUR EXT │ BEXT`

Trigger Delay - WLAN   **(R&S SMx and R&S AMU instruments only)**

Sets trigger signal delay in chips on external triggering (or on internal triggering via the second path for two-path instruments).

This enables the R&S Signal Generator to be synchronized with the device under test or other external devices.

Note
> *For two path-instruments, the delay can be set separately for each of the two paths.*

Remote-control command:
```
SOUR:BB:WLAN:TRIG:EXT:DEL 3
SOUR:BB:WLAN:TRIG:OBAS:DEL 3
```

Trigger Inhibit - WLAN   **(only trigger source External or, in case of two-path instruments, trigger source Internal Other baseband)**

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in chips.

In the **Retrigger** mode every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of chips.

This parameter is only available on external triggering or on internal triggering via the second path.

Note:
For two-path instruments, the trigger inhibit can be set separately for each of the two paths.

Remote-control command：
```
SOUR:BB:WLAN:TRIG:EXT:INH 1000
SOUR:BB:WLAN:TRIG:OBAS:INH 1000
```

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

Marker x Mode - WLAN   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:WLAN:TRIG:OUTP1:MODE   REST
```

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

Remote-control command:
```
SOUR:BB:WLAN:TRIG:OUTP1:MODE   FRAM
```

Frame Active   A marker signal is generated at the start of every active part of the frame.
The active data transfer part (PPDU) of a frame period is marked with high, the inactive part (idle time) with low. This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.

Remote-control command:
```
SOUR:BB:WLAN:TRIG:OUTP1:MODE   FACT
```

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.

Divider	2
Frequency	5.500 000 MHz

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

Pattern   A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when **pattern** is selected.

```
           0000 0000
```

Remote-control commands:
```
SOUR:BB:WLAN:TRIG:OUTP1:MODE PATT
SOUR:BB:WLAN:TRIG:OUTP1:PATT #B1111,4
```

ON/OFF ratio A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle.

Start of signal

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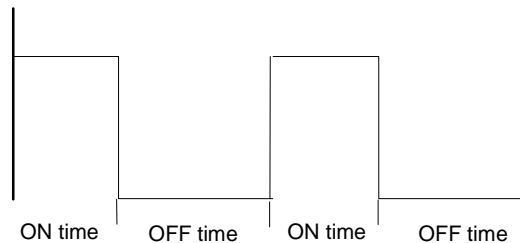
The ON time and OFF time are each expressed as a number of symbols and are set in an input field which opens when **ON/OFF ratio** is selected.

On Time	2	Sym
Off Time	3	Sym

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

The Marker Delay section can be used to set a delay for the markers.

Note:
The marker delay functions are available for SMx and AMU instruments only.

Marker x Delay - WLAN   **(R&S SMx and R&S AMU instruments only)**

Enters the delay between the marker signal at the marker outputs and the start of the signal.

The input is expressed as a number of chips.

If the setting "**Fix marker delay to dynamic range**" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals can be set without restarting the marker and signal.

The allocation of marker signals to the outputs is described in the section "*Marker Output Signals*".

Remote-control command:
SOUR:BB:WLAN:TRIG:OUTP2:DEL 20

Current Range without   **(R&S SMx and R&S AMU instruments only)**
Calculation - WLAN

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

Remote-control command:
SOUR:BB:WLAN:TRIG:OUTP2:DEL:MAX?
SOUR:BB:WLAN:TRIG:OUTP2:DEL:MIN?

Fix marker delay to current   **(R&S SMx and R&S AMU instruments only)**
range - WLAN

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

Remote-control command:
SOUR:BB:WLAN:TRIG:OUTP:DEL:FIX ON

The clock source is selected in the **Clock Settings** section.

Note:
   The clock delay functions are available for SMx and AMU instruments only.

Clock Source - WLAN   **(R&S SMx and R&S AMU instruments only)**

Selects the clock source (also see section "*Clock Signals*").

Internal   The internal clock reference is used to generate the chip clock.

Remote-control command:
SOUR:BB:WLAN:CLOC:SOUR INT

	External	The external clock reference is fed in as the chip clock or multiple thereof via the CLOCK connector.
		The chip rate must be correctly set to an accuracy of ± 2 % (see data sheet).
		The polarity of the clock input can be changed with the aid of **Global Trigger/Clock Settings**.
		In the case of two-path instruments, this selection applies to path A.
		Remote-control command: `SOUR:BB:WLAN:CLOC:SOUR EXT`

Clock Mode - WLAN **(R&S SMx and R&S AMU instruments only)**

(Clock source **External** only)

Enters the type of externally supplied clock.

	Chip	A chip clock is supplied via the CLOCK connector.
		Remote-control command: `SOUR:BB:WLAN:CLOC:MODE CHIP`
	Multiple	A multiple of the chip clock is supplied via the CLOCK connector; the chip clock is derived internally from this.
		The **Multiplier** window provided allows the multiplication factor to be entered.
		Remote-control command: `SOUR:WIM:CLOC:MODE MCH`

Chip Clock Multiplier - WLAN **(R&S SMx and R&S AMU instruments only)**

Enters the multiplication factor for clock type **Multiple**.

Remote-control command:
`SOUR:BB:WLAN:CLOC:MULT 4`

Measured External Clock - WLAN

(R&S SMx and R&S AMU instruments only)

(Clock source **External** only)

Displays the measured frequency of the external clock signal. This enables the user to permanently monitor the frequency of the externally introduced clock.

This information is displayed only if the external clock source has been selected.

Remote-control command:
`:CLOC:INP:FREQ?`

Global Trigger/Clock Settings - WLAN

(R&S SMx and R&S AMU instruments only)

Calls the **Global Trigger/Clock/Input Settings** menu. This menu is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

In the case of two-path instruments, these settings are valid for both paths.

The parameters in this menu affect all digital modulations and standards, and are described in the section "*Global Trigger/Clock/Input Settings – Setup -Environment*".

User Marker / AUX I/O Settings - WLAN

(R&S SMx and R&S AMU instruments only)

Calls the **User Marker AUX I/O Settings** menu. This menu is used to map the connector on the rear of the instruments, see section "*User Marker - AUX IO - Setup-Environment-Global...Settings*".

