R&S®SMW200A
Vector Signal Generator
Service Manual

1175721602
Version 11

ROHDE&SCHWARZ
Make ideas real

This manual describes the following vector signal generator:

- R&S® SMW200A, order no. 1412.0000.02

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The following abbreviation is used throughout this guide: R&S® SMW200A is abbreviated as R&S SMW200A

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built 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, you must 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 any purpose 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.

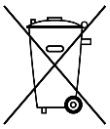
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. 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.

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 and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, 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. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation		ON/OFF Power
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Caution ! Hot surface		Alternating current (AC)
	Protective conductor terminal To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth		Direct/alternating current (DC/AC)
	Earth (Ground)		Class II Equipment to identify equipment meeting the safety requirements specified for Class II equipment (device protected by double or reinforced insulation)
	Frame or chassis Ground terminal		EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1.
	Be careful when handling electrostatic sensitive devices		EU labeling for separate collection of electrical and electronic devices For additional information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.
In the product documentation, the word ATTENTION is used synonymously.

These signal words 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 signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating 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 ±5 % to the nominal frequency, overvoltage category 2, pollution degree 2.
2. 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). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the mains-supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor 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.
4. If there is no power switch for disconnecting the product from the mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are 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, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC 60950-1 / EN 60950-1 or IEC 61010-1 / EN 61010-1 standards that apply in each case.
11. 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.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

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

2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with EN 55011/CISPR 11, and analogously with EN 55022/CISPR 22, EN 55032/CISPR 32)
   - Class A equipment:
     Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings
     Note: Class A equipment is intended for use in an industrial environment. This equipment may cause radio disturbances in residential environments, due to possible conducted as well as radiated disturbances. In this case, the operator may be required to take appropriate measures to eliminate these disturbances.
   - Class B equipment:
     Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts 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, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
6. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
7. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.
8. Follow the transport stipulations of the carrier (IATA-DGR, IMDG-Code, ADR, RID) when returning lithium batteries to Rohde & Schwarz subsidiaries.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.

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

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
   Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their 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 by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases 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. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir 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. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad de la UE 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.

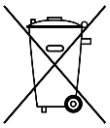
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones 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 conforme a las indicaciones de la correspondiente documentación del 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 técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría 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 entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Señalización de seguridad de los productos

Las siguientes señales de seguridad se utilizan en los productos para advertir sobre riesgos y peligros.

Símbolo	Significado	Símbolo	Significado
	Aviso: punto de peligro general Observar la documentación del producto		Tensión de alimentación de PUESTA EN MARCHA / PARADA
	Atención en el manejo de dispositivos de peso elevado		Indicación de estado de espera (standby)
	Peligro de choque eléctrico		Corriente continua (DC)
	Advertencia: superficie caliente		Corriente alterna (AC)
	Conexión a conductor de protección		Corriente continua / Corriente alterna (DC/AC)
	Conexión a tierra		El aparato está protegido en su totalidad por un aislamiento doble (reforzado)
	Conexión a masa		Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1.
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.

PELIGRO	Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.
ADVERTENCIA	Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.
ATENCIÓN	Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.
AVISO	Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales. 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 del 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 interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz 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, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de ±10 % sobre el voltaje nominal y de ±5 % sobre la frecuencia nominal. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, se pueden causar lesiones o, en determinadas circunstancias, incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
   El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
   Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. 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. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.

11. 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 lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.
2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.
8. En caso de devolver baterías de litio a las filiales de Rohde & Schwarz, debe cumplirse las normativas sobre los modos de transporte (IATA-DGR, código IMDG, ADR, RID).

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.
3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
   Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

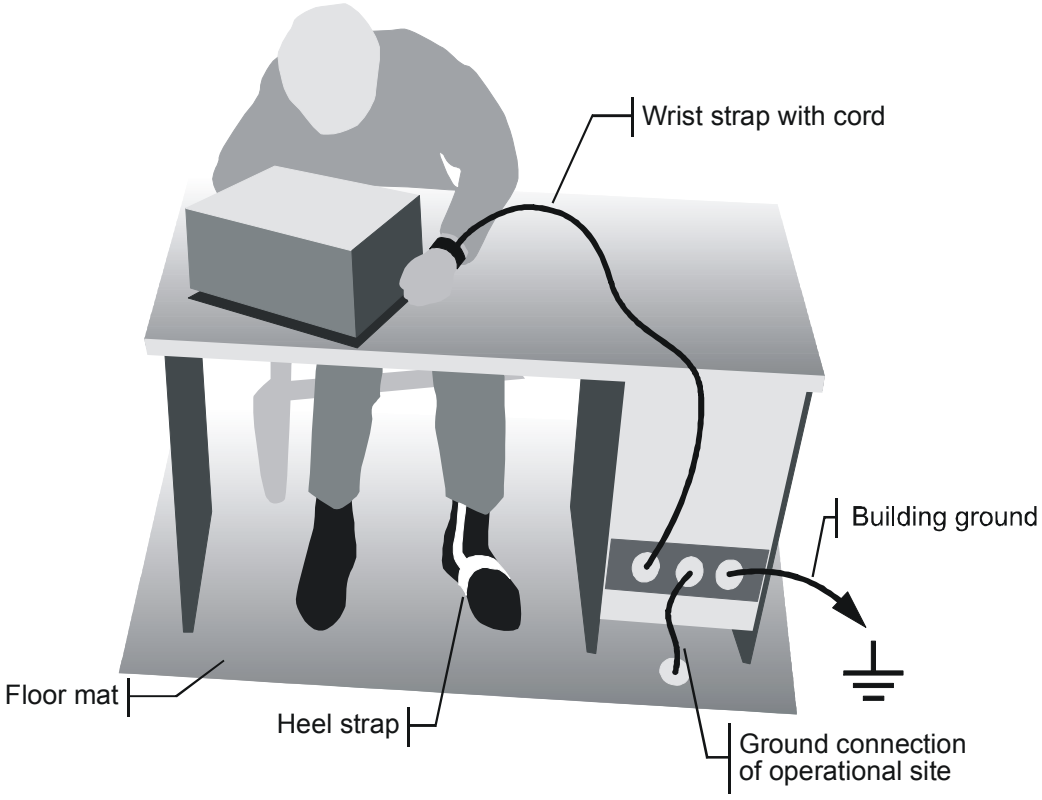
Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

Instructions for Electrostatic Discharge Protection

NOTICE

Risk of damaging electronic components

To avoid damage of electronic components, the operational site must be protected against electrostatic discharge (ESD).



The following two methods of ESD protection may be used together or separately:

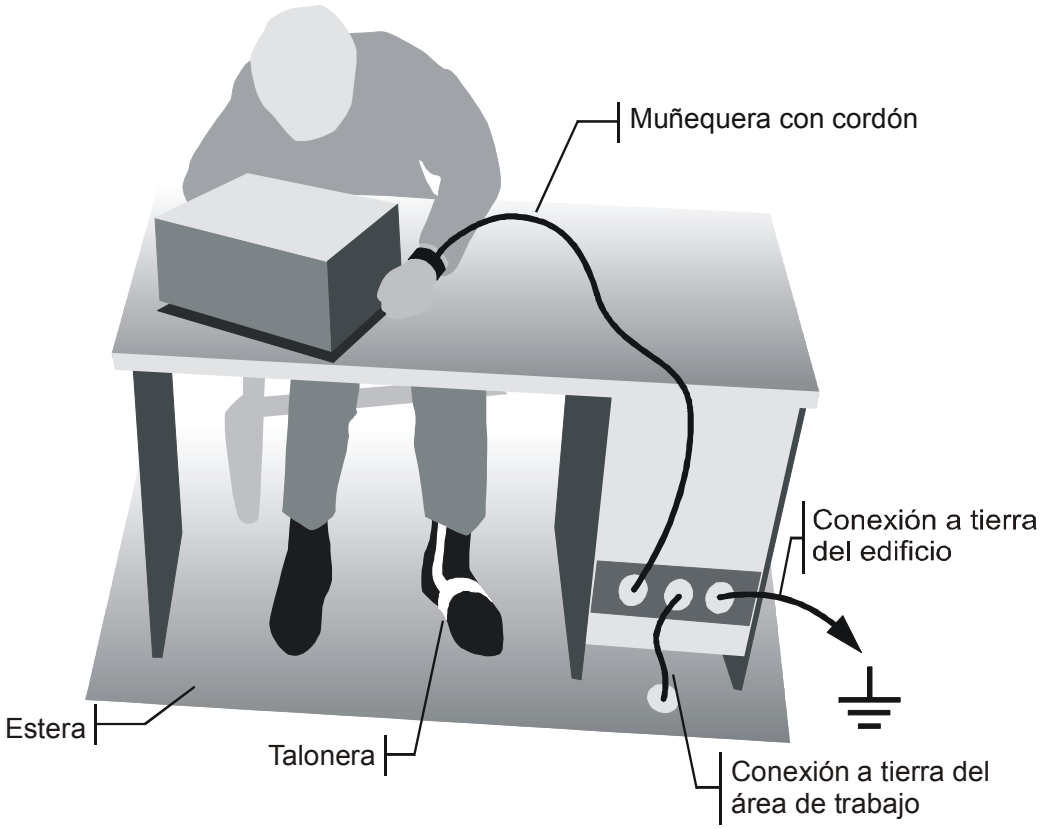
- Wrist strap with cord to ground connection
- Conductive floor mat and heel strap combination

Instrucciones para la protección contra descargas electroestáticas

AVISO

Riesgo de avería de los componentes electrónicos

Para evitar averías en los componentes electrónicos, el área de trabajo tiene que estar protegido contra descargas electroestáticas ESD (electrostatic discharge).



Los siguientes dos métodos de protección ESD pueden ser usados juntos o separados:

- Muñequera con cordón para conexión a tierra
- Combinación de estera antiestática y talonera

Procedure for servicing and repairs

This section contains information on shipping an instrument or module to your service center.

Please contact your local Rohde & Schwarz service center if your equipment needs to be serviced or repaired. You can find the current address of your representative at www.rohde-schwarz.com.

Shipping the instrument or module

We require the following information in order to answer your inquiry quickly and correctly and to determine whether the warranty is still valid for your product:

- Instrument model
- Serial number
- Firmware version
- Does the instrument have to be returned with this firmware?
- Detailed error description in case of repair
- Indication of desired calibration
- Contact person for questions

In many countries, an RMA process is available (pickup and delivery of your product). For details, contact your local representative.

When shipping the product, ensure that there is sufficient mechanical and antistatic protection.

- Where possible, use the original packaging to transport or ship the product. The front and rear protective covers prevent damage to the operating elements and the connectors.
- If you do not use the original packaging, ensure sufficient padding to prevent the product from moving around inside the box. Wrap antistatic film around the product to protect it from electrostatic charging.
- Comply with the relevant safety and security measures for products with batteries.

As the manufacturer, Rohde & Schwarz can ensure that your instruments perform optimally throughout their service life by regularly calibrating them on its own measurement systems. Rohde & Schwarz calibration includes preventative measures such as adjustments. The calibration documentation fulfills ISO 17025 requirements.

Contents

1 Performance Test

Test Instructions

This performance test describes the steps for testing the R&S SMW signal generator family and the installed options regarding function and compliance with the specifications.

In the following, the term DUT (Device Under Test) is used for any signal generator of this family. The tests to be performed depend on the installed options.

To ensure that the rated specifications are maintained, prepare the instrument as described in Chapter 1.3, "Preparation, Recommended Test Frequencies/Levels", on page 12.

1.1 Measuring Equipment and Accessories

The following instruments and accessories are used for the performance test.

Table 1-1: Recommended equipment

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S Order No.
1	Frequency counter	1 Hz to RF_{max}, resolution 0.1 Hz (included in RF analyzer item 19)		
2	Reference source for SSB noise measurements	Identical generator as DUT or generator with at least 10 dB lower SSB noise as DUT Frequency range up to RF_{max}	**SSYNW**	
			R&S SMA100B with R&S SMAB-B106/-B112/-B120/-B140 and R&S SMAB-B711	1419.8888K02 1420.8020.02
			SSYN	
			R&S SMA100A with R&S SMA-B106 and R&S SMA-B22	1400.0000K02 1405.0809.02 1405.1805.02
4	Controller	Industry standard PC/XT/AT with IEC 60625 interface, USB interface and LAN interface		
5	Signal generator	1 MHz to RF_{max}	**SSYNW**	
			R&S SMW200A R&S SMA100B R&S SMBV100B	1412.0000K02 1419.8888K02 1423.1003K02
			SSYN	

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S Order No.
			R&S SMW200A R&S SMA100A R&S SMU200A R&S SMBV100A	1412.0000K02 1400.0000K02 1141.2005.02 1407.6004K02
6	Phase noise test assembly	Phase Noise Test Set or Mixer: 10 MHz to RF_{max}, branching filter 20 MHz, DC decoupling after the mixer	R&S FSWP26 or R&S FSWP50 or R&S FSUP26 or R&S FSUP50 or Mixer: f < 1 GHz: Minicircuits ZFM2H 1 GHz: < f < 13 GHz: Miteq DB0118LA2	1322.8003.26 or 1322.8003.50 1166.3505.27 or 1166.3505.51
7	Oscilloscope	Bandwidth ≥500 MHz, two channels with DC coupling	R&S RTM or similar	
8	RF power meter	1 MHz to RF_{max}	R&S NRP with R&S NRP-Z55 or R&S NRP-Z51 or R&S NRP-Z91 or R&S NRP- Z92	1143.8500.02 1138.2008.02 1138.0005.0x
9	Low-noise preamplifier	10 Hz to 10 MHz, gain >20 dB, input noise <4 nV (1 Hz)		
10	Low-noise preamplifier	100 kHz to RF_{max}, gain >20 dB, noise figure <10 dB		
11	VSWR bridge	1 MHz to RF_{max}, directivity >30 dB	f < 4 GHz: R&S ZRC 3 GHz < f < 6 GHz: Agilent 773D	1039.9492.55
12	DC voltage source	Setting range 0 V to 10 V		
13	RF power amplifier	10 MHz to RF_{max}, power > 33 dBm		
14	Arbitrary waveform generator	Differential Baseband Output	**SSYNW** R&S SMBV100B with R&S SMBVB-K17 R&S AFQ100A R&S SMW200A **SSYN** R&S SMBV100A with R&S SMBV-B10/-B10F or R&S SMBV-B51	 1423.1003K02 1410.9000.02 1412.0000K02 1407.6004K02

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S Order No.
			R&S SMU200A with 2.5 MHz baseband filters R&S AFQ100A R&S SMW200A	1141.2005.02 1410.9000.02 1412.0000K02
15	AC/DC voltmeter	10 Hz to 10 MHz	R&S URE3 Keysight 34401A	0350.5315.03
16	Broadband FM demodulator	Included in RF analyzer item 19		
17	Pulse generator	Pulse repetition frequency up to 100 kHz Included in signal generator item 5		
19	RF analyzer & Demodulator for analog modulations, FM-demodulator and digital demodulation.	1 MHz to RF_{max}	**SSYNW**	
			R&S FSW-26/43/67 with R&S FSW-B8 R&S FSW-B13 R&S FSW-B24 R&S FSW-B2001 (or higher). **Only required in use with an FSW67.** R&S FSW-K7 R&S FSW-K10 R&S FSW-K15 R&S FSW-K17 R&S FSW-K70 R&S FSW-K144	1331.5003.xx 1313.2464.02 1313.0761.02 1313.0832.xx 1331.6916.14 1313.1339.02 1313.1368.02 1331.4388.02 1313.4150.02 1313.1416.02 1338.3606.02
			SSYN	
			R&S FSW-26/43 with R&S FSW-B24 R&S FSW-K7	1331.5003.xx 1313.0832.xx 1313.1339.02
20	Software for simulation of digital modulations	Generation of data for ARB generator	R&S WinIQSIM	
21	uW Signal generator	Identical generator as DUT or generator with at least 10 dB lower SSB noise as DUT noise Range 100 MHz to 40 GHz	R&S SMA100B with R&S SMW-B140 R&S SMW-B710 R&S SMW-B710N R&S SMW-B711 R&S SMW-B711N	1419.8888.02

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S Order No.
22	VSWR-Probe	3 GHz to 40 GHz	R&S ZRP40 VSWR-Probe	5017.7805.40
23	VSWR-Probe	3 GHz to 50 GHz	R&S ZRP50 VSWR-Probe	5017.7805.47
24	Power meter	Power range 1000 W / 230 VAC	Hameg HM8115-2	