SOURce:BB:WLAN Remote-control Commands

This subsystem contains commands for the primary and general settings of the IEEE 802.11a-g WLAN standard. These settings concern activation and deactivation of the standard, setting the transmission direction, filter, clock, trigger and clipping settings, defining the frame duration and the sequence length, as well as the preset setting.

The commands for defining the frame configuration for physical layer modes OFDM and CCK/PBCC are described in the next section. The commands are divided up in this way to make the comprehensive `SOURce:BB:WLAN` 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.

SOURce-WLAN - Primary Commands

Command	Parameters	Default unit	Comments
[SOURce<[1]|2>:]BB:WLAN:CLIPping:LEVel	1...100	PCT	
[SOURce<[1]|2>:]BB:WLAN:CLIPping:MODE	VECTor | SCALar		
[SOURce<[1]|2>:]BB:WLAN:CLIPping:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:CLOCk:MODE	CHIP | MCHip		
[SOURce<[1]|2>:]BB:WLAN:CLOCk:MULTiplier	1... 64		
[SOURce<[1]|2>:]BB:WLAN:CLOCk:SOURce	EXTernal | INTernal		
[SOURce<[1]|2>:]BB:WLAN:CRATe:VARiation	0.001 ... 40 Mcps	Hz (c/s)	
[SOURce<[1]|2>:]BB:WLAN:FFORmat	DATA | RTS | CTS | ACK | USER		
[SOURce<[1]|2>:]BB:WLAN:FILTer:ILENgth	1...128		
[SOURce<[1]|2>:]BB:WLAN:FILTer:ILENgth:AUTO	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:FILTer:OSAMpling	1...32		
[SOURce<[1]|2>:]BB:WLAN:FILTer:OSAMpling:AUTO	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:APCO25	0.15 ... 2.5		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:COSine	0.05 ... 0.99		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:GAUSs	0.15 ... 2.5		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:LPASs	0.05...2.0		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:PGAuss	0.15 ... 2.5		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:RCOSine	0.05 ... 0.99		
[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:SPHase	0.15 ... 2.5		

Command	Parameters	Default unit	Comments
[SOURce<[1]|2>:]BB:WLAN:FILTer:TYPE	RCOSine | COSine | GAUSs | LGAuss | CONE | COF705 | COEQualizer | LPASs COFequalizer | DIRac C2K3x | APCO25 | SPHase | ENPShape| RECTangle | PGAuss | EWPShape		
[SOURce<[1]|2>:]BB:WLAN:ILEaver:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:ITIMe	0.0 .... 1E-1		
[SOURce<[1]|2>:]BB:WLAN:PLCP:FORMat	LONG | SHORt		
[SOURce<[1]|2>:]BB:WLAN:PLCP:LCBit:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:MODE	OFDM | CCK | PBCC		
[SOURce<[1]|2>:]BB:WLAN:PRESet			No query
[SOURce<[1]|2>:]BB:WLAN:SCRambler:MODE	ON | OFF | RANDom | USER | PONLy		
[SOURce<[1]|2>:]BB:WLAN:SCRambler:PATTern	0x0 .. 0xFF		
[SOURce<[1]|2>:]BB:WLAN:SEQuence	AUTO | RETRigger | AAUTo | ARETrigger | SINGle		
[SOURce<[1]|2>:]BB:WLAN:SERVice:PATTern	0x0 .. 0xFFFF		
[SOURce<[1]|2>:]BB:WLAN:SETTing:CATalog?			Query only
[SOURce<[1]|2>:]BB:WLAN:SETTing:DELete	<file_name>		
[SOURce<[1]|2>:]BB:WLAN:SETTing:LOAD	<file_name>		
[SOURce<[1]|2>:]BB:WLAN:SETTing:STORe	<file_name>		
[SOURce<[1]|2>:]BB:WLAN:SLENgth	1... MAX		
[SOURce<[1]|2>:]BB:WLAN:SMODe	FRAMed | UNFRamed		
[SOURce<[1]|2>:]BB:WLAN:STANdard	STAN80211A | STAN80211B | STAN80211G		
[SOURce<[1]|2>:]BB:WLAN:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN::TDWindowing:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:ARM:EXECute			No query
[SOURce<[1]|2>:]BB:WLAN:TRIGger:EXECute			No query
[SOURce<[1]|2>:]BB:WLAN:TRIGger[:EXTernal<[1]|2>]:DELay	0 ...(2^32 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger[:EXTernal<[1]|2>]:INHibit	0 ...(2^32 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OBASeband:DELay	0 ...(2^32 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OBASeband:INHibit	0 ...(2^32 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:DELay	0 ...(2^32 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut:DELay:FIXed	ON | OFF	Hz	
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:DELay:MAXimum			Query only
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:DELay:MINimum			Query only
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:MODE	RESTart | FRAMe | PULSe | PATTern | RATio		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:OFFTime	2 ... (2^24 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:ONTime	2 ... (2^24 - 1) chips		

Command	Parameters	Default unit	Comments
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:PATTern	#B0,1...#B111..1,32		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:PULSe:DIVider	2 ... 1024		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:PULSe:FREQuency			Query only
[SOURce<[1]|2>:]BB:WLAN:TRIGger:RMODe			Query only
[SOURce<[1]|2>:]BB:WLAN:TRIGger:SLENgth	0 ...(2^32 - 1) chips		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:SLUNit	FRAMe | CHIP | SEQuence		
[SOURce<[1]|2>:]BB:WLAN:TRIGger:SOURce	EXTernal | INTernal | BEXTernal | OBASeband		
[SOURce<[1]|2>:]BB:WLAN:TTIMe	0 ... 1000.0 ns	s	
[SOURce<[1]|2>:]BB:WLAN:WAVeform:CREate			No query

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

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

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

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

     "BB:WLAN:CLIP:STAT ON"
     'activates level clipping.

*RST value	Resolution	SCPI
100 PCT	1	Device-specific

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

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

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

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

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

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

     "BB:WLAN:CLIP:STAT ON"
     'activates level clipping.

*RST value	Resolution	SCPI
VECTor	-	Device-specific

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

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

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

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:WLAN:CLOCk:MODE   CHIP | MCHip

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command enters the type of externally supplied clock (`:BB:WLAN:CLOCk:SOURce EXTernal`).

When `MCHip` is used, a multiple of the chip clock is supplied via the CLOCK connector and the chip clock is derived internally from this. The multiplier is entered with the command `:BB:WLAN:CLOCk:MULTiplier`.

For two-path instruments, the only numerical suffix allowed for SOURce is 1, since the external clock source is permanently allocated to path A.