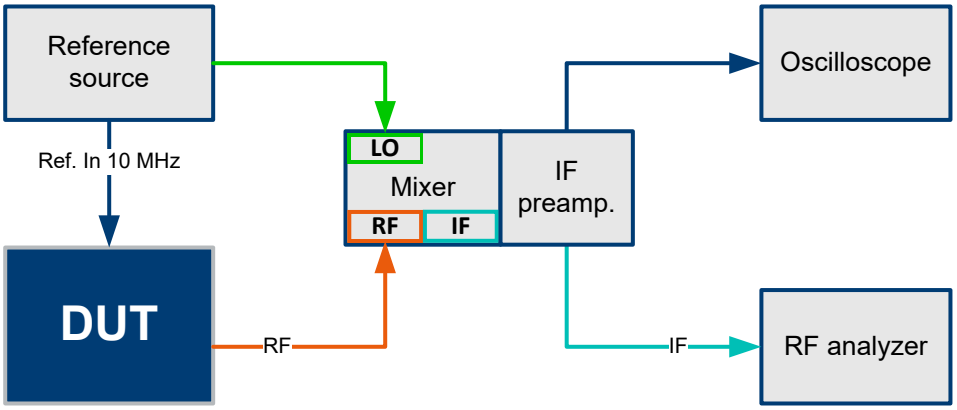
1.2 Test Assemblies

1.2.1 Test Assembly for SSB Phase Noise and Jitter

Test equipment:

- Reference Source (see Table 1-1, item 2)
- Phase noise test assembly consisting of mixer with low pass filter and preamplifier (see Table 1-1, item 6)
- Oscilloscope, (see Table 1-1, item 7)
- RF analyzer, (see Table 1-1, item 19)

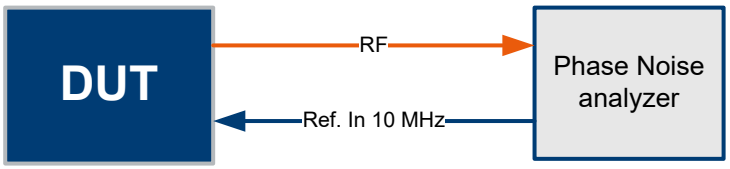
Test setup:



Test equipment:

For instruments equipped with R&S SMW-B709/-B710/-B711/-B719/-B720/-B721:

- Phase noise test assembly with phase noise analyzer, (see Table 1-1, item 6)

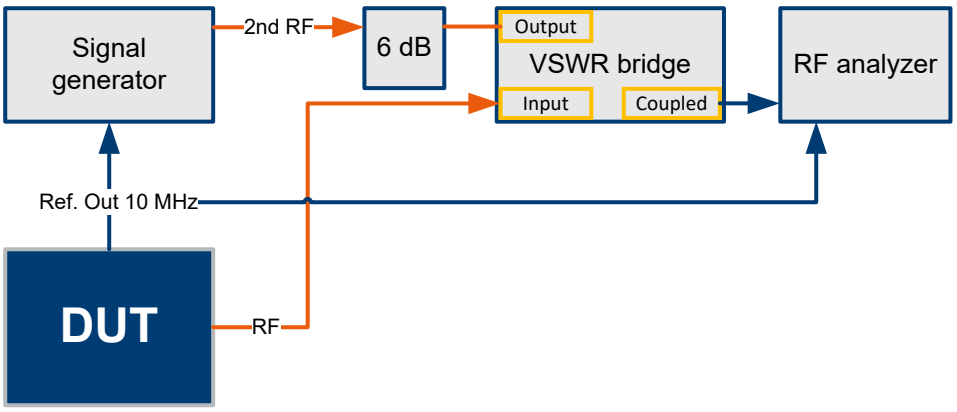


1.2.2 Test Assembly for Output Impedance (VSWR)

Test equipment:

- VSWR bridge, (see Table 1-1, item 11)
- Signal generator, (see Table 1-1, item 5)
- RF analyzer, (see Table 1-1, item 19)

Test setup:

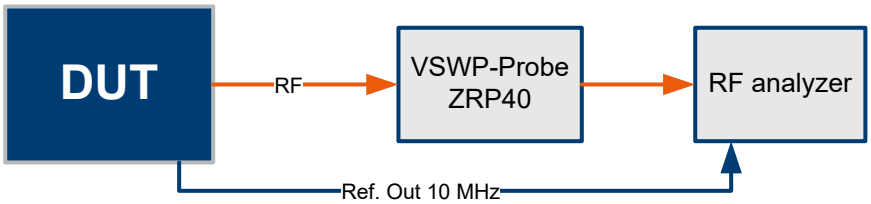


The INPUT of the directional coupler is directly screwed to the DUT. The second signal generator is connected to the line connector (OUTPUT), the analyzer to the coupling output (COUPLED) of the directional coupler.

Test setup:

For frequencies > 6 GHz:

- RF analyzer, (see Table 1-1, item 19)
- ZRP40 VSWR-Probe (see Table 1-1, item 24)

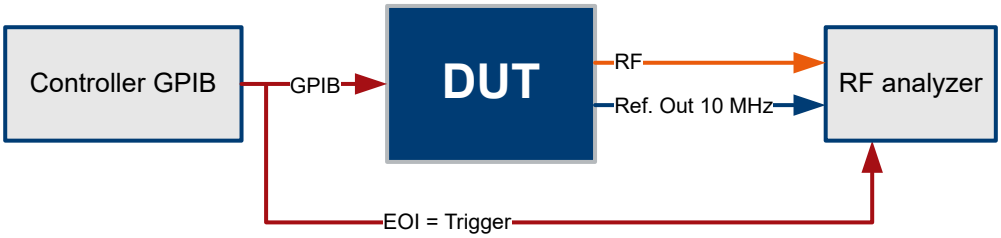


1.2.3 Test Assembly for Setting Time

Test equipment:

- RF analyzer, (see Table 1-1, item 19)

Test setup GPIB:



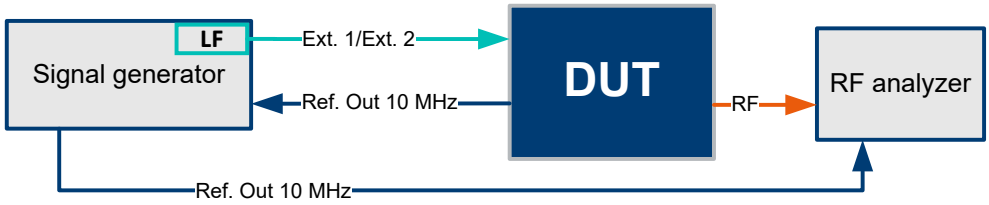
Test setup list mode:

1.2.4 Standard Test Assembly for Analog Modulation

Test equipment:

- RF analyzer, (see Table 1-1, item 19)
- Signal generator, (see Table 1-1, item 5)

Test setup: The RF analyzer is used as a modulation analyzer. The signal generator is used as modulation source in case of external modulation.

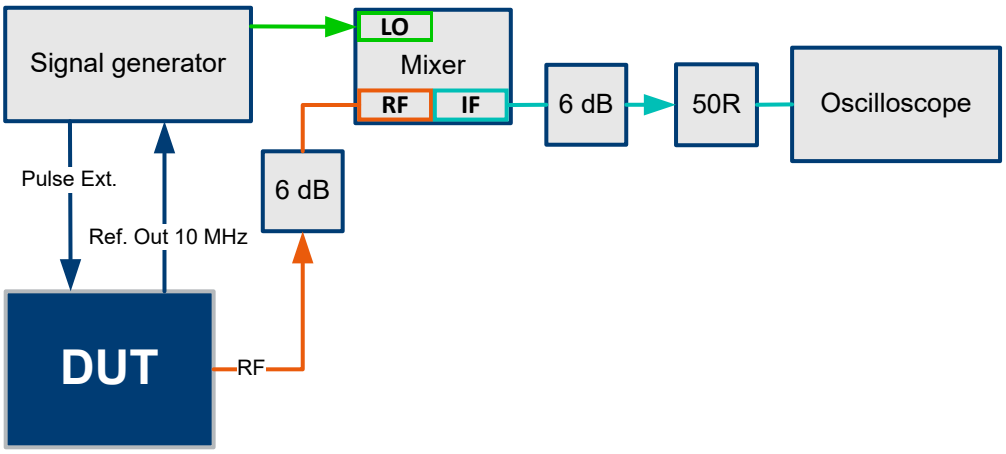


1.2.5 Test Assembly for Pulse Modulation

Test equipment:

- Oscilloscope, (see Table 1-1, item 7)
- Signal generator, (see Table 1-1, item 5)
- Mixer

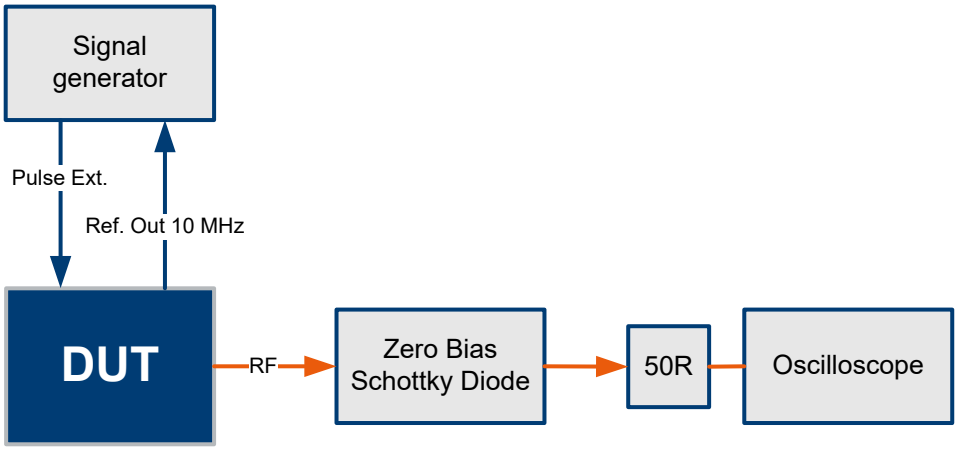
Test setup: The pulsed RF is mixed down to DC in phase and analyzed with an oscilloscope.



Alternatively (recommended):

Test setup: The pulsed RF is rectified by the schottky diode and the envelope analyzed with an oscilloscope.

- Signal generator, (see Table 1-1, item 5)
- Oscilloscope, (see Table 1-1, item 7)
- Zero bias schottky diode, (see Table 1-1, item 18)
- Termination

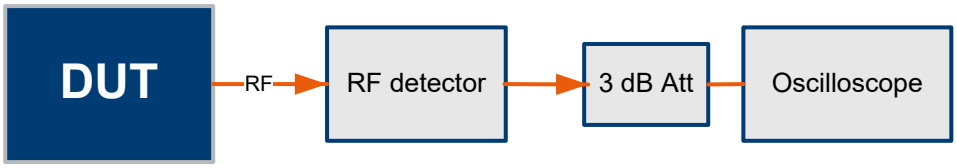


1.2.6 Test Assembly for Pulse Generator

Test equipment:

- Oscilloscope, (see Table 1-1, item 7)
- Detector-Diode, e.g. KRYTAR 704B
- 3 dB-Attenuator

Test setup: Connect RF-Out directly to RF-Detector e.g. KRYTAR 704B with 3 dB-Attenuator. Connect with 50 Ω-RF-Cable to Oscilloscope.

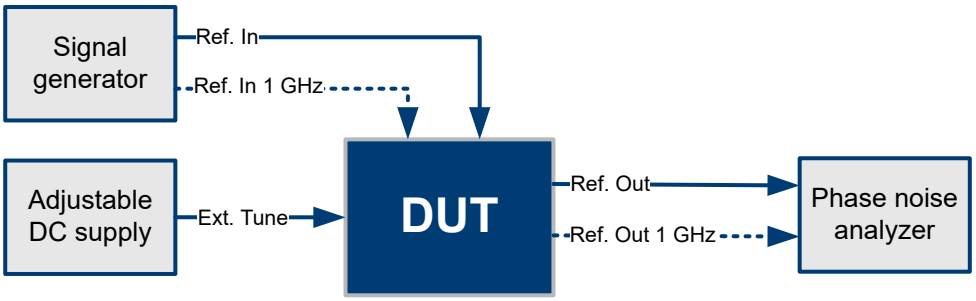


1.2.7 Test Assembly for Reference Measurements

Test equipment:

- PhNoise/AM Noise analyzer R&S®FSWP (see Table 1-1, item 6)
- Signal generator, (see Table 1-1, item 5)
- Adjustable DC voltage source, (see Table 1-1, item 12)

Test setup: The Signal generator is used as reference source for the REF IN input resp. 1 GHz IN input. The RF analyzer is used as frequency counter as well.

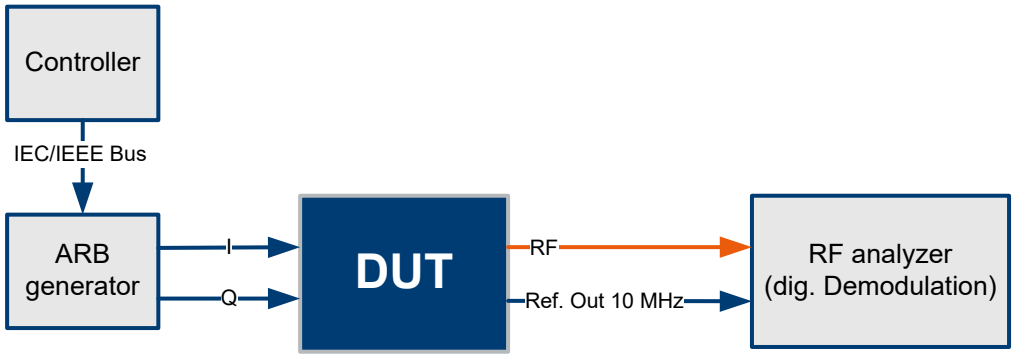


1.2.8 Test Assembly for I/Q Modulation

Test equipment:

- RF analyzer, (see Table 1-1, item 19)
- Arbitrary waveform generator, (see Table 1-1, item 14)
- Software for simulation of digital modulations, (see Table 1-1, item 20)
- Controller, (see Table 1-1, item 4)

Test setup: The pulsed RF is mixed down to DC in phase and analyzed with an oscilloscope.



1.3 Preparation, Recommended Test Frequencies/Levels

To ensure proper conditions for the performance test and prevent setting errors, prepare the instrument as follows:

- Allow for a minimum warm-up time of 30 minutes at ambient temperature.
- Perform all internal adjustments.
- Preset the instrument to establish a defined initial state before configuring a new measurement.

The values are given in the data sheet. Additional uncertainties introduced by the measurement equipment must be considered when checking the rated values.

The following sections list the important internal switch point frequencies and the recommended measurement frequencies derived from these frequencies. We recommend measurements at these frequencies unless particular test frequencies are specified.

Throughout this manual, RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

The test frequencies apply to all frequency options up to RF_{max} for both paths. For particularly specified test frequencies, the reason, e.g. dependencies on other options is pointed out.