Example: `"BB:WLAN:CLOC:MODE CHIP"`
                'selects clock type **Chip**, i.e. the supplied clock is a chip clock.

*RST value	Resolution	SCPI
CHIP	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:CLOCk:MULTiplier   1 ... 64

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command specifies the multiplier for clock type **Multiplied** (`:BB:WLAN:CLOCk:MODE MCHip`) in the case of an external clock source.

For two-path instruments, the only numerical suffix allowed for SOURce is 1, since the external clock source is permanently allocated to path A.

Example: `"BB:WLAN:CLOC:SOUR EXT"`
                'selects the external clock source. The clock is supplied via the CLOCK connector.

                `"BB:WLAN:CLOC:MODE MCH"`
                'selects clock type **Multiplied**, i.e. the supplied clock has a rate which is a multiple of the chip rate.

                `"BB:WLAN:CLOC:MULT 12"`
                'the multiplier for the external clock rate is 12.

*RST value	Resolution	SCPI
4	1	Device-specific

[SOURce<[1]|2>:]BB:WLAN:CLOCk:SOURce   INTernal | EXTernal | AINTernal

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command selects the clock source.

For two-path instruments, selecting EXTernal is only possible for path A, since the external clock source is permanently allocated to path A; selecting AINTernal is only possible for path B.

| Parameter: | **INTernal** | The internal clock reference is used. |
| | **EXTernal** | The external clock reference is supplied to the CLOCK connector. |

Example:	"BB:WLAN:CLOC:SOUR EXT"
	'selects an external clock reference. The clock is supplied via the CLOCK connector.
	"BB:WLAN:CLOC:MODE CHIP"
	'specifies that a chip clock is supplied via the CLOCK connector.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:CRATe:VARiation   1 kcps ... 40 Mcps

The command enters the output chip rate.

| Example: | "BB:WLAN:CRAT:VAR 4086001" |
| | ''sets the output chip rate to 4.08 Mcps. |

*RST value	Resolution	SCPI
802.11a: 20 Mcps 802.11b: 11 Mcps 802.11g: 11 Mcps	1 Hz	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FFORmat   DATA | RTS | CTS | ACK | USER

The command selects the frame type. The selection defines parameters of the MAC layer, e.g. the values of the MAC Header bit fields. The command is only valid in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Parameter:	**DATA**	Predefined settings for data transmission.
	RTS	Predefined settings for Request to Send.
	CTS	Predefined settings for Clear to Send.
	ACK	Predefined settings for Acknowledgement.
	USER	User defined settings (response for query only)

| Example: | "BB:WLAN:SMODe FRAM"   'selects framed mode. |
| | "BB:WLAN:FFOR RTS"   'selects frame type RTS. |

*RST value	Resolution	Dependencies	SCPI
DATA	-	The selection defines parameters of the MAC layer, e.g. the values of the MAC Header bit fields	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FILTer:ILENgth 1...128   E-2

Note: *This command is available for R&S WinIQSIM2 only.*

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

Example: "BB:WLAN:FILT:ILEN 10"

                    'sets the number of filter tabs to 10.

*RST value	Resolution	SCPI
10	1	Device-specific

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

Note: *This command is available for R&S WinIQSIM2 only.*

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

Example: "BB:WLAN:FILT:ILEN:AUTO ON"

                    'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

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

Note: *This command is available for R&S WinIQSIM2 only.*

The command sets the upsampling factor.

Example: "BB:WLAN:FILT:OSAM 32"

                    'sets the upsampling factor to 32.

*RST value	Resolution	SCPI
32	-	Device-specific

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

Note: *This command is available for R&S WinIQSIM2 only.*

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

Example: "BB:WLAN:FILT:OSAM:AUTO ON"

                    'the most sensible parameters are selected automatically.

*RST value	Resolution	SCPI
ON	-	Device-specific

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

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

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

*RST value	Resolution	SCPI
0.20	0.01	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:COSine 0.05 ... 0.99

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

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

*RST value	Resolution	SCPI
0.35	0.01	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:PGAuss 0.15 ... 2.5

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

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

*RST value	Resolution	SCPI
0.5	0.01	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:GAUSs 0.15 ... 2.5

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

Example: `"BB:WLAN:PAR:COS 0.5"`   'sets B x T to 0.5 for the Gauss filter type.

*RST value	Resolution	SCPI
0.5	0.01	Device-specific

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

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

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

*RST value	Resolution	SCPI
0.50		Device-specific

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

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

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

*RST value	Resolution	SCPI
0.22	0.01	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FILTer:PARameter:SPHase 0.15 ... 2.5

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

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

*RST value	Resolution	SCPI
2.00	0.01	Device-specific

[SOURce<[1]|2>:]BB:WLAN:FILTer:TYPE RCOSine|COSine|GAUSs|LGAuss|PGAuss|DIRAc|APCO25 COF705|COEQualizer|COFequalizer|C2K3x|SPHase|EWPShape|RECTangle|LPASs|ENPShape|CONE

The command selects the filter type. The filter types are described in Chapter 4, Section "*Custom Dig Mod*".

Example: `"BB:WLAN:FILT:TYPE COS"`
                'sets the filter type COSine.

*RST value	Resolution	SCPI
Depends on layer mode	-	Device-specific

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

The command activates/deactivates the interleaver. This command is only available in physical layer mode OFDM (`SOURce:BB:WLAN:MODE OFDM`).

Example: `"BB:WLAN:STAN STAN80211g"`
                'selects standard 802.11g.

                `"BB:WLAN:MODE OFDM"`
                'selects physical layer mode OFDM.

                `"BB:WLAN:ILE ON"`
                'activates the interleaver.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:ITIMe 0 ... 0.01 s

The command sets the idle time, i.e. the time between two PPDU bursts. This command is only available for framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: `"BB:WLAN:ITIM 10us"`
                'sets an idle time of 10 us.

*RST value	Resolution	SCPI
100 us	1 us	Device-specific

[SOURce<[1]|2>:]BB:WLAN:MODE   OFDM | CCK | PBCC

The command selects the Physical Layer Mode.