Table 1-2: RF frequency options overview

RF *frequency*	SSYNW R&S SMW- frequency options	SSYN R&S SMW- frequency options
RF_{max} = 3 GHz	R&S SMW-B1003/-B2003	R&S SMW-B103/-B203
RF_{max} = 6 GHz	R&S SMW-B1006/-B2006	R&S SMW-B106/-B206
RF_{max} = 7.5 GHz	R&S SMW-B1007/-B2007	R&S SMW-B107/-B207
RF_{max} = 12.75 GHz	R&S SMW-B1012 R&S SMW-B2012	R&S SMW-B112
RF_{max} = 20 GHz	R&S SMW-B1020/-B2020	R&S SMW-B120/-B220
RF_{max} = 31.8 GHz	R&S SMW-B1031 R&S SMW-B2031	R&S SMW-B131
RF_{max} = 40 GHz	R&S SMW-B1040 R&S SMW-B1040N	R&S SMW-B140 R&S SMW-B140N
RF_{max} = 44 GHz	R&S SMW-B1044 R&S SMW-B1044N R&S SMW-B2044 R&S SMW-B2044N	R&S SMW-B144 R&S SMW-B144N

1.3.1 Test frequencies for CW Mode (SSYNW)

Table 1-3: Range limits, main test frequencies for CW Mode (SSYNW)

Frequency Range	Hardware switching points	Recommended test frequencies
RF_{max} ≤ 6 GHz		
0.3 to 200 MHz		300 kHz, 500 kHz, 1 MHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz, 50 MHz, 100 MHz and 200 MHz
>200 to 375 MHz	290 MHz: Low Pass Filter RFOPUW	200.1 MHz, 290 MHz, 290.1 MHz and 375 MHz
>375 to 750 MHz	420 MHz: Low Pass Filter RFOPUW 600 MHz: Low Pass Filter RFOPUW	375.1 MHz, 420 MHz, 420.1 MHz, 600 MHz, 600.1 MHz and 750 MHz
>750 to 1500 MHz	850 MHz: Low Pass Filter RFOPUW 1200 MHz: Low Pass Filter RFOPUW	750.1 MHz, 850 MHz, 850.1 MHz, 1200 MHz, 1200.1 MHz and 1500 MHz

Frequency Range	Hardware switching points	Recommended test frequencies
>1500 to 3000 MHz	1700 MHz: Low Pass Filter RFOPUW 2500 MHz: Low Pass Filter RFOPUW	1500.1 MHz, 1700 MHz, 1700.1 MHz, 2500 MHz, 2500.1 MHz and 3000 MHz
>3000 to 6000 MHz	3600 MHz: VCO SSYNW (Var. 02/04/06/12) 3700 MHz: Low Pass Filter RFOPUW 4300 MHz: VCO SSYNW (Var. 02/04/06/12) 5400 MHz: VCO SSYNW (Var. 02/04/06/12)	3000.1 MHz, 3600 MHz, 3600.1 MHz, 3700 MHz, 3700.1 MHz, 4300 MHz, 4300.1 MHz, 5400 MHz, 5400.1 MHz and 6000 MHz
RF_{max} ≤ 7.5 GHz		
>6000 to 6500 MHz	Doubler RFOPUW active 5000 MHz: Output Units switchover frequency	6000.1 MHz, 6500 MHz 5000 MHz and 5000.1 MHz
>6.5 to 7.5 GHz	Microwave frequency doubler active 7 GHz: Lowpass filter MWOPU	7.2 GHz, 7.5 GHz
RF_{max} ≤ 12.75 GHz		
>6000 to 6500 MHz	Doubler RFOPUW active 5000 MHz: Output Units switchover frequency	6000.1 MHz, 6500 MHz 5000 MHz and 5000.1 MHz
>6.5 to 12.75 GHz	Microwave frequency doubler active 7 GHz: Lowpass filter MWOPU 10 GHz: Lowpass filter MWOPU	7.2 GHz, 8.8 GHz and 10.7 GHz
RF_{max} ≤ 20 GHz		
>6000 to 6500 MHz	Doubler RFOPUW active 5000 MHz: Output Units switchover frequency	6000.1 MHz, 6500 MHz 5000 MHz and 5000.1 MHz
>6.5 to 13 GHz	Microwave frequency doubler active 7 GHz: Lowpass filter MWOPU 10 GHz: Lowpass filter MWOPU	7.2 GHz, 8.8 GHz and 10.7 GHz
>13 to 20 GHz	Microwave frequency quadrupler active 14 GHz: Lowpass filter MWOPU 20 GHz: Lowpass filter MWOPU	13.001 GHz, 14.4 GHz, 17.8 GHz and 20 GHz
RF_{max} ≤ 44 GHz		
>6000 to 6500 MHz	Doubler RFOPUW active 5000 MHz: Output Units switchover frequency	6000.1 MHz, 6500 MHz 5000 MHz and 5000.1 MHz
>6.5 to 13 GHz	Microwave frequency doubler active 7 GHz: Lowpass filter MWOPU 10 GHz: Lowpass filter MWOPU	7.2 GHz, 8.8 GHz and 10.7 GHz

Frequency Range	Hardware switching points	Recommended test frequencies
>13 to 19.5 GHz	Microwave frequency quadrupler active 14 GHz: Lowpass filter MWOPU	13.001 GHz, 14.4 GHz and 17.8 GHz
>19.5 to 44 GHz	19.5 GHz: Output Units switchover frequency 25.7 GHz: Lowpass filter and Amplifier switchover frequency MW4OPU 27 GHz: Lowpass filter and Amplifier switchover frequency MW4OPU 33.7 GHz: Lowpass filter and Amplifier switchover frequency MW4OPU	19.5 GHz, 19.501 GHz, 22 GHz, 25.6 GHz, 26.9 GHz, 33.6 GHz, 36 GHz, 40 GHz and 44 GHz

For **high-resolution measurements**, we recommend that you measure with a logarithmic frequency grid in 1-2-5 sequence up to 50 MHz. Above this value, use linear 50 MHz steps up to the upper limit frequency.

The recommended test levels are at the upper and lower switching threshold of the attenuator.

- $RF_{max} \leq 12.75$ GHz
  The electronic step attenuator of the DUT is switched depending on frequency, modulation parameters and level, according to an internally stored table in approximately 4 dB steps.
- $RF_{max} > 12.75$ GHz
  The mechanical step attenuator is switched every 5 dB.

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

The switching thresholds can be detected under **Attenuator fixed range** in the **Level** menu. After setting all other parameters, the threshold level can be detected by level variation.

The level at which the attenuator fixed range changes is the threshold. By measuring at the last level setting of one range and the first level setting of the next range, the internal setting range borders are used. In the following, P_{max} is the highest level before switching the attenuator, and P_{min} is defined as P_{max} – 5 dB with same attenuator setting.

1.3.2 Test Frequencies for CW Mode (SSYN)

Table 1-4: Range limits, main test frequencies for CW Mode (SSYN)

Range	Frequency	Hardware switching points	Recommended test frequencies
RF_{max} ≤ 3 GHz			
Mixer	0.3 to 200 MHz		300 kHz, 500 kHz, 1 MHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz, 50 MHz, 100 MHz and 200 MHz
Divider /4	>200 to 375 MHz	Lowpass filter 290 MHz	200.1 MHz, 290 MHz, 290.1 MHz and 375 MHz
Divider /2	>375 to 750 MHz	Lowpass filters 420 MHz, 600 MHz	375.1 MHz, 420 MHz, 420.1 MHz, 705 MHz, 705.1 MHz and 750 MHz
Base octave	>750 to 1500 MHz	Lowpass filters 850 MHz, 1200 MHz Oscillator limits 890 MHz, 1070 MHz, 1285 MHz	750.1 MHz, 850 MHz, 850.1 MHz, 890 MHz, 890.1 MHz, 1070 MHz, 1070.1 MHz, 1200 MHz, 1200.1 MHz, 1285 MHz, 1285.1 MHz and 1500 MHz
Doubler	>1500 to 3000 MHz	Lowpass filters 1700 MHz, 2500 MHz	1500.1 MHz, 1700 MHz, 1700.1 MHz, 2500 MHz, 2500.1 MHz and 3000 MHz
RF_{max} ≤ 6 GHz			
PLL frequency Multiplier	>3000 to 6000 MHz	Lowpass filter 3700 MHz	3000.1 MHz, 3700 MHz, 3700.1 MHz, 4400 MHz, 5200 MHz and 6000 MHz
RF_{max} ≤ 7.5 GHz			
PLL frequency Multiplier	>3000 to 6500 MHz	Lowpass filter 3700 MHz	3000.1 MHz, 3700 MHz, 3700.1 MHz, 4400 MHz, 5200 MHz and 6500 MHz
Output Units switchover frequency		5000 MHz	5000 MHz and 5000.1 MHz
Microwave frequency doubler	>6.5 to 7.5 GHz	Lowpass filters 7 GHz	7.2 GHz, 7.5 GHz
RF_{max} ≤ 12.75 GHz			
PLL frequency Multiplier	>3000 to 6500 MHz	Lowpass filter 3700 MHz	3000.1 MHz, 3700 MHz, 3700.1 MHz, 4400 MHz, 5200 MHz and 6500 MHz
Output Units switchover frequency		5000 MHz	5000 MHz and 5000.1 MHz

Range	Frequency	Hardware switching points	Recommended test frequencies
Microwave frequency doubler	>6.5 to 12.75 GHz	Lowpass filters 7 GHz, 10 GHz	7.2 GHz , 8.9 GHz and 10.7 GHz
RF_{max} ≤ 20 GHz			
PLL frequency Multiplier	>3000 to 6500 MHz	Lowpass filter 3700 MHz	3000.1 MHz, 3700 MHz, 3700.1 MHz, 4400 MHz, 5200 MHz and 6500 MHz
Output Units switchover frequency		5000 MHz	5000 MHz and 5000.1 MHz
Microwave frequency doubler	>6.5 to 13 GHz	Lowpass filters 7 GHz, 10 GHz	7.2 GHz , 8.9 GHz and 10.7 GHz
Microwave frequency quadrupler	>13 to 20 GHz	Lowpass filters 14 GHz, 20 GHz	13.001 GHz , 14.4 GHz, 17.8 GHz and 20 GHz
RF_{max} ≤ 44 GHz			
PLL frequency Multiplier	>3000 to 6500 MHz	Lowpass filter 3700 MHz	3000.1 MHz, 3700 MHz, 3700.1 MHz, 4400 MHz, 5200 MHz and 6500 MHz
Output Units switchover frequency		5000 MHz	5000 MHz and 5000.1 MHz
Microwave frequency doubler	>6.5 to 13 GHz	Lowpass filters 7 GHz, 10 GHz	7.2 GHz , 8.9 GHz and 10.7 GHz
Microwave frequency quadrupler	>13 to 19 GHz	Lowpass filter 14 GHz	13.001 GHz , 14.4 GHz and 17.8 GHz
Output Units switchover frequency		19.5 GHz	19.5 GHz and 19.501 GHz
Microwave frequency octupler	>19.5 to 44 GHz	Lowpass filters and Amplifier switchover frequencies 25.7 GHz, 27 GHz, 33.7 GHz	22 GHz, 25.6 GHz, 26.9 GHz, 33.6 GHz, 36 GHz, 40 GHz and 44 GHz.

For **high-resolution measurements**, we recommend that you measure with a logarithmic frequency grid in 1-2-5 sequence up to 50 MHz. Above this value, use linear 50 MHz steps up to the upper limit frequency.

The recommended test levels are at the upper and lower switching threshold of the attenuator.

- RF_{max} ≤ 12.75 GHz
  The electronic step attenuator of the DUT is switched depending on frequency, modulation parameters and level, according to an internally stored table in approximately 4 dB steps.
- RF_{max} > 12.75 GHz
  The mechanical step attenuator is switched every 5 dB.

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

The switching thresholds can be detected under **Attenuator fixed range** in the **Level** menu. After setting all other parameters, the threshold level can be detected by level variation.

The level at which the attenuator fixed range changes is the threshold. By measuring at the last level setting of one range and the first level setting of the next range, the internal setting range borders are used. In the following, P_{max} is the highest level before switching the attenuator, and P_{min} is defined as P_{max} – 5 dB with same attenuator setting.

1.4 Test Procedures

1.4.1 Checking the Reference Frequency Accuracy

1.4.1.1 Internal Reference (SSYNW)

Accredited calibration: Same coverage as performance test.

Allow the DUT to warm up for at least 2 hours before starting the measurement.

Test equipment:
- RF power meter (see Table 1-1, item 8)
- Frequency counter (see Table 1-1, item 1)

Test setup:
► Connect an RF power meter to the REF OUT output (at the rear panel).

Measurement 1:
1. Measure the output level.
2. Settings on DUT:
   a) **Reference Frequency Source** Internal
   b) **Reference Output** 10 MHz

   The output level should be within the data sheet specifications.
3. With option **R&S SMW-K704/-K703**, repeat the above measurement with further frequency settings.
   For R&S SMW-K703 option, use the 1 GHZ OUT connector as output.

Recommended test frequencies: 10 MHz; 100 MHz (option R&S SMW-K704) and 1 GHz (option R&S SMW-K703).

Test setup: ► Connect a calibrated frequency counter to the REF OUT output (at the rear panel).

Measurement:

1. Measure the frequency.
2. Settings on DUT:
   a) **Reference Frequency Source** Internal
   b) **Reference Output** 10 MHz

   The frequency deviation must not exceed the sum of deviations resulting from the frequency error in the rated temperature range and from aging.
3. With option R&S SMW-K703 (1GHZ REF IN/OUT), perform the measurement at the 1 GHz OUT output connector to achieve higher accuracy.
   If the specified accuracy is not met, the internal reference oscillator must be adjusted.

1.4.1.2 Internal Reference (SSYN)

Accredited calibration: Same coverage as performance test.

Allow the DUT to warm up for at least 2 hours before starting the measurement.

Test equipment:

- RF power meter (see Table 1-1, item 8)
- Frequency counter (see Table 1-1, item 1)

Test setup: ► Connect an RF power meter to the REF OUT output (on rear panel).

Measurement 1:

1. Measure the output level. It should be within the data sheet specifications.
2. Settings on DUT:
   - **Internal Reference**
   - **Ref Output Frequency** 10 MHz

Test setup: ► Connect a calibrated frequency counter to the REF OUT output (on rear panel).

Measurement:

1. Measure the frequency.
2. Settings on DUT:
   - **Internal Reference**
   - **Ref Output Frequency** 10 MHz

   The frequency deviation must not exceed the sum of deviations resulting from the frequency error in the rated temperature range and from aging.

1.4.1.3 Electronic Tuning of Reference from EFC Input

Accredited calibration: No minimum requirement.

Test equipment:
- DC voltage source (see Table 1-1, item 11) or arbitrary wave generator as DC-Voltage source (see Table 1-1, item 13)
- Frequency counter (see Table 1-1, item 1)

Test setup:
1. Connect the calibrated frequency counter to the REF OUT output (on rear panel).
2. Connect the DC source to the EFC input.

Measurement 1:
1. Settings on DUT:
   - **Internal Reference**
   - **Ref Output Frequency** 10 MHz
   - **Ext Ref/Lo Coupling** menu: **Adjustment Active** enable.
2. Set the DC voltage to -5 V and measure the frequency f1.
3. Set the DC voltage to +5 V and measure the frequency f2.

The frequency deviation f2-f1 divided by the voltage difference of 10 V is the sensitivity of the EFC input.

1.4.1.4 Variable Reference Input (only with SSYNW / SSYN3)

SSYNW requires option R&S SMW-K704.

Accredited calibration:
No minimum requirement.

Test equipment:
- Signal generator (see Table 1-1, item 5)
- Frequency counter (see Table 1-1, item 1)
- RF power meter (see Table 1-1, item 8)

Test setup:
1. Connect the signal generator output to the REF IN input (on rear panel).
2. Connect the calibrated frequency counter to the REF OUT output (on rear panel).

Measurement 1:
1. Settings on DUT:
   - **Reference Source** external
   - **External Reference Frequency** variable, 12.288 MHz
   - **Reference Frequency Output** 10 MHz derived from Ref. Input

   Settings on Reference Signal Generator:
   - **Reference Source** internal
   - **Level** 5 dBm
   - **Frequency** 12.288 MHz
2. Measure the output Frequency at the REF OUT output.
   The frequency deviation from 10 MHz must be < 1 Hz.
   Measure the output level. It should be within the data sheet specifications.

3. Settings on DUT:
   - **Reference Frequency Output** Same As Reference Input

   Measure the output Frequency at the REF OUT output.
   The frequency deviation from 12.288 MHz must be < 1 Hz.
4. Set the output Frequency of the Reference Signal Generator to 1.0 MHz and the **External Reference Frequency** of the DUT to 1.0 MHz.
   Measure the output Frequency at the REF OUT output.
   The frequency deviation from 1.0 MHz must be < 1 Hz.
   Measure the output level. It should be within the data sheet specifications.
5. Set the output Frequency of the Reference Signal Generator to 100.0 MHz and the **External Reference Frequency** of the DUT to 100.0 MHz.
   Measure the output Frequency at the REF OUT output.
   The frequency deviation from 100.0 MHz must be < 1 Hz.
   Measure the output level. It should be within the data sheet specifications.

1.4.1.5 Noise Floor of Internal Reference (only with SSYNW and R&S SMW-K703)

Accredited calibration: Same coverage as performance test.

Test assembly: See Table 1-1.

Test setup:
1. Connect the noise analyzer to the REF OUT output (at the rear panel).
2. With option R&S SMW-K703, perform the measurement also for the 1 GHZ OUT output (at the rear panel).
3. Connect the signal generator output to the REF IN input (at the rear panel).

Measurement 1:
1. Measure the wideband noise of the reference output at 100 MHz carrier , respectively at 1 GHz carrier for instruments with option R&S SMW-K703 at 10 MHz offset frequency.
2. Perform the settings on the instruments.

   Settings on DUT:
   - **Reference source** internal
   - **Ref output frequency** 100 MHz

   Settings on phase noise analyzer:
   - **Mode** Signal source analyzer
   - **Center** 100 MHz, respectively 1 GHz
   - **Offset frequency** 10 kHz to 10 MHz
   - **Number of correlations** 1E4
   - **Attenuation** 5 dB
   - **Bandwidth** 10%

1.4.2 Checking the Frequency Accuracy

1.4.2.1 Frequency Setting

Accredited calibration: No minimum requirement.

Test method: The frequency setting is tested by running the internal synthesizer adjustments to check the frequency overlap of the VCOs.

Measurement 1:

► Run: Setup ⇨ Internal Adjustments ⇨ Adjust All
There must be no error message.

1.4.2.2 Setting Time

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.3, "Test Assembly for Setting Time", on page 9

Test method: The spectrum analyzer is operated as an FM demodulator. A controller transmits the start and the stop frequency via the IEC/IEEE bus. The analyzer is triggered by the positive edge on the EOI line of the IEC/IEEE bus or the trigger pulse in list mode. At switch over from start to stop frequency, the settling procedure is displayed on the screen of the analyzer.

Preparation of measurement:

1. Synchronize the reference frequencies of the DUT and the analyzer.
2. Make LAN and RF connections.
3. Connect spectrum analyzers trigger connector to EOI line (pin 5) of IEC/IEEE bus.
4. Settings on DUT:
   - **Frequency** start frequency unmodulated
   - **Level Settings/Setting Characteristic** Auto
   - **Level** 0 dBm
5. Settings on spectrum analyzer:
   - **AMPT/REF LEVEL** 0 dBm
   - **FREQ**/CENTER/STOP FREQUENCY
   - **FM DEMOD** ON
   - **DEMOD BW** 100 kHz
   - **RANGE /DEVIATION PER DIV** 200 Hz
   - **MEAS TIME** 5 ms
   - **TRIGGER** EXTERN
   - External triggering by positive edge at 1.4 V

Measurement 1:

1. Set the analyzer to the stop frequency.
2. Set the DUT to the start frequency f_{start}.

3. Send the stop frequency f_{stop} from the controller to the DUT.
   ⇨ The externally triggered analyzer displays the settling curve. The setting time is defined as the time required to make the frequency deviation from the stop frequency less than the specified deviation in the data sheet.
4. Repeat the measurement with the start and the stop frequency interchanged.
5. Switch on I/Q-Modulation:
   I/Q Settings Menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On

   Supply 0.5 V DC to the I_{ext} Input and repeat the measurement.
6. Repeat Measurement in List Mode with CW.
   Connect a Trigger source to External Trigger input of the spectrum analyzer and the Trigger Input **INST TRIG A** or **B** of the DUT.
   Setting on DUT:
   List Mode Menu:
   - Generate List with recommended Frequencies and Levels.
   - **Run Mode**
     Depending on the options:
     – Learned (Frozen RF Settings)
       Learn List Mode Data.
     – Live
       (R&S SMW-B711/-B721)
   - **Mode** Extern Step
   - **State** on
   - Generate Trigger Pulses and measure the Setting Time.
7. Repeat List Mode Measurement with I/Q-Modulation switched on.

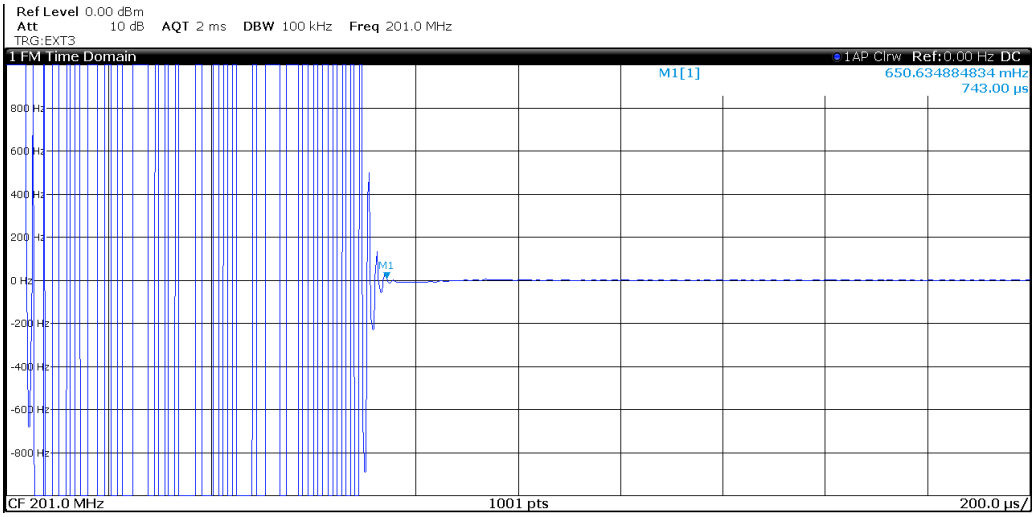
Recommended test frequencies and modes:

f_{start}	f_{stop}	Mode
199 MHz	201 MHz	CW, IQ, List
750 MHz	751 MHz	CW, IQ, List
1500 MHz	1501 MHz	CW, IQ, List
1500 MHz	1540 MHz	CW, IQ, List
3000 MHz	3001 MHz	CW, IQ, List
3779 MHz	3781 MHz	CW, IQ, List
4399 MHz	4401 MHz	CW, IQ, List
4759 MHz	6000 MHz	CW, IQ, List
6499 MHz	6501MHz	CW, IQ, List
6999 MHz	7001MHz	CW, IQ, List
7199 MHz	7201MHz	CW, IQ, List

f_{start}	f_{stop}	Mode
7799 MHz	7801 MHz	CW, IQ, List
8899 MHz	8901 MHz	CW, IQ, List
9999 MHz	10001 MHz	CW, IQ, List
10699 MHz	10701 MHz	CW, IQ, List
11699 MHz	11701 MHz	CW, IQ, List
12999 MHz	13001MHz	CW, IQ, List
14399 MHz	14401 MHz	CW, IQ, List
17799 MHz	17801 MHz	CW, IQ, List
199 MHz	20 GHz	CW, IQ, List
19499 MHz	19501 MHz	CW, IQ, List
26999 MHz	27001 MHz	CW, IQ, List
199 MHz	37 GHz	CW, IQ, List
1 GHz	30 GHz	CW, IQ, List
10 GHz	40 GHz	CW, IQ, List
33 GHz	5.5 GHz	CW, IQ, List
30 GHz	4.2 GHz	CW, IQ, List
27 GHz	100 MHz	CW, IQ, List
40 GHz	44 GHz	CW, IQ, List

Example:

Measurement



The marker is set to the time when the trace enters the specified interval of 201 MHz ± 20.1 Hz. The setting time is 743 µs.

1.4.3 Checking the Spectral Purity

1.4.3.1 Harmonics

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test setup:
1. Connect the RF analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Measurement 1:
1. Settings on analyzer:
   - **Reference level** test level + 3 dB, 10 dB/div.
   - **Span** 0 Hz
   - **Resolution bandwidth** 1 kHz
2. Settings on DUT:
   - **Frequency** test frequencies
   - **Level** test levels
3. First measure the level of the fundamental P_f at the test frequency f as a reference. Then measure the signal levels P_{2*f} and P_{3*f} at twice and three times the carrier frequency f.
   ⇨ The harmonic spacing is the measured harmonic level referred to the fundamental:
   - HD2 = P_f - P_{2*f}
   - HD3 = P_f – P_{3*f}

   (in dBc = referred to the carrier)
4. Repeat the measurement with I/Q-Modulation switched on.
5. **I/Q Settings** Menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On
6. Supply 0.5 V DC to the I_{ext} Input.

Recommended test frequencies and levels:

► Test frequencies:
- 100 kHz (factory only)
- 1 MHz; 5.1 MHz; 6 MHz; 10.1 MHz; 12 MHz
- 20 MHz to 200 MHz in steps of 20 MHz
- 200.1 MHz; 290 MHz; 290.1 MHz; 420 MHz; 420.1 MHz; 600 MHz; 600.1 MHz; 850 MHz; 850.1 MHz; 1 GHz; 1200 MHz; 1200.1 MHz; 1.7 GHz; 1700.1 MHz; 2 GHz; 2.5 GHz; 2500.1 MHz; 3 GHz; 3.5 GHz; 3500.1 MHz; 3.7 GHz; 3700.1 MHz; 4 GHz; 5 GHz; 5.2 GHz; 5200.1 MHz; 6 GHz; 7.2 GHz;

7.201 GHz; 8.9 GHz; 8.901 GHz; 10.7 GHz; 10.701 GHz; 12 GHz; 12.001 GHz; 14.4 GHz; 14.401 GHz; 17.8 GHz; 17.801 GHz; 19.501 GHz; 20 GHz.

For f > f_{max} / 3, the third harmonic is outside the specified frequency range and has not to be measured.
Test levels: Maximum specified level for harmonics

1.4.3.2 Subharmonics

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test setup:
1. Connect the spectrum analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Measurement 1:
▶ First the level of the fundamental is measured as reference, then a signal is searched for at 0.125*, 0.25*, 0.5*, 0.75*, 0.875*, 1.125, 1.25* and 1.5*test frequency.
⇨ The subharmonic spacing is the measured level referred to the reference level (dBc = referred to the carrier).

Recommended test frequencies and levels:
1. Test frequencies:
   - 1501 MHz; 1550 MHz to 1800 MHz in 50 MHz steps
   - 1800 MHz to 2200 MHz in 100 MHz steps
   - 2200 MHz to 2500 MHz in 50 MHz steps
   - 2500 MHz to 6 GHz in 100 MHz steps
   - 6.2 GHz to RF_{max} in 200 MHz steps

   Level: P_{min} (in Att mode with level readjusted at +10 dBm)
2. Repeat Measurement with I/Q-Modulation switched on.
   I/Q Settings Menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On

   Supply 0.5 V DC to the I_{ext} Input.

1.4.3.3 Nonharmonics (SSYNW)

Accredited calibration: No minimum requirement.

Test equipment: RF analyzer (see Table 1-1, item 19)

Test setup:
1. Connect the RF analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Measurement 1:

► First the carrier level P_f is measured at the test frequency f as reference and then the signal level P_{search} is measured at the analyzer search frequency.
⇨ The nonharmonic spacing D is the measured level referred to the reference level: $D = P_f - P_{search}$ (in dBc = referred to the carrier).

Some of the nonharmonics suppression values to be measured might be outside analyzer specifications. In case of doubt, repeat the measurement with a 3 dB attenuator pad at the analyzer input. If the nonharmonics suppression changes the nonharmonics are due to the analyzer. Because of the bell-shaped noise of the analyzer near the carrier, smaller resolution bandwidths may have to be used. To exclude amplitude independent nonharmonics of the analyzer, use a second generator with different synthesis architecture.

Recommended settings and search frequencies:

Table 1-5: Nonharmonics of the synthesis at test level 10.0 dBm, unmod.

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
51.0	50
375.0	100
375.0	150
375.0	200
375.0	250
697.25934868	697.38571868
991.0	1000.0
999.95	1000.0
1000.05	1000.0
1009.0	1000.0
1143.57492185	1143.65170185
2995.08466011	2995.14233011
3023.79422901	3073.79422901
3023.79422901	3123.79422901
3510.88780633	3532.23698635327
3510.88780633	3489.53862630673
4410.97851747	4433.81411572391
4410.97851747	4388.14291921609
4876.66870932	4876.73330932
4876.66870932	4876.60410932
5456.07632442	5456.20952442
5456.07632442	5455.94312442

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
5798.85829906	5799.01574906
5999.95	50.0
5999.95	100.0
5999.95	150.0
5999.95	200.0
5999.95	250.0
5999.95	300.0
5999.95	350.0
5999.95	400.0
5999.95	450.0
5999.95	500.0
5999.95	550.0
5999.95	600.0
5999.95	650.0
5999.95	700.0
5999.95	750.0
5999.95	800.0
5999.95	850.0
5999.95	900.0
5999.95	950.0
5999.95	1000.0
5999.95	2000.0
5999.95	3000.0
5999.95	4000.0
5999.95	5000.0
5999.95	6000.0
6000.0	5900.0
6000.0	5950.0
6000.0	6050.0
6000.0	6100.0
11610.12453280	11610.21181280
17442.47333228	17442.6019228
23565.62431	23565.356178

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
23565.62431	23565.892442
38422.1887	38422.001462
38422.1887	38422.375938
39193.96494	39193.872677
39193.96494	39194.057203

Table 1-6: Additionally test Nonharmonics of the synthesis with option R&S SMW-B711/-B721 at test level 10.0 dBm, unmodulated at the following frequencies:

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
3766.797216310	3766.602516310
3766.797216310	3766.991916310
3766.797216310	3766.884016310
3766.797216310	3766.710416310
4514.632413385	4514.427613385
4514.632413385	4514.837213385
4649.993231415	4649.721831415
4649.993231415	4650.264631415
4763.063077520	4763.160977520
4763.063077520	4762.965177520
5462.922400540	5549.892400540
5462.922400540	5361.072400540
5491.857804200	5535.867804200
5491.857804200	5447.847804200
5543.908011755	5603.998011755
5543.908011755	5483.818011755
5495.741915590	5524.461915590
5495.741915590	5467.021915590
5495.741915590	5539.551915590
5495.741915590	5451.931915590
5502.802796805	5517.342796805
5502.802796805	5488.853139295
5983.914531505	5984.087031505
5983.914531505	5983.742031505
3967.235328185	3967.523928185

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
3967.235328185	3966.946728185
4919.658909710	4919.848609710
4919.658909710	4919.469209710
3644.390747580	3644.674247580
3644.390747580	3644.107247580
5638.540407110	5638.738207110
5638.540407110	5638.342607110
5492.580485590	5535.090485590
5492.580485590	5450.070485590
5492.580485590	5550.570485590
5492.580485590	5434.590485590
5503.926333585	5531.446333585
5503.926333585	5476.406333585
4417.688911215	4417.916911215
4417.688911215	4417.460911215
5459.987413055	5560.237413055
5459.987413055	5359.737413055
5515.334451730	5518.284451730
5515.334451730	5512.384451730
74.37228361	37.18633361
293.97339440	228.56949440
5793.76119683	5793.96024683
9785.03596909	9785.41458909
17252.54850994	17252.83811994

Table 1-7: Nonharmonics of output mixer, test level P_{max} unmodulated

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
197.0	1197.00
197.0	606.00
197.0	409.00
197.0	212.00
197.0	15.00
197.0	182.00
197.0	379.00

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
172.0	140.00
172.0	32.00
172.0	204.00
152.0	88.00
152.0	64.00
197.0	1000.00 at P_{min}

1.4.3.4 Nonharmonics (SSYN)

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test setup:
1. Connect the RF analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Measurement 1:
► First the carrier level P_f is measured at the test frequency f as reference and then the signal level P_{search} is measured at the analyzer search frequency.
⇨ The nonharmonic spacing D is the measured level referred to the reference level: $D = P_f - P_{search}$ (in dBc = referred to the carrier).

Some of the nonharmonics suppression values to be measured might be outside analyzer specifications. In case of doubt, repeat the measurement with a 3 dB attenuator pad at the analyzer input. If the nonharmonics suppression changes the nonharmonics are due to the analyzer. Because of the bell-shaped noise of the analyzer near the carrier, smaller resolution bandwidths may have to be used. To exclude amplitude independent nonharmonics of the analyzer, use a second generator with different synthesis architecture.

Recommended settings and search frequencies:

Table 1-8: Nonharmonics of the synthesis without option R&S SMW-B22 at test level 3.0 dBm, unmod.

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
984.001	987.557
1007.6443	1007.6515
1027.155	1027.20444
1144.005	1144.055
1253.0	1265.2
1401.26	1401.3074
1499.02379	1499.03469

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
1696.853	1696.8639
1849.5328	1849.5438
2696.296	2696.3058

Table 1-9: Nonharmonics of output mixer without option R&S SMW-B22, test level P_{max} unmodulated

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
200.0	1240.00
200.0	640.00
200.0	440.00
200.0	240.00
200.0	40.00
200.0	160.00
200.0	360.00
172.0	180.00
172.0	8.00
172.0	164.00
152.0	128.00
152.0	24.00
200.0	1040.00 at P_{min}

Table 1-10: Nonharmonics of the synthesis with option R&S SMW-B22 at test level 3.0 dBm, unmodulated

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
750.08	750.00
800.08	800.00
proceed in 50 MHz steps up to	
1450.08	1450.00
1000.00	1018.18
1499.92	1500.00
1538.469258	1538.619798
1592.58110430	1592.82240430
1632.762933	1633.031073
1687.354142	1687.645892
1700.94616990	1700.47315990
1746.74317	1746.93182

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
1719.096818	1719.678558
1786.29022436	1786.89326436
1800.28930450	1800.72343450
1806.873895	1807.078775
1828.65883132	1828,81149132
1834.39736688	1834.59060688
1875.38113408	1875.47165408
1879.75989280	1880.57816280
1990.39112151	1990.48938151
1924.53660942	1924.75680942
2040.13419274	2039.79070274
2043.92934349	2044.11700349
2104.44390554	2106.01121554
2110.663972	2111.026712
2163.630319	2163.796569
2167.27616036	2168.19042036
2210.14856183	2210.25761183
2356.00000	2356.54075
2684.95121340	2684.61542340
2985.158823	2985.300303

Table 1-11: Nonharmonics of the synthesis with option R&S SMW-B22 at test level 3.0 dBm, unmodulated

DUT frequency (Frequency in MHz)	Analyzer search frequency (in MHz)
1000.08	1000.0
1050.08	1050.0
1100.08	1100.0
1150.08	1150.0
1200.08	1200.0
1250.08	1250.0
1300.08	1300.0
1350.08	1350.0
1400.08	1400.0
1450.08	1450.0

DUT frequency (Frequency in MHz)	Analyzer search frequency (in MHz)
1499.92	1500.0
1500.506680	1500.76002
1500.506680	1502.02672
1500.506680	1517.426687
1746.74317	1746.93402
1800.2893045	1800.7234345
1828.65883132	1828.81149132
1875.38113408	1875.47165408
1924.53660942	1924.75680942
2043.92934349	2044.11700349
2110.663972	2111.026712
2163.630319	2163.796569
2210.14856183	2210.25761183
2356.0	2356.54075
2684.95121340	2684.6154234
2898.0	2898.909
2985.158823	2985.300303

Table 1-12: Nonharmonics of output mixer with option R&S SMW-B22, test level P_{max} unmodulated

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
1.00	1201.00
152.00	288.00
152.00	136.00
180.00	300.00
180.00	120.00
180.00	60.00
198.00	210.00
198.00	12.00
198.00	186.00
198.00	1200.00 at P_{min}

1.4.3.5 Non-systematic Nonharmonics

Accredited calibration: No minimum requirement.