Parameter:	**OFDM**	The OFDM (orthogonal frequency division multiplexing) physical layer supports a frame-based transmission. The OFDM (orthogonal frequency division multiplexing) signal is divided into 52 carriers. The symbol rate of the modulation on the individual carriers is 250 kHz. A user data rate of up to 54 Mbps at a channel bandwidth of 20 MHz can be obtained by combining 48 useful carriers for data transmission (4 carriers are used for pilots) and using 64QAM for subcarrier modulation. With OFDM, the individual carriers are superimposed mutually orthogonal, which, in the ideal case, does not cause any intercarrier interference (ICI).
	CCK	The CCK (complementary code keying) physical layer mode is used for the 5.5 Mbps and 11 Mbps data rates.
	PBCC	The PBCC (packet binary convolutional coding) physical layer can optionally be used instead of CCK modulation.

Example: `"BB:WLAN:MODE OFDM"`
                'selects physical layer mode OFDM.

*RST value	Resolution	SCPI
OFDM	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PLCP:FORMat   LONG | SHORt

The command selects the packet type (PPDU format) with long or short PLCP (physical layer convergence protocol) (framed mode only). Depending on the format selected, the structure, modulation and data rate of the PLCP preamble and header are modified. The command is only available in framed mode (SOURce:BB:WLAN:SMODe FRAMed) and for physical layer mode CCK and PBCC (SOURce:BB:WLAN:MODE CCK|PBCC).

Example: `"BB:WLAN:PLCP:FORM LONG"`
                'selects the packet type (PPDU format) with long PLCP.

*RST value	Resolution	SCPI
LONG	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PLCP:LCBit:STATe ON | OFF

The command sets the Locked Clock Bit in Service Field of the PLCP Header. The command is only available in framed mode (`SOURce:BB:WLAN:SMOD FRAMed`) and for physical layer mode CCK and PBCC (`SOURce:BB:WLAN:MODE CCK|PBCC`).

Example:　　　　`"BB:WLAN:PLCP:LCB:STAT OFF"`　　　'disables the Locked Clock Bit.

*RST value	Resolution	SCPI
ON	-	Device-specific

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

The command produces a standardized default for the IEEE 802.11a-g 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:WLAN:PRES"`
　　　　　　　'resets all the IEEE 802.11a-g settings to default values.

*RST value	Resolution	Dependencies	SCPI
-	-	All IEEE 802.11a-g settings are preset. An overview is provided by Table in Chapter 4 (see Set to Default).	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SCRambler:MODE OFF | RANDom | USER (OFDM) OFF | ON | PONLy (CCK / PBCC)

The command activates/deactivates the scrambler and selects the mode of determining the initialization value. The valid parameters depend on the selected physical layer mode (`SOURce:BB:WLAN:MODE  OFDM | CCK|PBCC`).

Parameter:　　　**OFF**　　　　The scrambler is deactivated.

　　　　　　　RANDom　　`(OFDM only)`The scrambler is activated. The initialization value of the scrambler is selected at random. Each frame has a different random initialization value. This value is also different in case of successive recalculations with the same setting parameters so that different signals are generated for each calculation.

　　　　　　　USER　　　　`(OFDM only)`The scrambler is activated. The initialization value of the scrambler is set to a fixed value that is entered at **Scrambler Init (hex)** . This value is then identical in each generated frame.

　　　　　　　ON　　　　`(CCK | PBCC only)`The scrambler is activated.

　　　　　　　PONLy　　　`(CCK | PBCC only)`The scrambler is activated. Only the data of the preamble is scrambled.

Example:　　　　`"BB:WLAN:SCR OFF"`
　　　　　　　'the scrambler is deactivated.

*RST value	Resolution	SCPI
OFDM: RANDom CCK/PBCC: ON	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SCRambler:PATTern #H0,0 ... #HFF,8

The command enters the initialization value for scrambling mode User. This value is then identical in each generated frame. The command is only available for physical layer mode OFDM (SOURce:BB:WLAN:MODE OFDM).

Example: "BB:WLAN:SCR USER"   'the scrambler is activated.

                    "BB:WLAN:SCR:PATT #H3F,8"   'the initialization value is set.

*RST value	Resolution	SCPI
#H0,0	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SERVice:PATTern #H0,0 ... #HFF,8

The command enters the value for service fieldThe command is only available for physical layer mode OFDM (SOURce:BB:WLAN:MODE OFDM).

Example: "BB:WLAN:SERV:PATT #H3F,8"   'the value for the service field is set.

*RST value	Resolution	SCPI
#H0,0	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SEQuence AUTO | RETRigger | AAUTo | ARETrigger | SINGle

> *Note:*   *This command is available for R&S SMx and R&S AMU instruments only.*

The command selects the trigger mode.

Parameter:

AUTO   The modulation signal is generated continuously.

RETRigger   The modulation signal is generated continuously. A trigger event (internal or external) causes a restart.

AAUTo   The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command SOUR:BB:WLAN:TRIG:ARM:EXEC and started again when a trigger event occurs.

ARETrigger   The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart. Signal generation is stopped with command SOUR:BB:WLAN:TRIG:ARM:EXEC and started again when a trigger event occurs.

SINGle   The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command SOUR:BB:WLAN:TRIG:SLEN. Every subsequent trigger event causes a restart.

Example: "BB:WLAN:SEQ AAUT"
                    'sets the **Armed_auto** trigger mode; the device waits for the first trigger (e.g. with *TRG) and then generates the signal continuously.

*RST value	Resolution	SCPI
AUTO	-	Device-specific

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

This command reads out the files with IEEE 802.11a-g 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 ***.wlan** will be listed.
The command is a query command and therefore has no *RST value.

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

                    `"BB:WLAN:SETT:CAT?"`
                    'reads out all the files with IEEE 802.11a-g settings in the default directory.

                    Response: `"'wlana','wlang'"`
                    'the files '`'wlana'` and `'wlang'`' are available.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SETTing:DELete <file_name>

This command deletes the selected file with IEEE 802.11a-g WLAN 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 ***.wlan** will be deleted.
This command triggers an event and therefore has no *RST value and no query form.

Example: `"BB:WLAN:SETT:DEL 'wlana'"`   'deletes file 'wlana'.

*RST value	Resolution	SCPI
-	-	Device-specific

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

This command loads the selected file with IEEE 802.11a-g WLAN 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 ***.wlan** will be loaded. This command triggers an event and therefore has no *RST value and no query form.

Example: `"BB:WLAN:SETT:LOAD 'wlana'"`   'loads file 'wlana'.

*RST value	Resolution	SCPI
-	-	Device-specific

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

This command stores the current IEE 802.11a-g WLAN 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. IEE 802.11a-g WLAN settings are stored as files with the specific file extensions ***.wlan**.
This command triggers an event and therefore has no *RST value and no query form.

Example: `"BB:WLAN:SETT:STOR 'wlan_g'"`
                    'stores the current settings into file '`wlan_g`'.

*RST value	Resolution	SCPI
	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SLENgth 1 ... 511 frames

The command selects the number of frames. The command is only valid in framed mode
(`SOURce:BB:WLAN:SMODe FRAMed`).

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

*RST value	Resolution	SCPI
1	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:SMODe FRAMed | UNFRamed

The command selects the simulation mode.

Parameter:	**FRAMed**	The **framed mode** is the standard operating mode which is also used in the real system. Data packets with the frame structure defined by the standard are generated.
	UNFRamed	The **unframed mode** is offered in addition. In this mode, a non-packet-oriented signal without a frame structure is generated with the modulations and data rates defined by 802.11a-g.

Example: "`BB:WLAN:SMOD UNFR`"
                'selects unframed mode.

*RST value	Resolution	SCPI
FRAMed	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:STANdard STAN80211A | STAN80211B | STAN80211G

The command selects the standard according to which the signal is simulated.

Parameter:	**STAN80211A**	The standard supports OFDM (orthogonal frequency division multiplexing). This modulation is defined by the IEEE 802.11a specification in the 5 GHz frequency band.
	STAN80211B	The standard includes the modulation mode CCK (complementary code keying) and the data rates 5.5 Mbps and 11 Mbps. PBCC (packet binary convolutional coding) can optionally be used instead of CCK modulation for the 5.5 Mbps and 11 Mbps data rates.
	STAN80211G	Standard 802.11g extends standard 802.11b with higher transmission rates. 802.11g contains the previous 802.11b modes and also integrates the OFDM method used in 802.11a for frequencies in the 2.4 GHz band.

Example: "`BB:WLAN:STAN STAN80211B`"
                'selects signal generation according to 802.11b.

*RST value	Resolution	SCPI
STAN80211G	-	Device-specific

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

The command activates modulation in accordance with the IEE 802.11a-g WLAN 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:WLAN:STAT ON"

'activates modulation in accordance with the IEE 802.11a-g WLAN standard.

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

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

The command activates/deactivates the time domain windowing. Time domain windowing is a method to influence the spectral characteristics of the signal, which is not stipulated by the standard. However, it does not replace oversampling and subsequent signal filtering. The command is only available for physical layer mode OFDM (SOURce:BB:WLAN:MODE OFDM).

Example: "BB:WLAN:TDW:STAT OFF"

'deactivates the time domain windowing.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:ARM:EXECute

Note:　　　*This command is available for R&S SMx and R&S AMU instruments only.*

The command stops signal generation for trigger modes Armed_Auto and Armed_Retrigger. A subsequent internal or external trigger event restart signal generation.

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

Example: "BB:WLAN:TRIG:SOUR INT"

'sets internal triggering.

"BB:WLAN:TRIG:SEQ ARET"

'sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.

"BB:WLAN:TRIG:EXEC"

'executes a trigger, signal generation is started.

"BB:WLAN:TRIG:ARM:EXEC"

'signal generation is stopped.

"BB:WLAN:TRIG:EXEC"

'executes a trigger, signal generation is started again.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:EXECute

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command executes a trigger. The internal trigger source must be selected using the command `:BB:WLAN:TRIG:SOUR INT` and a trigger mode other than `AUTO` must be selected using the command `:BB:WLAN:TRIG:SEQ`.

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

Example: `"BB:WLAN:TRIG:SOUR INT"` 'sets internal triggering.

   `"BB:WLAN:TRIG:SEQ RETR"`
      'sets Retrigger mode, i.e. every trigger event causes signal generation to restart.

   `"BB:WLAN:TRIG:EXEC"`   'executes a trigger.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger[:EXTernal<[1]|2>]:DELay 0 ... 2^32-1

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command specifies the trigger delay (expressed as a number of chips) for external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `"BB:WLAN:TRIG:SOUR EXT"`
      'sets an external trigger via the TRIGGER 1 connector.

   `"BB:WLAN:TRIG:DEL 50"`
      'sets a delay of 50 chips for the trigger.

*RST value	Resolution	SCPI
0 chips	1 chip	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger[:EXTernal<[1]|2>]:INHibit 0 ... 2^32-1

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command specifies the number of chips by which a restart is to be inhibited following a trigger event. This command applies only in the case of external triggering. The numeric suffix to EXTernal distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

Example: `"BB:WLAN:TRIG:SOUR EXT"`
      'selects an external trigger via the TRIGGER 1 connector.

   `"BB:WLAN:TRIG:INH 200"`
      'sets a restart inhibit for 200 chips following a trigger event.

*RST value	Resolution	SCPI
0 chips	1 chip	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OBASeband:DELay 0 ... 2^32-1

Note:
    This command is available for R&S SMx and R&S AMU two-path instruments only.

The command specifies the trigger delay (expressed as a number of chips) for triggering by the trigger signal from the second path.

Example: `"BB:WLAN:TRIG:SOUR OBAS"`
         'sets for path A the internal trigger executed by the trigger signal from the second path (path B).

         `"BB:WLAN:TRIG:OBAS:DEL 50"`
         'sets a delay of 50 chips for the trigger.

*RST value	Resolution	SCPI
0 chips	1 chips	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OBASband:INHibit 0 ... 2^32-1

Note:
    This command is available for R&S SMx and R&S AMU two-path instruments only.

The command specifies the number of chips by which a restart is to be inhibited following a trigger event. This command applies only for triggering by the second path.

Example: `"BB:WLAN:TRIG:SOUR OBAS"`
         'sets for path A the internal trigger executed by the trigger signal from the second path (path B).

         `"BB:WLAN:TRIG:INH 200"`
         'sets a restart inhibit for 200 chips following a trigger event.

*RST value	Resolution	SCPI
0 chips	1 chip	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:DELay 0 ... 2^32 - 1 Samples

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of chips. Command `:BB:WLAN:TRIGger:OUTPut:DELay:FIXed` can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Example: `"BB:WLAN:TRIG:OUTP2:DEL 1600"`
         'sets a delay of 1600 chips for the signal on connector MARKER 2.