Test equipment:

- RF analyzer (see Table 1-1, item 19)

Test setup:

1. Connect the RF analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Measurement 1:

1. Settings on DUT:
   - **Level** P_{min}
   - **Frequency** recommended test frequencies
2. Recommended settings on analyzer:
   - **Detector** Sample
   - Frequency far from the carrier:
     - **AMPT/MIXER/MIXER LVL MANUAL** -5 dBm
     - **Resolution bandwidth** 30 kHz
     - **Video bandwidth** 1 kHz
     - **Span** 10 MHz
   - Frequency at 50 kHz to 1 MHz from the carrier:
     - **Resolution bandwidth** 1 kHz
     - **Video bandwidth** 1 kHz

     Average over at least 3 sweeps.
3. Search for nonharmonics from 10 kHz to 20 MHz offset from carrier.
4. Start searching at the positive frequency deviation.

Recommended test frequencies and levels:

1. Test frequencies (CW-mode):
   40 MHz; 520 MHz; 1499 MHz; 1501 MHz; 2000 MHz; 2700 MHz; 3001 MHz;
   4 GHz; 6 GHz;
   6001 MHz; 10 GHz; 15 GHz; 20 GHz;
   25 GHz; 30 GHz; 35 GHz; 40 GHz; 44 GHz.
   R&S SMW-B1007/-B2007, R&S SMW-B107/-B207
   7.5 GHz additionally
2. Repeat the measurement with external I/Q-Modulation switched on:
   - **I/Q Settings** Menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On
   - Supply 0.5 V DC to the I_{ext} Input
3. Repeat the measurement with internal I/Q-Modulation switched on:
   I/Q Settings Menu:
   - **Source** Internal Baseband
   - **State** On

   ARB Menu:
   - **Create Test Signal** Const I/Q
   - **I Value** 0.5 FS
   - **Q Value** 0.5 FS

- **Generate Signal RAM**

4. Test frequencies:
   - RF_{max} < 7 GHz
     1501 MHz and 3001 MHz
   - RF_{max} ≥ 7 GHz
     6001 MHz and 15 GHz

   RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
   See RF frequency options overview.
5. Repeat the measurement at 1 GHz with I/Q-modulation switched on. Check for nonharmonics from 10 kHz to 20 MHz from carrier at P_{min} with a reduced analyzer Resolution bandwidth of 5 Hz.
   Nonharmonics from 40 Hz to 10 kHz from carrier should be below data sheet value at 10 kHz.

Some of the nonharmonics suppression values to be measured might be outside analyzer specifications. In case of doubt, repeat the measurement with a 3 dB attenuator pad at the analyzer input. If the nonharmonics suppression changes the nonharmonics are due to the analyzer. Because of the bell-shaped noise of the analyzer near the carrier, smaller resolution bandwidths may have to be used. To exclude amplitude independent nonharmonics of the analyzer, use a second generator with different synthesis architecture.

1.4.3.6 Wideband Noise

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test setup:
1. Connect the RF analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Test method: The carrier power is measured first. Then the center frequency of the analyzer is increased by 30 MHz and the noise power in a small bandwidth is measured. The difference of the carrier power and the noise power in 1 Hz bandwidth, which is calculated from the measurement, is defined as wideband noise. Because wideband noise degrades with lower electronic levels at the output step attenuator input, the output level of the generator has to be set to the lowest level before switching the step attenuator.

Measurement 1:
1. Settings on DUT:
   - **Frequency** test frequency
     RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
     – RF_{max} < 12 GHz

Set **Level** to +13 dBm
Level Settings Characteristic auto
determine P_{upper}: ⇨ RF ⇨ Level ⇨ Level range ⇨ upper
$P_{min} = P_{upper}$ - 5 dB

– $RF_{max} \geq 12$ GHz
Set **Level** to +6 dBm
Level Settings Characteristic auto
determine P_{min}: ⇨ RF ⇨ Level ⇨ Level range ⇨ lower

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
See RF frequency options overview.

2. Settings on analyzer:
   - **Center** test frequency
   - **Reference level** Level of DUT + 1 dB
   - **Attenuator** D_{min} = Reference Level - P_{1dB} ⇨ round to next larger available Attenuation of the analyzer (P_{1dB} = analyzer P1dB level at test frequency)
   - **Span** 110 kHz
   - **Detector** RMS
   - **Sweep Time Manual** 1 s
3. Switch on channel power measurement with 100 kHz bandwidth.
4. Measure the channel power P_{ref} with the center frequency of the analyzer set to the test frequency.
5. Increase the analyzer center frequency by 30 MHz.
6. Inhibit the switching of the attenuator with AMPT RF ATTEN MANUAL without entering a value so that the input mixer is not overdriven.
7. Lower the reference level of the analyzer by 20 dB, measure the new channel power P_{noise}.
8. Minimize the output level on the DUT by means of RF OFF, measure the channel power P_{res}.

Evaluation:

1. If the power $P_{res} < P_{noise}$ - 0.41 dB the inherent noise power of the analyzer can be subtracted:

$$W\_Noise = -P_{ref} + 10 * \log 10(10^{Pnoise/10} - 10^{Pres/10}) - 50dB$$

2. If the power $P_{res} > P_{noise}$ - 0.41 dB the analyzer resolution is not sufficient for a precise measurement. The true result is in such case more than 10 dB below the measured value. The result then is at least:

$$W\_Noise = -P_{ref} + P_{noise} - 50dB - 10dB$$

⇨ The difference between the power W_{noise} in dBm and the power P_{ref} in dBm is the broadband noise floor in dBc.

Recommended test frequencies and levels:

1. Recommended test frequencies:
   1 MHz; 5.1 MHz; 10.1 MHz; 20.1 MHz; 200 MHz; 200.1 MHz; 290 MHz; 290.1 MHz; 420 MHz; 420.1 MHz; 480 MHz; 600 MHz; 600.1 MHz; 800 MHz; 850 MHz; 850.1 MHz; 1 GHz; 1000.1 MHz; 1200 MHz; 1.4 GHz; 1.7 GHz; 1700.1 MHz; 2 GHz; 2.25 GHz; 2.5 GHz; 2500.1 MHz; 3 GHz; 3.5 GHz; 3500.1 MHz; 3.7 GHz; 3700.1 MHz; 4 GHz; 5 GHz; 5.2 GHz; 5200.1 MHz; 6 GHz 6.001 GHz; 7.2 GHz; 7.201 GHz; 8.9 GHz; 8.901 GHz; 10.7 GHz; 10.701 GHz; 12 GHz; 12.001 GHz; 14.4 GHz; 14.401 GHz; 17.8 GHz; 17.801 GHz; 19.5 GHz; 19.501 GHz; 20 GHz
   22 GHz; 24 GHz; 25.7 GHz; 25.701 GHz; 27 GHz; 27.001 GHz; 29 GHz; 31 GHz; 33.7 GHz; 33.701 GHz; 35 GHz; 37 GHz; 39 GHz; 40 GHz; 41 GHz; 42 GHz; 43 GHz; 44 GHz
   R&S SMW-B1007/-B2007, R&S SMW-B107/-B207
   7.5 GHz additionally
   Recommended test levels:
   +10 dBm and P_{min}.
2. Repeat the measurement with I/Q-Modulation switched on:
   I/Q Settings dialog:
   - **Source** Analog Wideband I/Q Input
   - **State** On
3. Supply 0.5 V DC to the I_{ext} Input.
4. For Each test frequency:
   a) Set **Level Settings Characteristic** auto.
   b) Determine P_{min} as described above.
   c) Set **Level Settings Characteristic** Strictly Monotone.
   d) Set **Level** P_{min}.
   e) Measure the Wideband Noise.

1.4.3.7 SSB Phase Noise

Accredited calibration:

No minimum requirement.

The SSB phase noise of the DUT can be measured directly if a Phase Noise Test Set is available. An R&S FSWP or any other analyzer with phase noise option is suitable if its own phase noise is at least 6 dB less than the guaranteed DUT Phase noise in the data sheet.

Measurement

► Set the Level of the DUT to 0 dBm and measure the phase noise at recommended offset with the analyzer in phase noise mode.

If no suited analyzer is available, the Phase noise can be measured with the aid of a second generator and a mixer.

Test equipment:

- RF analyzer (see Table 1-1, item 19)
- Reference source for SSB noise measurements (see Table 1-1, item 2)
- Phase noise test assembly (see Table 1-1, item 6)

Test assembly: See Chapter 1.2.1, "Test Assembly for SSB Phase Noise and Jitter", on page 8

Test method: The two generators are set to the test frequency and synchronized with a phase offset of 90 ° (phase quadrature). Mixing to 0 Hz suppresses the RF carrier. Due to the phase quadrature, the mixer supplies a voltage representing the phase difference between the input signals. This voltage is measured with the spectrum analyzer and can be converted into SSB phase noise.

Measurement 1:

1. Set the levels of the two generators in accordance with the specifications of the mixer used (unmodulated or I/Q modulation with max. level).
2. For calibration, reduce the level of the DUT by 40 dB and detune one signal generator by 20 kHz. Check the signal for harmonics; the 2nd and 3rd harmonic should be more than 30 dB below the fundamental. Measure the reference value at 20 kHz at the analyzer and note it down.
3. Set the detuned signal generator to the previous frequency and set the signal generators for phase quadrature. To this end, raise the level of the DUT to the previous level and call "Delta Phase" in the "Frequency/Phase" menu. Observe the output voltage of the mixer on the oscilloscope and vary the phase until the voltage is zero.
4. Read the noise voltage, normalized to a bandwidth of 1 Hz (noise level) from the analyzer.

Evaluation:

► Determine the difference relative to the reference level and add to the value found 6 dB for the second (correlated) sideband and 40 dB for level switchover. If the S/N ratio of the reference source is not at least 10 dB better than that of the DUT, the noise component of the reference signal generator must be determined and subtracted as well.
⇨ The corrected S/N ratio is the wanted measured value.

Example:

The measured reference level is assumed to be 12 dBm. A noise level of -78 dBm (1 Hz) is determined at 20 kHz. The difference is 90 dB, plus the correction for the second sideband (6 dB) and level switchover (40 dB), yielding an S/N ratio of -136 dB or a noise level of -136 dBc (dB referred to the carrier power). If two identical signal generators are used, the result must be reduced by 3 dB for the (uncorrelated) noise power of the reference signal generator.

⇨ The final result is then -139 dBc.

If an R&S FSWP is in use, choose the reference bandwidth of the analyzer to 100 MHz for all phase noise measurements.

Recommended test frequencies:

SSYNW

The test frequencies vary, depending on the installed options.

Without R&S SMW-B709/-B710-/-B719/-B720 and/or R&S SMW-B711/-B721:

1. Perform the measurement at:
   10 MHz; 100 MHz; 1 GHz; 2 GHz; 3 GHz; 4 GHz; 5 GHz; 5.2 GHz; 6 GHz; 10 GHz; 12 GHz; 20 GHz; 40 GHz; 44 GHz
   in CW mode with 20 kHz offset.
2. Repeat the measurement at:
   1 GHz; 5 GHz; 12 GHz; 20 GHz; 40 GHz; 44 GHz;
   with offsets from 10 Hz to 1 MHz with analog I/Q modulation switched on:

   I/Q Settings dialog:
   - **Source** Analog Wideband I/Q Input
   - **State** On

   Supply 0.5 V DC to the I_{ext} input.

With R&S SMW-B709/-B710/-B719/-B720 and/or R&S SMW-B711/-B721:

1. Perform the meassurement at:
   10 MHz; 100 MHz; 1 GHz; 2 GHz; 3 GHz; 4 GHz; 5 GHz; 6 GHz; 10 GHz; 12 GHz; 20 GHz; 40 GHz; 44 GHz;
   with offset from 10 Hz to 10 MHz
2. Repeat the measurement at:
   1 GHz; 5 GHz; 12 GHz; 20 GHz; 40 GHz; 44 GHz
   with offsets from 10 Hz to 10 MHz with a single sideband CW test signal of 50.1 MHz and internal I/Q-Modulation switched on (measurement frequency is 1.0501 GHz).

   I/Q Settings dialog:
   - **Source** Analog Wideband I/Q Input
   - **State** On

   Test generator: The test generator functionality is available with protection level 1.
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency 50.1 MHz`
   - `:TEST:BB:GENerator:GAIN 1.0`
   - `:TEST:BB:GENerator:STATe ON`

Recommended test frequencies:

SSYN

1. Measurement at 100 MHz; 1 GHz; 2 GHz; 3 GHz; 4 GHz; 5 GHz; 6 GHz; 6.001 GHz; 10 GHz; 12 GHz; 12.001 GHz; 16 GHz; 20 GHz; 24 GHz; 27 GHz; 30 GHz; 34 GHz; 37 GHz; 40 GHz; 44 GHz
   with 20 kHz offset.
   RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
   See RF frequency options overview.
2. Measurement at 1 GHz with offsets from 10 Hz to 1 MHz.

3. Repeat the measurement at 1 GHz with offsets from 10 Hz to 1 MHz with analog I/Q-Modulation switched on.

   I/Q Settings menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On

   Supply 0.5 V DC to the I_{ext} Input.

4. Repeat the measurement at 1 GHz with a single sideband CW test signal of 50.1 MHz at offsets from 10 Hz to 1 MHz with internal I/Q modulation switched on (measurement frequency is 1.0501 GHz).

   I/Q Settings dialog:
   - **Source** Internal Baseband
   - **State** On

   Test generator: The test generator functionality is available with protection level 1.
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency 50.1 MHz`
   - `:TEST:BB:GENerator:GAIN 1.0`
   - `:TEST:BB:GENerator:STATe ON`

1.4.3.8 Residual FM

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)
- Reference source for SSB noise measurements (see Table 1-1, item 2)
- Phase noise test assembly (see Table 1-1, item 6)

Test assembly: See Chapter 1.2.1, "Test Assembly for SSB Phase Noise and Jitter", on page 8

Test method: The Residual FM is calculated from the phase noise measurement data. The measurement setup and procedure is identical to the phase noise measurement.

Measurement 1:

1. Settings on DUT:
   - **Frequency** 1 GHz
   - **Level** Level P_{max}, unmodulated

2. Settings on RS FSQ analyzer:
   - **Coupling** DC
   - **FILTER-TYPE** FFT
   - **RBW** 10 Hz
   - **DETECTOR** SAMPLE
   - Set up measurement and calibrate as described under SSB Phase Noise Measurement.

The Residual FM is defined as

$$\sigma = \sqrt{2 \cdot \int_{f\,\min}^{f\,\max} L_{\Phi}(f) \cdot f^2 df}$$

with $L_{\Phi}(f)$ being the single side band phase noise.

1. Set Analyzer Start and Stop Frequency to
   F_{start} = *300 Hz* and F_{stop} = *3 kHz*
2. Read Trace Data $T(\mu)$ with $\mu\varepsilon$ *[1, N]* and N = *625* from R&S FSQ analyzer and calculate the summed residual FM of the DUT and the Reference Signal Generator

   $$\sigma = \sqrt{2\sum_{\mu=1}^{N} \frac{10^{(T(\mu)-P_{ref}-46dB)/10}}{RBW} \cdot \frac{F_{stop}-F_{start}}{N} \left(F_{start} + (\mu-1) \cdot \frac{F_{stop}-F_{start}}{N-1} \right)^2}$$

   with P_{ref} being the reference level from the SSB Phase Noise Measurement with 40 dB reduced level with 20 kHz detuned frequency.
   The sum of the residual FM of the DUT and the Reference Signal Generator should be well below the guaranteed value of the DUT, so no correction of the measurement result is necessary.
3. Repeat measurement with a test bandwidth of 20 Hz to 23 kHz in two steps: First sweep from 20 Hz to 1 kHz with an RBW of 3 Hz and then sweep from 1 kHz to 23 kHz with an RBW of 100 Hz. Calculate the Residual FM for both measurements with the formula given above. The Residual FM from 20 Hz - 23 kHz is:

   $$\sigma_{20\,Hz-23\,kHz} = \sqrt{\sigma^2_{20\,Hz-1\,kHz} + \sigma^2_{1\,kHz-23\,kHz}}$$

1.4.3.9 Residual AM

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

RF-signal of the DUT is demodulated with a zero Bias Schottky Detector. The demodulated signal is fed to the Spectrum analyzer RF input.