*RST value	Resolution	SCPI
0	1 chip	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut:DELay:FIXed ON | OFF

Note:	*This command is available for R&S SMx and R&S AMU instruments only.*

The command restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is generated.

Example: `"BB:WLAN:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

*RST value	Resolution	SCPI
OFF	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:DELay:MAXimum

Note:	*This command is available for R&S SMx and R&S AMU instruments only.*

The command queries the maximum marker delay for setting `:BB:WLAN:TRIG:OUTP:DEL:FIX ON`.

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

Example: `"BB:WLAN:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`"BB:WLAN:TRIG:OUTP:DEL:MAX"`
'queries the maximum of the dynamic range.

Response: `"2000"`
'the maximum for the marker delay setting is 2000 chips.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:DELay:MINimum

Note:	*This command is available for R&S SMx and R&S AMU instruments only.*

The command queries the minimum marker delay for setting `:BB:WLAN:TRIGger:OUTPut:DELay:FIXed ON`.

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

Example: `"BB:WLAN:TRIG:OUTP:DEL:FIX ON"`
'restricts the marker signal delay setting range to the dynamic range.

`"BB:WLAN:TRIG:OUTP:DEL:MIN"`
'queries the minimum of the dynamic range.

Response: `"0"`
'the minimum for the marker delay setting is 0 chips.

*RST value	Resolution	SCPI
-	-	Device-specific

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

The command defines the signal for the selected marker output.

Parameter:	**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:WLAN:FCOunt`).
	FRAMe	A marker signal is generated at the start of each frame (period = PPDU + idle time).
	FACTive	A marker signal is generated at the start of every active part of the frame. The active data transfer part (PPDU) of a frame period is marked with high, the inactive part (idle time) with low. This marker can be used to decrease the carrier leakage during inactive signal parts by feeding it into the pulse modulator.
	PATTern	A marker signal is generated according to the user defined pattern (command `SOURce:BB:WLAN:TRIGger:OUTPut:PATTern`).
	PULSe	A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the `SOUR:BB:WLAN:TRIG:OUTP:PULSe:DIVider` command and can be queried with the `SOUR:BB:WLAN:TRIG:OUTP:PULSe:FREQuency?` command.
	RATio	A marker signal corresponding to the Time Off / Time On specifications in the commands `SOURce:BB:WLAN:TRIGger:OUTPut:OFFT` and `SOURce:BB:WLAN:TRIGger:OUTPut:ONT` is generated.
Example:		`"BB:WLAN:TRIG:OUTP2:MODE FRAM"` 'selects the frame marker signal on output MARKER 2.

*RST value	Resolution	SCPI
RESTart	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:OFFTime   1.. 2^24 - 1 (1..16 777 215) chips

The command sets the number of chips in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:WLAN:TRIGger:OUTPut:MODE RATio` on the marker outputs is OFF.

Example: `"BB:WLAN:TRIG:OUTP2:OFFT 200"`
                'sets an OFF time of 200 chips for marker signal 2.

*RST value	Resolution	SCPI
1	1	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:OUTPut<[1]...4>:ONTime　1.. 2^24 - 1 (1..16 777 215) chips

The command sets the number of chips in a period (ON time + OFF time) during which the marker signal in setting `SOURce:BB:WLAN:TRIGger:OUTPut:MODE RATio` on the marker outputs is ON.

Example:　　　　`"BB:WLAN: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:WLAN:TRIGger:OUTPut<[1]...4>:PATTern　#B0,1 ... #B111...1, 2

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

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

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

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

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

　　　　　　　　`"BB:WLAN:TRIG:OUTP2:FREQ?"`
　　　　　　　　　'queries the resulting pulse frequency of the marker signal.

　　　　　　　　Response: `"66 000"`
　　　　　　　　　'the resulting pulse frequency is 66 kHz.

*RST value	Resolution	SCPI
2	1	Device-specific

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

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

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

`"BB:WLAN:TRIG:OUTP2:PULS:FREQ?"`
'queries the pulse frequency of the marker signal.

Response: `"33 000"`
'the resulting pulse frequency is 33 kHz.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:RMODe

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command queries the current status of signal generation for all trigger modes with IEEE 802.11a-g WLAN modulation on.

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

Parameter: **RUN**

the signal is generated. A trigger event occurred in the triggered mode.

STOP

the signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command `:BB:WLAN:TRIG:ARM:EXECute` (armed trigger modes only).

Example: `"BB:WLAN:TRIG:SOUR EXT"`
'sets external triggering via the TRIGGER 1 connector.

`"BB:WLAN:TRIG:MODE ARET"`
'selects the Armed_Retrigger mode.

`"BB:WLAN:TRIG:RMOD?"`
'queries the current status of signal generation.

Response: `"RUN"`
'the signal is generated, an external trigger was executed.

*RST value	Resolution	SCPI
-	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:SLENgth   1 … (2^32-1) chips

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command defines the length of the signal sequence to be output in the **Single** trigger mode (SOUR:BB:WLAN:SEQ SING). The input is made in terms of chips.

It is possible to output deliberately just part of the frame, an exact sequence of the frame, or a defined number of repetitions of the frame.

Example: `"BB:WLAN:SEQ SING"`
                    'sets trigger mode Single.

                    `":BB:WLAN:TRIG:SLEN 200"`
                     'sets a sequence length of 200 chips. The first 200 chips of the current frame will be output after the next trigger event.

*RST value	Resolution	SCPI
32 768 chips	1 chip	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:SLUNit   FRAMe | CHIP | SEQuence

Note: *This command is available for R&S SMx and R&S AMU instruments only.*

The command defines the unit for the entry of the length of the signal sequence (SOUR:BB:WLAN:TRIG:SLEN) to be output in the **Single** trigger mode (SOUR:BB:WLAN:SEQ SING).

Parameter: **FRAMe**
                              Unit Frame. A single frame is generated after a trigger event.

                       CHIP
                              Unit Chip. A single chip is generated after a trigger event.

                       SEQuence
                              Unit Sequence Length. A single sequence is generated after a trigger event.

Example: `"SOUR:BB:WLAN:SEQ SING"`
                    'sets trigger mode Single.

                    `"SOUR:BB:WLAN:TRIG:SLUN FRAM"`
                     'sets unit Frame for the entry of sequence length.