Test method: The signal is AM-demodulated with a zero Bias Schottky Detector.

Measurement 1:

1. Settings on DUT:
   - **Frequency:** 1 GHz
   - Level according to the mixer specification in linear range
   - **AM-Source:** internal
   - **AM Depth:** 1 %
   - **LF-Gen-Frequency:** 10 kHz
   - **Level:** 12 dBm
     R&S SMW- Bx(0)03 / Bx(0)06 / : 8 dBm.

2. Settings on RS FSQ analyzer:
   - **Coupling** DC
     (an external Preamplifier with > 30 dB Gain and a DC-blocking Capacitor is necessary (f-3 dB < 10 Hz)).
   - **FILTER TYPE** FFT
   - **RBW** 100 Hz
   - ***F_{start}*** *9900 Hz*
   - ***F_{stop}*** *10100 Hz*
   - **DETECTOR** MAX PEAK

► Calibrate the setup:
   - Measure power level P_{ref} [dBm] at f = 10 kHz.

1. Switch of AM
2. Settings on RS FSQ analyzer:
   - **RBW** 3 Hz
   - ***F_{start}*** *20 Hz*
   - ***F_{stop}*** *1 kHz*
   - **DETECTOR** SAMPLE

► Read Trace $^{T(\mu)}$ with $^{\mu\varepsilon[1, N]}$ and $^{N = 625}$ from R&S FSQ analyzer and calculate the summed power.

$$P = \sum_{\mu=1}^{N} \frac{10^{T(\mu)/10}}{RBW} \cdot \frac{F_{stop} - F_{start}}{N}$$

► Repeat Measurement with:
   - **RBW** 100 Hz
   - ***Fstart*** *1 kHz*
   - ***Fstop*** *23 kHz*
   - Calculate Power as above

► Calculate the residual AM:

$$AM_{residual} = \frac{1}{\sqrt{2}} \cdot \sqrt{\frac{P_{20Hz-1kHz} + P_{1kHz-23kHz}}{10^{P_{ref}/10}}} [\%]$$

Test frequencies: 5 MHz; 100 MHz; 1 GHz; 3 GHz; 4.25 GHz; 5.25 GHz; 6 GHz;
6.001 GHz; 10 GHz; 12.75 GHz; 13.001 GHz; 15 GHz; 20 GHz;
24 GHz; 27 GHz; 27.001 GHz; 30 GHz; 34 GHz; 37 GHz; 40 GHz; 44 GHz

R&S SMW-B1007/-B2007, R&S SMW-B107/-B207

7.5 GHz additionally.

1.4.4 Checking the Level Data

1.4.4.1 Level Uncertainty

Accredited calibration: Same coverage as performance test for levels ≥ -40 dBm.

Test method: The level uncertainty is measured in two steps. First, the frequency response is measured at a fixed level with high frequency resolution. Then the level dependant uncertainty is measured at fixed frequencies over the specified range.

Test equipment:
- RF power meter (see Table 1-1, item 8)
- RF analyzer (see Table 1-1, item 19)
- Low noise preamplifier (see Table 1-1, item 9)

Test method for levels in measurement range of power meter

Test equipment:
- RF power meter (see Table 1-1, item 8)

Test setup: ► Connect power meter to RF output socket.

Measurement 1:
1. Settings on DUT:
   - **Levels** test levels
2. Measure the level $P_{absolute}$ at the recommended test frequencies up to RF_{max}.
   ⇨The level error is the deviation of the measured level from the set value.
3. Repeat the measurement with IQ-Modulation switched on.
4. I/Q Settings menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On
5. Supply 0.5 V DC to the I_{ext} Input.

Recommended test levels for frequency response measurement:
1. **CW** 0 dBm and maximum specified level
2. **I/Q-Mode** +7 dBm with ALC-mode = Off (Sample & Hold)

Recommended test frequ. for level frequency response measurement:
100 kHz; 300 kHz; 1 MHz; 3 MHz; 5 MHz; 9 MHz; 10 MHz; 200 MHz; 200.1 MHz; 12.5 MHz to 6 GHz in 25 MHz steps.

6.025 GHz to RF_{max} in 100 MHz steps.

R&S SMW-B1007/-B2007, R&S SMW-B107/-B207

6 GHz to 7.5 GHz in 25 MHz steps additionally.

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

Test method for low levels

Test principle: Low levels can only be measured using a frequency selective measurement instrument. Spectrum analyzers with digital IF are best suited for this measurement due to their low linearity error. The absolute accuracy of these analyzers is not sufficient for this measurement. So a relative measurement referred to the measurements performed with the power meter is used to increase the accuracy of the measurement.

Only by switching the input attenuator and preamplifier (when available) of the analyzer the needed dynamic range of more than 120 dB can be reached. After switching the analyzer attenuator or preamplifier, a continuity calibration is to be carried out. It is therefore recommended to switch the attenuator not until reaching 50 dB under full scale, since the linearity errors are very small in this range.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test setup:
► Connect the spectrum analyzer to the RF output of the DUT with precision RF measurement cables.

Measurement 1:
1. Settings on DUT:
   - **Frequency** recommended test frequencies
   - **Level** +7 dBm, unmodulated
2. Settings on analyzer:
   - **Test frequency**
   - **SPAN** 10 Hz
   - **FILTER TYPE** FFT
   - **RES BW** 5 Hz
   - Set Marker to test frequency
   - **Reference level P_{ref}** +8 dBm
3. Read the marker level P_{Marker} and calculate the correction factor:
   $C = P_{absolute} - P_{Marker}$
   with $P_{absolute}$ from the measurements performed with the power meter.
4. Now decrease the DUT level in 5 dB steps and calculate the output power P by adding the Correction factor C to the marker readout.
5. When the marker level P_{Att1} is lower than P_{ref} -45 dB, increase the sensitivity of the analyzer by reducing the input attenuation, switching on the internal preamplifier if available, and reducing the resolution bandwidth to 1 Hz for levels below -90 dBm. Set the analyzer reference level to P_{Att1} + 1 dB. After switching on the analyzer sensitivity, read out the marker level P_{Att2} and recalculate the Correction factor:
   $C_{new} = C_{old} + P_{Att1} - P_{Att2}$
6. Continue the measurement down to -120 dBm in 5 dB steps.

Recommended test frequencies:

► 300 kHz; 75 MHz; 525 MHz; 1025 MHz; 2025 MHz; 2925 MHz; 3975 MHz; 4925 MHz; 5925 MHz;
6.025 GHz; 10.025 GHz; 12.525 GHz; 15.025 GHz; 17.525 GHz; 19.975 GHz; 22.525 GHz; 25.025 GHz; 27.525 GHz; 30.025 GHz; 32.525 GHz; 35.025 GHz; 37.525 GHz; 39.975 GHz; 40.025 GHz; 43.975 GHz.
R&S SMW-B1007/-B2007/-B107/-B207
7.425 GHz additionally.

1.4.4.2 Maximum Level

Test equipment:

- RF power meter (see Table 1-1, item 8)

Test setup:

► Connect power meter to RF output socket.

Measurement 1:

1. Settings on DUT:
   - **Level** 30 dBm
2. Measure the level P_{max} at the recommended test frequencies up to RF_{max}.
3. Repeat the measurement with IQ-Modulation switched on.
   I/Q Settings menu:
   - **Source** Analog Wideband I/Q Input
   - **State** On
   - **Baseband Gain** +8 dB

   Supply 0.5 V DC to the I_{ext} Input.
4. The measured level P_{max} must be:
   - RF_{max} < 6 GHz
     f ≤ 3 MHz: P_{max} ≥ max specified level + 3 dB
     3 MHz < f ≤ 5.5 GHz: P_{max} ≥ max specified level + 5 dB
     5.5 GHz < f ≤ 6 GHz: P_{max} ≥ max specified level + 4 dB
   - RF_{max} < 7 GHz
     f ≤ 3 MHz: P_{max} ≥ max specified level + 3 dB
     3 MHz < f ≤ 2 GHz: P_{max} ≥ max specified level + 5 dB
     2 GHz < f ≤ 7.5 GHz: P_{max} ≥ 20 dBm
   - RF_{max} < 12 GHz
     f ≤ 3 MHz: P_{max} ≥ max specified level + 3 dB
     3 MHz < f ≤ 2 GHz: P_{max} ≥ max specified level + 5 dB
     2 GHz < f ≤ 5 GHz: P_{max} ≥ 20 dBm
     5 GHz < f ≤ 12 GHz: P_{max} ≥ 19 dBm
     12 GHz < f ≤ 12.75 GHz: P_{max} ≥ 18 dBm
   - RF_{max} < 20 GHz
     f ≤ 3 MHz: P_{max} ≥ max specified level + 3 dB
     3 MHz < f ≤ 2 GHz: P_{max} ≥ max specified level + 5 dB
     2 GHz < f ≤ 5 GHz: P_{max} ≥ 20 dBm

5 GHz < f ≤ 10 GHz: P_{max} ≥ 19 dBm
10 GHz < f ≤ 14 GHz: P_{max} ≥ 21 dBm
14 GHz < f ≤ 18 GHz: P_{max} ≥ 20 dBm
18 GHz < f ≤ 20 GHz: P_{max} ≥ 19 dBm

- RF_{max} < 44 GHz
  f ≤ 3 MHz: P_{max} ≥ max specified level + 3 dB
  3 MHz < f ≤ 2 GHz: P_{max} ≥ 22 dBm
  2 GHz < f ≤ 14 GHz: P_{max} ≥ 18 dBm
  14 GHz < f ≤ 19.5 GHz: P_{max} ≥ 16 dBm
  19.5 GHz < f ≤ 29 GHz: P_{max} ≥ 18 dBm
  29 GHz < f ≤ 34 GHz: P_{max} ≥ 17 dBm
  34 GHz < f ≤ 37 GHz: P_{max} ≥ 16 dBm
  37 GHz < f ≤ 40 GHz: P_{max} ≥ 15 dBm
  40 GHz < f ≤ 42 GHz: P_{max} ≥ 13 dBm
  42 GHz < f ≤ 44 GHz: P_{max} ≥ 11 dBm

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
See RF frequency options overview.

5. Set **Baseband Gain** to -4 dB and repeat the measurement.

   The measured level P_{max} must be:

   - RF_{max} < 20 GHz
     f ≤ 17 GHz: ≥ 11 dBm
     f > 17 GHz: ≥ 9 dBm
   - RF_{max} < 44 GHz
     f ≤ 5 GHz: ≥ 11 dBm
     5 GHz < f ≤ 7 GHz: ≥ 9 dBm
     7 GHz < f ≤ 15 GHz: ≥ 11 dBm
     15 GHz < f ≤ 16 GHz: ≥ 10 dBm
     16 GHz < f ≤ 19.5 GHz: ≥ 7 dBm
     19.5 GHz < f ≤ 40 GHz: ≥ 15 dBm
     40 GHz < f ≤ 42 GHz: ≥ 13 dBm
     42 GHz < f ≤ 44 GHz: ≥ 11 dBm

   RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

   See RF frequency options overview.

Recommended test frequencies:

► 1 MHz; 5 MHz; 10 MHz; 480 MHz; 25 MHz to 200 MHz in 25 MHz steps; 200.1 MHz and 250 MHz up to 7.5 GHz in 50 MHz steps
and from 7.5 GHz to RF_{max} in steps of 100 MHz.
RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

1.4.4.3 Level Linearity Electronic Attenuation (ATT Mode Fixed)

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test setup:
► Connect the analyzer to the RF output of the DUT.

Measurement 1:

1. Settings on DUT:
   - **Frequencies** 5 MHz; 150 MHz; 1.1 GHz; 2.2 GHz; 3.2 GHz; 4 GHz; 5 GHz; 6 GHz, unmodulated.
     6.05 GHz; 8 GHz to RF_{max} in 2 GHz steps.
     $RF_{max} \leq 7.5$ GHz:
     7 GHz; 7.5 GHz, unmodulated additionally.
   - **Level** P_{max} (= Reference)
   - **Level/EMF** menu
     – **Level Settings characteristic** Uninterrupted Level Settings

   RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
   See RF frequency options overview.
2. Settings on analyzer:
   - Same as for the measurement of level frequency response and linearity. Measure the signal level P_{ref} as reference value.
3. Now reduce the level at the DUT in steps of 5 dB and measure the deviations from the nominal level difference.
   ⇨ The following deviations should not be exceeded:

Level Difference to P_{ref}	Tolerance in dB	
0		Reference
-5	$RF_{max} \leq 6$ GHz:	0.1 dB for f ≤ 6 GHz
	$RF_{max} > 6$ GHz:	0.1 dB for f ≤ 3.5 GHz 0.1 dB for 3.5 GHz < f ≤ 30 GHz 0.2 dB for f > 30 GHz
-10	$RF_{max} \leq 6$ GHz:	0.1 dB
	$RF_{max} > 6$ GHz:	0.1 dB for f ≤ 3.5 GHz 0.15 dB for 3.5 GHz < f ≤ 30 GHz 0.2 dB for f > 30 GHz

Level Difference to P_{ref}	Tolerance in dB
-15	0.2 dB for f ≤ 30 GHz 0.3 dB for f > 30 GHz
-20	0.25 dB for f ≤ 30 GHz 0.35 dB for f > 30 GHz

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

1.4.4.4 Output Impedance

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.2, "Test Assembly for Output Impedance (VSWR)", on page 9

Test method: For the VSWR measurement of a source, the effect of the level control must be considered. For this purpose, an auxiliary generator is used which transmits a wave with a slightly offset carrier frequency into the DUT. The difference frequency has to be within the control bandwidth of the level control. In the case of ideal source impedance, the wave from the auxiliary generator is not reflected by the DUT. In the case of not ideal DUT source impedance, the output wave of the DUT and the reflected wave of the auxiliary generator are superimposed on one another. A directional coupler couples a part of these outgoing superimposed waves to an analyzer. The frequency offset, results in a beat of the superimposed outgoing waves. The VSWR is the ratio between the maximum and minimum amplitude of the beat.

Measurement 1:

1. Settings on DUT:
   - **Level** +7 dBm
   - **Frequency** Increase the level control bandwidth using the command CALibration<Channel>:LEVel:BWIDth HIGH
2. Settings on spectrum analyzer:
   - **Test frequency**, **Span** 0 Hz, measured test level + 6 dB
   - **Resolution and video bandwidth** 10 kHz
   - **Linear level** scale
   - **Sweep time** 20 ms
3. Settings on second signal generator:
   - Set the frequency to the test frequency -100 Hz
   - Set minimum level, unmodulated
4. Vary the reference level to bring the line displayed on the screen of the spectrum analyzer approximately into the middle of the screen. Measure the voltage of the signal $V_{ref.}$

5. Unscrew the VSWR bridge from the DUT and let the test port open. Increase the level of the second signal generator until the voltage on the analyzer is V_{ref} ± 0.5 %.
6. Screw the VSWR bridge onto the DUT again.
7. Measure the maximum voltage V_{max} and minimum voltage V_{min} of the sinusoidal trace. Calculate the VSWR.
   VSWR = V_{max} / V_{min}

Recommended test frequencies and levels:

1.
   - f ≤ 6 GHz
     Test frequencies: 1 MHz to≤ 6 GHz in 50 MHz steps
   - f ≤ 50 GHz
     – Test frequencies for attenuator settings n = 0 and 1:
       1 MHz; 10 MHz; 25 MHz; 100 MHz to f ≤ 50 GHz in 50 MHz steps
     – Test frequencies for attenuator settings n = 2, 4 and 8:
       1 MHz; 10 MHz; 25 MHz; 500 MHz;
       1 GHz to ≤ 38 GHz or RF_{max}, whichever is lower: in 1 GHz steps;
       38 GHz to ≤ 50 GHz or RF_{max}, whichever is lower: in 250 MHz steps;

   RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
   See RF frequency options overview.
2. Settings on DUT:
   a) Enable Level-Cal-Mode:
   `:CALibration<Channel>:LEVel:STATe OFF`
   b) Measure the attenuator settings:
      - f ≤ 6 GHz
        Attenuator settings: n = -1, -4, 0, 1, 2, 3, 5 and 6
      - 6 GHz < RF_{max} < 12 GHz
        Attenuator settings: n = -1, 0, 1, 2, 3, 4 and 5
        f ≤7.2 GHz, select the lower band amplifier of the ASATT13, variant 02:
        `:CALibration<Channel>:LEVel:ATT:AMPL 0`
        f > 7.2 GHz, select the higher band amplifier of the ASATT13, variant 02:
        `:CALibration<Channel>:LEVel:ATT:AMPL 1`
        For ASATT13, variant 08, select the lower band amplifier:
        `:CALibration<Channel>:LEVel:ATT:AMPL 0`
      - f ≤ 50 GHz or RF_{max}, whichever is lower:
        Attenuator settings: n = 0, 1, 2, 4 and 8
        `:CALibration<Channel>:LEVel:ATT:STAGe n`

      RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
      See RF frequency options overview.

1.4.4.5 Level Setting Time

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.3, "Test Assembly for Setting Time", on page 9

Test method: The RF analyzer is operated as a fast level meter in zero span. A controller transfers the start and the stop level via the IEC bus. The analyzer is triggered by the positive edge on the EOI line of the IEC bus. At switch over from start to stop level, the settling procedure is displayed on the screen of the analyzer.

Preparation of measurement:

1. Synchronize the reference frequencies of the DUT and the analyzer.
2. Make IEC/IEEE bus and RF connections.
3. Connect the spectrum analyzer trigger input to the EOI line (pin 5) of the IEC/IEEE bus.
4. Setting on DUT:
   - **Frequency** test frequency
   - **Level** start level
5. Settings on spectrum analyzer:
   - **REFERENCE LEVEL** target level + 3 dB
   - **AMPLITUDE LOG RANGE** 10 dB
   - **RESOLUTION BANDWIDTH** 200 kHz
   - **VIDEO BANDWIDTH** 2 MHz
   - **SPAN** 0 Hz
   - **SWEEP TIME** 1 s / 2 ms
   - **TRIGGER** EXTERN
   - **External triggering** by positive edge at 1.4 V

Measurement 1:

1. First send the start and then the stop level from controller.
   ⇨ The externally triggered analyzer displays the settling curve. The setting time is defined as the time from which on the level deviation from the final level (= level 1 second after switch over) is less than the specified deviation in the data sheet.
2. Measure the recommended steps in Mode CW.
3. Measure the recommended steps with IQ-Modulation switched on:
   - **I/Q Settings** Menu:
     – **State** On
     – **Source** Analog Wideband I/Q Input
     – Supply 0.5 V DC to the I_{ext} Input.
4. Measure the recommended steps in List Mode with CW.
   Connect a Trigger source to External Trigger input of the spectrum analyzer and the trigger **Input INST TRIG A** or **B** of the DUT.
   Setting on DUT:
   List Mode Menu:

- Generate List with recommended Frequencies and Levels.
- **Run Mode**
  Depending on the options:
  – Learned (Frozen RF Settings)
    Learn List Mode Data.
  – Live
    (R&S SMW-B711/-B721)
- **Mode** Extern Step
- **State** on
- Generate Trigger Pulses and measure the Setting Time.

5. Repeat List Mode Measurement with I/Q-Modulation switched on.

Recommended test frequencies and levels:

► Frequencies: 30 MHz; 375 MHz; 1 GHz; 2 GHz; 3 GHz; 4.5 GHz and 6 GHz; 7.5 GHz; 10 GHz; 12.5 GHz; 15 GHz; 17.5 GHz; 20 GHz; 22.5 GHz; 25 GHz; 27.5 GHz; 30 GHz; 32.5 GHz; 35 GHz; 37.5 GHz; 40 GHz; 42 GHz; 44 GHz;

Start level	Stop level
-120 dBm	13 dBm
-27.3 dBm	2.7 dBm
2.7 dBm	-27.3 dBm

Test Levels in **List Mode**:

Start level	Stop level
5.01 dBm	11 dBm
11 dBm	5.01 dBm

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).
See RF frequency options overview.

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

1.4.4.6 Overvoltage Protection

Only for instruments equipped with an Electronic Step Attenuator ASATT6HP

$RF_{max} < 6$ GHz

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

Accredited calibration: No minimum requirement.

Test equipment:
- Signal generator (see Table 1-1, item 5)
- Power amplifier (see Table 1-1, item 13)

Test setup:
► Connect an RF-signal generator with a power level of 33 dBm to 36 dBm into the RF output socket of the DUT.

Measurement 1:
1. Settings on DUT:
   - **RF** On
   - **Frequency** 1 GHz
   - **Level** - 30 dBm
2. Switch on the RF signal generator.
   ⇨ The overvoltage protection has to respond immediately.

1.4.4.7 Test of RF-Signal Blanking

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19)

Test method: The spectrum analyzer is operated as a fast level meter in zero span. A controller transfers the start and the stop level via the IEC/IEEE bus. The analyzer is triggered by the positive edge on the EOI line of the IEC/IEEE bus. At switch over from start to stop level, the settling procedure is displayed on the screen of the analyzer.

Preparation of measurement:
1. Connect the spectrum analyzer to the RF connector of the DUT.
2. Synchronize the reference frequencies of the DUT and the analyzer.
3. Make IEC/IEEE bus and RF connections.
4. Connect spectrum analyzers trigger connector to EOI line (pin 5) of IEC/IEEE bus.
5. Setting on DUT:
   - **Frequency**
     1 GHz; 10 GHz; 30 GHz;
   - **Level** 0 dBm
     Increase level in Steps of 0.5 dB until RF Level ⇨ Attenuator Settings ⇨ Fixed Range changes by at least 0.5 dB. This value is the Measurement-level.
6. Settings on spectrum analyzer:
   - **REFERENCE LEVEL** Measurement-level + 1 dB
   - **AMPLITUDE LOG RANGE** 100 dB
   - **RESOLUTION BANDWIDTH** 100 kHz
   - **VIDEO BANDWIDTH** 300 kHz
   - **SPAN** 0 Hz
   - **SWEEP TIME** Level-Setting Time for ALC = on + 100 µs
   - **TRIGGER** EXTERN

- **External triggering** by positive edge at 1.4 V

Measurement 1:

1. Send Level = Measurement Level – 1 dB from the controller to the DUT.
   ⇨ The externally triggered analyzer displays the settling curve. The RF signal will be blanked for a few hundred µs during the step attenuator switch over.
2. Check that no level-spike more than 0.5 dB above the level at the start of the trace occurs.
3. Check that the level during blank is at least 40 dB below the signal level.
4. Check that the time the RF-signal is blanked is at least 50 µs.

1.4.5 Checking the Internal Modulation Generator

1.4.5.1 Frequency Accuracy

Accredited calibration:

No minimum requirement.

The LF-Generator is integrated into an FPGA clocked with the same reference frequency as the synthesizer. Therefore, the LF frequency has the same accuracy as the RF and has not to be measured.

1.4.5.2 Level Accuracy and Frequency Response

Level Accuracy

Accredited calibration:

No minimum requirement.

Test equipment:

- AC voltmeter (see Table 1-1, item 15)

Test method:

The output level of the LF Generator is measured direct with an AC voltmeter.

Test setup:

► Connect the AC voltmeter to the LF socket of the DUT.

Measurement of level accuracy:

► Settings on DUT:

- **LF Output** dialog:
  – **LF Gen Frequency** 1 kHz
  – Set **LF Output Voltage** to recommended levels and measure the output level

Recommended test levels for level accuracy:

3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V and 2 V

Frequency Response

Accredited calibration:

No minimum requirement.

Test equipment:

- Powersensor for lower frequences (see Table 1-1, item 8)

Test method: The output level of the LF Generator is measured directly with the powersensor.

Test setup: ► Connect the powersensor to the LF socket of the DUT.

Measurement of frequency response:

1. Settings on DUT:
   - **LF Output** dialog:
     – **LF Output Voltage** 1 V
     – Set **LF Gen Frequency** to recommended test frequencies and measure the output level.
2. Normalize frequency response to 1 kHz (i.e. subtract the value measured at 1 kHz (in dB) from all measurements).
   The level error of the normalized frequency response shall be < 0.2 dB.

Recommended test frequencies: 10 Hz; 100 Hz; 1 kHz; 10 kHz; 100 kHz; 1 MHz; 2 MHz; 3 MHz; 4 MHz; 5 MHz; 6 MHz; 7 MHz; 8 MHz; 9 MHz; 10 MHz

1.4.5.3 Distortions

Accredited calibration: No minimum requirement.

Test equipment: • Spectrum analyzer (see Table 1-1, item 19)

Test method: The fundamental and harmonics of the LF-generator are measured with the analyzer. The analyzer calculates the Total Harmonic Distortion with the ‘Harmonic Distortion’ function.

Test setup: ► Connect the spectrum analyzer to the LF socket of the DUT.

Measurement of frequency settings and distortion:

1. Settings on DUT:
   - **LF Output** dialog:
     – **LF Gen Voltage** 1 V
     – Set **LF Gen Frequency** 1 kHz
2. Settings on spectrum analyzer:
   - **RF INPUT** DC
   - **AMPT REF LEVEL** 10 dBm
   - **FREQ CENTER** LF Gen Frequency
   - **MEAS ⇨ HARMONIC DISTOR**
   - **RF ATTEN MANUAL** increase automatically set attenuator by 10 dB
3. Read the THD.
4. Repeat the measurement at the recommended test frequencies by changing the DUT LF Gen Frequency and the analyzer center frequency.

Recommended test frequencies: 100 Hz; 300 Hz; 1 kHz; 3 kHz; 10 kHz; 30 kHz; 100 kHz; 300 kHz; 1 MHz; 2 MHz; 3 MHz; 4 MHz; 5 MHz; 6 MHz; 7 MHz; 8 MHz; 9 MHz; 10 MHz

1.4.6 Checking the Amplitude Modulation

SSYNW: Requires option AM/FM/PhiM (R&S SMW-K720).

1.4.6.1 AM Setting Uncertainty

Accredited calibration:

No minimum requirement.

Test assembly:

See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Measurement of accuracy versus modulation depth:

1. Settings on DUT:
   - **RF** On
   - **Frequency** 150 MHz
   - **Level** 0 dBm
   - **Amplitude Modulation** Menu:
     - **AM Path 1 State** On
     - **AM Path 1 Source** LF Generator 1
   - **Modulation Sources** Menu:
     - **LF Generator 1 Frequency** 1 kHz
2. Settings on analyzer:
   - **AMPTD** ⇨ **REF LEVEL** test level + 6 dB
   - **FREQ** ⇨ **CENTER** 150 MHz
   - **FM DEMOD**
     - **FMDEMOD ON**
     - **RESULT DISPLAY** ⇨ **AM**
     - **DEMOD BW** 50 kHz
     - **RANGE** ⇨ **DEVIATION PER DIV** 20 %
     - **MEAS TIME** 100 ms
3. Set the **AM Path 1 Depth** to the recommended modulation depths and read the modulation depth **±peak/2** from the analyzer.
4. Repeat measurement at 10 GHz and 30 GHz, if applicable.
5. Repeat the measurement for external modulation input EXT1:
   Supply a Sinus with 1 kHz frequency and 1V Peak amplitude to EXT 1.
   Settings on DUT:
   - **AM Path 1 depth** 30 %
   - **AM Path 1 Source** External 1

   Read the modulation depth **±peak/2** from the analyzer.
6. Repeat the measurement for external modulation input EXT2.

Recommended modulation depths:

m = 5 %, 10 % to 90 % in steps of 10 % and 96 %

Measurement of accuracy versus RF:

1. Settings on DUT:
   - **RF** On

- **Frequency** recommended test frequencies
- **Level** 0 dBm
- **Amplitude Modulation** Menu:
  - **AM Path 1 State** On
  - **AM Path 1 Source** LF Generator 1
  - **AM Path 1 Depth** 80 %
- **Modulation Sources** Menu:
  - **LF Generator 1 Frequency** 1 kHz

2. Settings on analyzer:
   - **AMPTD** ⇨ **REF LEVEL** 6 dBm
   - **FREQ** ⇨ **CENTER** same as DUT
   - **FM DEMOD**
     - **FMDEMOD ON**
     - **RESULT DISPLAY ⇨ AM**
     - **DEMOD BW** 50 kHz
     - **RANGE ⇨ DEVIATION PER DIV** 20 %
     - **MEAS TIME** 100 ms
3. Measure the modulation depth for all recommended test frequencies.

Recommended test frequencies:

- RF_{max}≤6 GHz
  300 kHz, 1 MHz, 10 MHz, 200 MHz, 200.1 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz, 6 GHz
- RF_{max}≤ 7.5 GHz
  7.5 GHz additionally
- RF_{max} ≤44 GHz
  6 GHz up to RF_{max} in steps of 2 GHz, (with RF_{max} depending on installed frequency option)

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

1.4.6.2 AM Frequency Response

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Frequency** 1 GHz
   - **Level** 0 dBm
   - **Amplitude Modulation** Menu:
     - **AM Path 1 Source** External
     - **AM Path 1 depth** 60 %

- **Modulation Sources** Menu:
  - **External 1 Coupling** DC

2. Settings on R&S FSQ:
   - **AMPTD** ⇨ **REF LEVEL** 6 dBm
   - **FREQ** ⇨ **CENTER** 1 GHz
   - **FM DEMOD**
     - **FMDEMOD** On
     - **RESULT DISPLAY** ⇨ **AM**
     - **RESULT DISPLAY** ⇨ **AF SPECTRUM**
     - **DEMOD BW** 200 kHz
     - **RANGE** ⇨ **DEVIATION PER DIV** 20 %
     - **MEAS TIME** ≥ $16/f_{mod}$ s
3. Settings on the signal generator:
   - **LF Output** On
   - **LFGen Voltage** 1 V (V_{peak}).
   - Set the generator frequency to the frequencies given below and measure the modulation depth in RMS.

Gen. frequency	20 Hz	100 Hz	1 kHz	10 kHz	50 kHz	100 kHz	500 kHz
MEAS TIME	0.8 s	0.2 s	0.2 s	0.2 s	0.2 s	0.2 s	0.2 s

   ⇨ The modulation frequency response in dB is the difference between the greatest and the smallest modulation depth m_{max} and m_{min}:
   $m_{max-min} = 20 * \log_{10} (m_{max}) - 20 * \log_{10} (m_{min})$
4. Repeat the measurement with the setting:
   - **Modulation Sources** Menu:
     - **External 1 Coupling** AC
5. Repeat the measurement with the internal modulation generator:
   - **Amplitude Modulation** Menu:
     - **AM Path 1 Source** LF Generator 1

1.4.6.3 AM Distortion

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Amplitude Modulation** Menu:
     - **AM Path 1 depth** 30 %
     - **AM Path 1 Source** LF Generator 1

- **Modulation Sources** Menu:
  - **LF Generator 1 Frequency** 1 kHz

2. Settings on R&S FSQ:
   - **AMPTD** ⇨ **REF LEVEL** 6 dBm
   - **FREQ** ⇨ **CENTER** test frequency
   - **FM DEMOD**
     - **FMDEMOD** On
     - **RESULT DISPLAY** ⇨ **AM**
     - **RESULT DISPLAY** ⇨ **AF SPECTRUM**
     - **DEMOD BW** > 7* f_{mod}
     - **RANGE** ⇨ **DEVIATION PER DIV** 20 %
     - **MEAS TIME** 0.16 s
3. Measure the THD for all recommended test frequencies.
   To convert the displayed THD value in dB to percent, calculate:
   THD_{pct} = 100 * 10 ^ (THD_{dB}/20).
4. Repeat the measurement with AM depth set to 80 %.
5. Repeat the measurement for external modulation input EXT1:
   Supply a Sinus with 1 kHz frequency and 1V Peak amplitude to EXT 1.
   Settings on DUT:
   - **AM Path 1 depth** 30 %
   - **AM Path 1 Source** External 1

   Measure the THD at 1 GHz.
6. Repeat the measurement for external modulation input EXT2 at 1GHz.

Recommended test frequencies:

- RF_{max}≤6 GHz
  300 kHz, 10 MHz, 200 MHz, 200.1 MHz and 1 GHz to 6 GHz in steps of 1 GHz
- RF_{max}≤ 7.5 GHz
  7.5 GHz additionally
- RF_{max} ≤44 GHz
  6 GHz up to RF_{max} in steps of 2 GHz (with RF_{max} depending on installed frequency option)

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

1.4.6.4 Synchronous PhiM with AM

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Measurement 1:

1. Settings on DUT:

- **RF** On
- **Level** PEP = P_{max} 0 dBm
- **Amplitude Modulation** Menu:
  - **AM Path 1 Source** LF Generator 1
  - **AM Path 1 depth** 30 %
- **Modulation Sources** Menu:
  - **LF Generator 1 Frequency** 1 kHz

2. Settings on spectrum analyzer:
   - **AMPTD** ⇨ **REF LEVEL** 3 dBm
   - **FM DEMOD**
     - **DEMOD BW** 12.5 kHz
     - **MEAS TIME** 100 ms
     - **RESULT DISPLAY** ⇨ **PM**

Recommended test frequencies:

- RF_{max}≤6 GHz
  10 MHz, 200 MHz, 200.1 MHz and 1 GHz to 6 GHz in steps of 1 GHz
- RF_{max}≤ 7.5 GHz
  7.5 GHz additionally
- RF_{max} ≤44 GHz
  6 GHz up to RF_{max} in steps of 2 GHz (with RF_{max} depending on installed frequency option)

RF_{max} is the maximal settable RF frequency (depending on the installed frequency option).