                    `"SOUR:BB:WLAN:TRIG:SLEN 2"`
                     'sets a sequence length of 2 frame. Two frames will be output after the next trigger event.

*RST value	Resolution	SCPI
SEQuence	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TRIGger:SOURce INTernal | EXTernal | BEXTernal | OBASeband

The command selects the trigger source.

Parameter:	**INTernal**
	Triggering is executed by means of the Trigger command `SOURce<[1]|2>:BB:WLAN:TRIGger:EXECute` or `*TRG` in the case of remote control and by means of **Execute Trigger** in the case of manual operation.
	EXTernal
	Triggering is executed by means of the signal on the TRIGGER 1 connector.
	BEXTernal
	Triggering is executed by means of the signal on the TRIGGER 2 connector.
	OBASeband
	Triggering is executed by means of the trigger signal from the second path (two-path instruments only).

Example: `"BB:WLAN:TRIG:SOUR EXT"`
'sets external triggering via the TRIGGER 1 connector.

*RST value	Resolution	SCPI
INTernal	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:TTIMe 0 ... 1000 ns

The command sets the transition time. The transition time defines the overlap range of two OFDM symbols when time domain windowing is active. At a setting of 100 ns, one sample overlaps. This command is only available in physical layer mode OFDM (`SOURce:BB:WLAN:MODE OFDM`) and with active time domain windowing (`SOURce:BB:WLAN:TDWindowing:STATe ON`).

Example: `"BB:WLAN:TTIM 10 ns"`
'sets a transition time of 10 ns.

*RST value	Resolution	SCPI
100 ns	1 ns	Device-specific

SOURce-WLAN - PSDU Settings

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

Command	Parameters	Default unit	Com ments
[SOURce<[1]|2>:]BB:WLAN:PSDU:BRATe	6MBPS | 9MBPS | 12MBPS | 18MBPS | 24MBPS | 36MBPS | 48MBPS | 54MBPS		
[SOURce<[1]|2>:]BB:WLAN:PSDU:BSPReading:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:PSDU:DATA	PN9 | PN15 | PN16 | PN20 | PN21 | PN23 | ZERO | ONE | PATTern | DLISt		
[SOURce<[1]|2>:]BB:WLAN:PSDU:DATA:DSELect	<dlist_name>		
[SOURce<[1]|2>:]BB:WLAN:PSDU:DATA:PATTern	#B0,1...B11..1, 64		
[SOURce<[1]|2>:]BB:WLAN:PSDU:DLENgth	4095 (Framed), 100000 (Unframed)	bytes	
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:ADDRess<1|2|3|4>	#H0000 0000 0000,48 ... #HFFFFFFFFFF FF,48		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:ADDRess<1|2|3|4>:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:DID	#H0000,16 ... #HFFFF,16		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol	#H0000,16 ... #HFFFF,16		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:FDS	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:MDATa	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:MFRagments	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:ORDer	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:PMANagement	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:PVERsion	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:RETRy	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:SUBType	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:TDS	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:TYPE	#H0,2 ... #H3,2		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:WEP	#H0,1 ... #H1,1		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCSequence:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:FRAGment:INCRement	0 ... 1024		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:FRAGment:STARt	#H0,1 ... #HF,4		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:SEQuence:INCRement	0 ... 1024		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:SEQuence:STARt	#H0,1 ... #HFFF,12		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:STATe	ON | OFF		

Command	Parameters	Default unit	Com ments
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:STATe	ON | OFF		
[SOURce<[1]|2>:]BB:WLAN:PSDU:MODulation	BPSK |QPSK | QAM16 | M64 | DBPSK | DQPSK | CCK | PBCC		
[SOURce<[1]|2>:]BB:WLAN:PSDU:SCOunt	1...1378		

[SOURce<[1]|2>:]BB:WLAN:PSDU:BRATe 6MBPS | 9MBPS | 12MBPS | 18MBPS | 24MBPS | 36MBPS | 48MBPS | 54MBPS (OFDM) / 1MBPS | 2MBPS | 5.5MBPS | 11MBPS | 22MBPS CCK|PBCC)

The command selects the bit rate of the PSDU. The available values depend on the selected physical layer mode. Value `1MBPS` is available only for selection of long PLCP format in physical layer modes CCK and PBCC.

Example: `"BB:WLAN:MODE"`
'selects physical layer mode OFDM.

`"BB:WLAN:PSDU:BRAT 12MBPS"`
'sets a bit rate of 12MBPS.

*RST value	Resolution	SCPI
OFDM: 54MBPS CCK|PBCC: 11MBPS	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:BSPReading:STATe ON | OFF

The command activates/deactivates barker spreading. The command is only available only for selection of bit rates 1MBPS or 2 MBPS in physical layer modes CCK and PBCC.

Example: `"BB:WLAN:MODE CCK`
'selects physical layer mode CCK.

`"BB:WLAN:PSDU:PLCP:FORM LONG"`
'selects long PLCP format.

`"BB:WLAN:PSDU:BRAT 1MBPS"`
'sets a bit rate of 1MBPS.

`"BB:WLAN:PSDU:BSPR OFF"`
'deactivates barker spreading.

*RST value	Resolution	SCPI
ON	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:DATA
PN9 | PN15 | PN16 | PN20 | PN21 | PN23 | DLISt | ZERO | ONE | PATTern

The command 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:WLAN:PSDU: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:WLAN:PSDU:DATA:PATTern`.
Example:	`"BB:WLAN:PSDU:DATA PATT"`	
		'selects as the data source for the data fields of burst 0, the bit pattern defined with the following command.
	`"BB:WLAN:PSDU:DATA:PATT #H3F,8"`	
		'defines the bit pattern.

*RST value	Resolution	SCPI
PN9	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:DATA:DSELect <data list name>

The command 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:WLAN:PSDU:DATA DLIS"`
	'selects the Data Lists data source.
	`"MMEM:CDIR 'D:\Lists\DM\IqData'"`
	'selects the directory for the data lists.
	`"BB:WLAN:PSDU:MAC:DATA:DLIS 'wlan_list1'"`
	'selects file 'wlan_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]|2>:]BB:WLAN:PSDU:DATA:PATTern #B0,1... #B111..1,64

The command determines the bit pattern for the PATTern selection. The maximum length is 64 bits.

Example: `"BB:WLAN:PSDU:MAC:DATA:PATT  #H3F,8"`
                      'defines the bit pattern.

*RST value	Resolution	SCPI
0	-	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:DLENgth 0 ... 4095 Bytes (Framed), 100000 Bytes (Unframed)

The command sets the data length in bytes. In the framed mode, data field lengths of up to 4095 bytes are possible. This corresponds to the maximum data length. The unframed mode offers a data length of up to 100000 bytes.

Example: `"BB:WLAN:PSDU:DATA:LENG 256"`
                      'sets a data length of 256.

*RST value	Resolution	Dependencies	SCPI
OFDM: 100 Bytes, CCK|PBCC: 1024 Bytes	-	If the data field length is changed, the generator calculates the number of OFDM data symbols as a function of the set PSDU bit rate (`SOUR:BB:WLAN:PSDU:SCO`).	Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:ADDRess<1|2|3|4> #H000000000000,48
#HFFFFFFFFFFFF,48

The command enters the value of the address fields 1 ... 4. Exactly 48 bits must be entered. Each address is 6 bytes (48 bit) long. The addresses can be entered in hexadecimal form in the entry field of each address field. The least significant byte (LSB) is in left notation.

The MAC header can only be configured in framed mode (`SOURce:BB:WLAN:SMODe FRAMed`).

Example: `"BB:WLAN:PSDU:MAC:ADDR2 #H124836C7EA54,48"`
                      'set the value for address field 2.

*RST value	Resolution	SCPI
#H000000000000,48		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:ADDRess<1|2|3|4>:STATe ON | OFF

The command activates/deactivates the selected address field.

The MAC header can only be configured in framed mode (`SOURce:BB:WLAN:SMODe FRAMed`).

Example: `"BB:WLAN:PSDU:MAC:ADDR2:STAT ON"`
                      'activates generation of address field 2.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:DID #H0000,16 ... #HFFFF,16

The command enters the value of the duration Id field. Depending on the frame type, the 2-byte field Duration/ID is used to transmit the association identity of the station transmitting the frame or it indicates the duration assigned to the frame type. Exactly 16 bit must be entered.

The MAC header can only be configured in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU:MAC:FORM #HA5A5,16"
                  'sets the value of the duration Id field.

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

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol #H0000,16 ... #HFFFF,16

The command 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 and its function, etc.. As an alternative, the individual bits can be set with the following commands.

The MAC header can only be configured in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU:MAC:FCON #H100A,16"
                  'sets the value of the frame control field.

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

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:FDS #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:MDATa #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:MFRagments   #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:ORDer   #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:PMANagement #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:PVERsion #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:RETRy   #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:SUBType #H0,4 ... #HF,4#H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:TDS #H0,1 ... #H1,1
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:TYPE   #H0,2 ... #H3,2
[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCONtrol:WEP #H0,1 ... #H1,1

The command enters the value of the individual bits of the frame control field.

The MAC header can only be configured in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU:MAC:FCON:MDAT #H1,1"
                  'sets the value of the More Data bit.

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

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:FCSequence:STATe   #H0000,16 ... #HFFFF,16

Activates/deactivates the calculation of the FCS (frame check sequence). The standard defines a 32-bit (4-byte) check sum to protect the MAC header and the user data (frame body).

The command is only available in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU:MAC:FCS:STAT ON"
                'activates the calculation of the FCS.

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:FRAGment:INCRement   0 ... 1024

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

The MAC header can only be configured in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU: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]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:FRAGment:STARt   #H0,4 ... #HF,4

The command enters the start number of the fragment bits of the sequence control.

The MAC header can only be configured in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU:MAC:SCON:FRAG:STAR #H4,4"
                'sets the start value of the fragment bits of the sequence control.

*RST value	Resolution	SCPI
#H0,04		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:SEQuence:INCRement   0 ... 1024

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

The MAC header can only be configured in framed mode (SOURce:BB:WLAN:SMODe FRAMed).

Example: "BB:WLAN:PSDU:MAC:SCON:FRAG:INCR 2"
                'two packets are required to increment the counter of the sequence bits.

*RST value	Resolution	SCPI
1		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:SEQuence:STARt   #H0,12 ... #HFFF,12

The command enters the start number of the fragment bits of the sequence control.

The MAC header can only be configured in framed mode (`SOURce:BB:WLAN:SMODe FRAMed`).

Example: `"BB:WLAN:PSDU:MAC:SCON:SEQ:STAR #H4,4"`
`'sets the start value of the sequence bits of the sequence control.`

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

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:SCONtrol:STATe   ON | OFF

The command activates/deactivates the sequence control.

The MAC header can only be configured in framed mode (`SOURce:BB:WLAN:SMODe FRAMed`).

Example: `"BB:WLAN:PSDU:MAC:SCON:STAT ON"`
`'activates the sequence control field.`

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MAC:STATe   ON | OFF

The command activates/deactivates the generation of the MAC Header.

The MAC header can only be configured in framed mode (`SOURce:BB:WLAN:SMODe FRAMed`).

Example: `"BB:WLAN:PSDU:MAC:SCON:STAT ON"`
`'activates the generation of the MAC Header.`

*RST value	Resolution	SCPI
OFF		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:MODulation

The command queries the modulation type. The modulation mode depends on the selected PSDU bit rate which depends on the selected physical layer mode (`SOURce:BB:WLAN:MODE`).

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

Example: `"BB:WLAN:PSDU:MOD?"`
`'queries the modulation mode.`

Response: `"DQPSK"`

*RST value	Resolution	SCPI
-		Device-specific

[SOURce<[1]|2>:]BB:WLAN:PSDU:SCOunt 1 ... 1378

The command sets the number of data symbols. If the number of OFDM data symbols is changed, the generator calculates the data field length as a function of the set PSDU bit rate.

The command is only available in physical layer mode OFDM (`SOURce:BB:WLAN:MODE OFDM`).

Example: `"BB:WLAN:PSDU:SCO 256"`
                'sets the number of data symbols to 256.

*RST value	Resolution	Dependencies	SCPI
4		If the number of OFDM data symbols is changed, the generator calculates the data field length (`SOUR:BB:WLAN:PSDU:DLEN`) as a function of the set PSDU bit rate.	Device-specific

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

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

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

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

                `"BB:WLAN:WAV:CRE 'wlan_1'"`
                'creates the waveform file `wlan.wv` in the default directory.

*RST value	Resolution	SCPI
-	-	device-specific

Alphabetical List of Commands

Index

W