See RF frequency options overview.

► Measure the resulting phase modulation with peak detection (±peak/2-value).

1.4.7 Checking the Frequency Modulation

Depending on the instrument series, the R&S SMW provides the following options for frequency modulation:

- SSYNW: R&S SMW-K720
- SSYN: R&S SMW-B20/-B22

Test assembly:

See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method FFT demodulation (option FS-K7):

1. The FM deviation and distortion are determined by digital signal processing in the spectrum analyzer.
2. Settings on R&S FSQ:
   - **AMPTD** ⇨ **REF LEVEL** test level
   - **FREQ** ⇨ **CENTER** test frequency
   - **FM DEMOD**
     - **FMDEMOD** On
     - **RESULT DISPLAY** FM resp. PM

- **DEMOD BW** > 2 * (deviation + f_{mod}) for FM
- **DEMOD BW** > 2 * fmod * (1 + deviation) for PM
- **RANGE ⇨ DEVIATION PER DIV** 0.5 * deviation
- **MEAS TIME** 3/f_{mod} for distortion (up to 3rd harmonic)
- **RESULT DISPLAY** FM resp. PM / AF SPECTRUM
- **DEMOD BW** > 2 * (deviation + 3.5 * f_{mod}) for FM
- **DEMOD BW** > 7 * f_{mod} * (1 + deviation) for PM
- **MEAS TIME** 16/f_{mod}

1.4.7.1 FM Setting Uncertainty

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Measurement 1:

► Settings on DUT:

- **RF** On
- **Level** 0 dBm
- **Frequency Modulation** Menu:
  - **FM Path 1 State** On
  - **FM Path 1 Source** LF Generator 1
  - **FM Mode** Normal

Recommended settings:

1. Center Frequency:
   - **RF_{max} ≤ 6 GHz**
     46.8 MHz, 3 GHz, 6 GHz
   - **RF_{max} = 7.5 GHz**
     46.8 MHz, 3 GHz, 6.5 GHz, 6.501 GHz, 7.5 GHz
   - **RF_{max} ≥ 12.75 GHz**
     46.8 MHz, 3 GHz, 6.5 GHz, 6.501 GHz, 10 GHz, 13 GHz, 20 GHz, 27 GHz, 35 GHz, 40 GHz, 44 GHz

   with LFGen Freq = 1 kHz, FM Deviation = 100 kHz
2. Deviation sweep:
   Measurement at Center Frequency 3000 MHz, f_{mod} = 10 kHz, deviation 1 kHz, 40 kHz
   Measurement at Center Frequency 70.687 MHz, f_{mod} = 20 kHz, deviation 312.5 kHz
3. Repeat the measurement at 70.687 MHz with changing settings to:
   - **Frequency Modulation** Menu:
     - **FM Path 1 Source** External 1
   - **Modulation sources** Menu:

– **External 1 Coupling** DC
– **External 1 Impedance** 50 Ohm

Feed in a 20 kHz 1 V_{peak} external modulation signal at EXT1-Input connector.

1.4.7.2 FM Distortion

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Frequency Modulation** Menu:
     – **FM Path 1 State** On
     – **FM Path 1 Source** LF Generator 1
     – **FM Mode** Normal
   - **Modulation sources** Menu.
     – **LF Generator 1 Frequency** 10 kHz
2. Settings on R&S FSQ:
   - **DEMOD BW** 5 * FM deviation
   - **RANGE ⇨ DEVIATION PER DIV** 250 kHz
   - **RESULT DISPLAY** FM / AF SPECTRUM
   - **SWEEP** MEAS TIME 2.5 ms
   - **FREQ** AF STOP 50 kHz
3. Read the THD from the display.
   To convert to percent, calculate:
   THD_{pct} = 100 * 10 ^ (THDdB/20)

Recommended settings:

1. Test frequencies:
   - **RF_{max} ≤ 6 GHz**
     46.8 MHz, 3 GHz, 6 GHz
   - **RF_{max} = 7.5 GHz**
     46.8 MHz, 3 GHz, 6.5 GHz, 6.501 GHz, 7.5 GHz
   - **RF_{max} ≥ 12.75 GHz**
     46.8 MHz, 3 GHz, 6.5 GHz, 6.501 GHz, 10 GHz, 13 GHz, 20 GHz, 27 GHz, 35 GHz, 40 GHz, 44 GHz,
2. **FM Path 1 deviation** maximum specified deviation for FM distortion.
   FM Path 1 deviation
   f ≤ 24 GHz: maximum specified deviation for FM distortion.

f > 24 GHz: 16 MHz

1.4.7.3 FM Frequency Response

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Frequency Modulation** Menu:
     - **FM Path 1 Source** External 1
     - **FM Mode** Normal
     - **FM Path 1 Deviation** 1 MHz
   - **Modulation sources** Menu:
     - **External 1 Coupling** DC
     - **LF Generator 1 Shape** Sine
2. Setting on the signal generator:
   - For frequencies up to 300 kHz the internal LF generator of the signal generator is used, > 300 kHz the RF output.
   - We recommend that you use an AC voltmeter (see Table 1-1, item 15) or a Power Meter (see Table 1-1, item 8) to control the correct input voltage.
   - **LFGen Voltage** 0.707 V
   - **State** On
   - **RF Level** 10 dBm (equivalent to 1 V peak voltage).
3. Settings on R&S FSQ:
   - FFT Demodulation
4. Vary the signal generator frequency and measure the modulation depth.
   ⇨ The modulation frequency response is the factor between the greatest and the smallest modulation depth.
5. Repeat the measurement with the internal modulation generator with the setting **FM Path 1 Source Internal**.

Recommended settings:

1. LF in logarithmic steps
   4 steps per decade (1, 1.8, 3.2, 5.6)
2. **FM Mode** Normal

RF [MHz]	Mod-Source	F mod	Deviation
46.8	Int.	10 kHz … 10 MHz	5 MHz
375.5	Ext. DC	10 kHz … 10 MHz	5 MHz

RF [MHz]	Mod-Source	F mod	Deviation
502	Ext. AC	10 kHz … 10 MHz	5 MHz
502	Ext. AC	10 Hz … 10 kHz	100 kHz
565	Ext. AC	10 kHz … 10 MHz	5 MHz
595	Ext. AC	10 kHz … 10 MHz	5 MHz
660	Ext. AC	10 kHz … 10 MHz	5 MHz
693	Ext. AC	10 kHz … 10 MHz	5 MHz
3001	Ext. AC	10 kHz … 8 MHz	5 MHz
4000	Ext. AC	10 kHz … 8 MHz	5 MHz
5400	Ext. AC	10 kHz … 8 MHz	5 MHz
6500	Ext. AC	10 kHz … 8 MHz	5 MHz
15000	Ext. AC	10 kHz … 8 MHz	5 MHz
27000	Ext. AC	10 kHz … 8 MHz	5 MHz
35000	Ext. AC	10 kHz … 8 MHz	5 MHz

1.4.7.4 Synchronous AM with FM

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Frequency Modulation** Menu:
     - **FM Path 1 State** On
     - **FM Path 1 Source** LF Generator 1
     - **FM Mode** Normal
     - **FM Path 1 Deviation** 40 kHz
   - **Modulation Sources** Menu:
     - **LF Generator 1 Frequency** 1 kHz
     - **LF Generator 1 Shape** Sine
2. Settings on spectrum analyzer:
   - **AMPTD / REF** LEVEL 6 dBm
   - **FREQ / CENTER** test frequency
   - **FMDEMOD**
     - **FMDEMOD** On
     - **RESULT DISPLAY** AM / AF SPECTRUM
     - **AF Start** 0 Hz
     - **AF Stop** 5 kHz
     - **RES BW** 30 Hz

- **DEMOD BW** 100 kHz
- **IF BW MANUAL** 10 MHz
- **RANGE** REFERENCE VALUE 0.2 %
- **MEAS TIME** 3 ms

3. Read the AM depth at 1 kHz modulation frequency from the demodulated AF spectrum.

Recommended test frequencies:

- **RF ≤ 6 GHz**
  10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2.2 GHz, 4 GHz, 6 GHz
- **RF ≥ 7.5 GHz**
  10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2.2 GHz, 4 GHz, 6.5 GHz, 6.501 GHz, 10 GHz, 13 GHz, 19.5 GHz, 19.501 GHz, 27 GHz, 27.001 GHz, 33 GHz, 40 GHz, 44 GHz,

1.4.7.5 Carrier Frequency Offset with FM

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Frequency** 1 GHz
   - **Frequency Modulation** Menu:
     - **FM Path 1 State** On
     - **FM Path 1 Source** LF Generator 1
     - **FM Path 1 Deviation** 1 MHz
   - **Modulation Sources** Menu:
     - **LF Generator 1 Frequency** 1 MHz
     - **LF Generator 1 Shape** Sine
2. Settings on spectrum analyzer:
   - **AMPTD / REF** LEVEL 0 dBm
   - **FREQ / CENTER** 1 GHz
   - **SPAN** 10 kHz
   - **MKR / SIGNAL COUNT / NEXT / CNT RESOL** 10 Hz
3. Terminate the DUT External Modulation input with 50 Ω and execute the internal FM offset adjustment.
4. Execute a single sweep. Using **MKR / PEAK**, read counted marker frequency.
   ⇨ The offset is the difference between marker frequency and set carrier frequency.
5. Repeat measurement with FM source external, impedance 50 Ω and high Z, coupling AC and DC (4 measurements).

1.4.8 Checking the Phase Modulation

Depending on the RF hardware of the instrument, the R&S SMW provides the following options for phase modulation:

- SSYNW: R&S SMW-K720
- SSYN: R&S SMW-B20/-B22

1.4.8.1 PhiM Setting Uncertainty

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Phase Modulation** Menu:
     - **PhiM Path 1 State** On
     - **PhiM Path 1 Source** LF Generator 1
     - **PhiM Path 1 Deviation** 1 rad
   - **Modulation Sources** Menu:
     - **LF Generator 1 Freq** 1 kHz
     - **LF Generator 1 Shape** Sine
2. Settings on spectrum analyzer:
   See Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Recommended settings:

1. CF sweep:
   - **RF_{max} ≤ 6 GHz**
     46.8 MHz, 3 GHz, 6 GHz
   - **RF_{max} ≥ 7.5 GHz**
     46.8 MHz, 3 GHz, 6.5 GHz, 6.501 GHz, 10 GHz, 13 GHz, 20 GHz, 27 GHz, 33 GHz, 40 GHz,

   with f_{mod} = 10 kHz, Deviation = 10 rad, Mode: High Dev.
2. Deviation sweep:
   - Measurement at CF 500 MHz, f_{mod} = 10 kHz
   - Deviation in Mode High Bw.:
     1 mrad, 10 mrad, 0.1 rad, 0.5 rad
   - Deviation in Mode High Dev.:
     1 rad, 2.5 rad, 5 rad
3. Repeat the measurement at 70.687 MHz with external modulation in Mode High Bw. Deviation = 0.625 rad

1.4.8.2 PhiM Distortion

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Phase Modulation** Menu:
     - **PhiM Path 1 State** On
     - **PhiM Path 1 Source** LF Generator 1
     - **PhiM Mode** High Bandwidth
   - **Modulation Sources** Menu.
     - **LF Generator 1 Freq** 10 kHz
     - **LF Generator 1 Shape** Sine
2. Settings on R&S FSQ:
   - See Chapter 1.4.7, "Checking the Frequency Modulation", on page 60
   - **SWEEP** MEAS TIME 2.5 ms
   - **FREQ** AF STOP 50 kHz
   - **AMPTD** REF LEVEL 0 dBm
   - **FREQ / CENTER** test frequency
3. Read THD from the Display.
   To convert to percent, calculate:
   THD_{pct} = 100 * 10 ^ (THDdB/20)

Recommended settings:

1. CF sweep:
   - **RF_{max} ≤ 6 GHz**
     10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2.2 GHz, 4 GHz, 6 GHz
   - **RF_{max} ≥ 7.5 GHz**
     10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2.2 GHz, 4 GHz, 6.5 GHz, 6.501 GHz, 10 GHz, 13 GHz, 20 GHz, 27 GHz, 33 GHz, 40 GHz,
2. **PhiM Path 1 deviation** maximum deviation specified for PhiM distortion.

1.4.8.3 PhiM Frequency Response

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation", on page 10

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation", on page 60

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Phase Modulation** Menu:
     - **PhiM Path 1 State** On
     - **PhiM Path 1 Source** External 1
     - **PhiM Path 1 Deviation** 1 rad
   - **Modulation Sources** Menu:
     - **External 1 Coupling** AC
2. Setting on the signal generator:
   - For frequencies up to 300 kHz the internal LF generator of the signal generator is used, > 300 kHz the RF output.
   - It is recommended to use an AC voltmeter (see Table 1-1, item 15) or a Power Meter (see Table 1-1, item 8) to control the correct input voltage.
   - **LFGen Voltage** 0.707 V
   - **State** On
   - **RF Level** 10 dBm (equivalent to 1 V peak voltage).
3. Settings on R&S FSQ:
   - See Chapter 1.4.7, "Checking the Frequency Modulation", on page 60
4. Vary the signal generator frequency and measure the modulation depth.
   ⇨ The modulation frequency response is the factor between the greatest and the smallest modulation depth.

Recommended settings:

1. LF in logarithmic steps
   3 steps per decade (1, 2, 5) from 10 Hz to 500 kHz
2. CF sweep:
   - in Mode High Dev.:
     - RF = 79.9 MHz
       deviation = 0.3125 rad, f_{mod} = 10 kHz … 500 kHz
   - in Mode High Bw.:
     - RF = 187.4 MHz
       deviation = 0.125 rad, f_{mod} = 10 kHz … 10 MHz
     - RF = 3001 MHz, 4 GHz, 5.4 GHz, 6.5 GHz, 6.501 GHz, 10 GHz, 13 GHz, 15 GHz, 20 GHz, 27 GHz, 33 GHz and 40 GHz,
       deviation = 0.125 rad, f_{mod} = 10 kHz … 8 MHz
   - in Mode Low Noise:
     - RF = 500 MHz
       deviation = 0.125 rad, f_{mod} = 10 kHz … 100 kHz

1.4.9 Checking the Pulse Modulation

Applies to instruments equipped with option Pulse Modulator (R&S SMW-K22).

1.4.9.1 ON/OFF Ratio

Accredited calibration: No minimum requirement.

Test equipment:
- Spectrum analyzer (see Table 1-1, item 19)
- Pulse generator (see Table 1-1, item 17)

Test setup:
► To determine the ON/OFF ratio, connect the spectrum analyzer to the RF output socket of the DUT and let the PULSE EXT input open.

Measurement 1:
1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Frequency** recommended test frequencies
   - **Pulse Modulation** Menu:
     - **Source** External 1
     - **State** On
     - **Polarity** Inverse
2. Settings on analyzer:
   - **FREQ/CENTER** test frequency
   - **SPAN** 0 Hz
   - **AMPT/REF LEVEL** 0 dBm
   - **BW ⇨ RES BW MANUAL** 3 kHz
   - **SWEEP ⇨ SWEEP TIME MANUAL** 100 ms
   - **MEAS ⇨ TIME DOM POWER** On
3. Determine the output level of the DUT at the recommended test frequencies with **Pulse Modulation ⇨ Polarity Inverse** and **Pulse Modulation ⇨ Polarity Normal**.
   ⇨ The level difference between the output level with Polarity Inverse and Polarity Normal is the ON/OFF ratio.

Recommended test frequencies: 5 MHz, 150 MHz, 400 MHz and from 1 GHz to RF_{max} in steps of 1 GHz.

Recommended test level: P_{min}

1.4.9.2 Rise/ Fall Time and Pulse Overshoot

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.5, "Test Assembly for Pulse Modulation", on page 10

Test method: The RF signal is down converted to 0 Hz in phase. Thus, the IF output reproduces the RF amplitude vs. time.

Measurement 1:

1. Setting on pulse generator:
   - For adjustment statically high level
   - For measurement square wave pulse sequence with a frequency of 1 MHz, TTL level
2. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - **Frequency** recommended test frequencies
   - **Pulse Modulation** Menu:
     - **State** On
     - **Transition Type** Smoothed
3. Settings on signal generator:
   - **RF** On
   - **Level** Recommended Lo-Level of Mixer
   - **Frequency** same as DUT
4. Settings on oscilloscope:
   - Adjust V/div according to the mixer in use
   - Time base 20 ns/div
   - Trigger:
     - for adjustment free running
     - for measurement 50 % of signal amplitude, rising and falling edge
5. Adjustment:
   - At each test frequency, adjust the phase using menu RF Mod / Frequency/ Phase / Phase Settings. Vary the Delta Phase to obtain maximal signal output at the mixers IF port. The voltage at maximum corresponds to 100 % of RF amplitude.
6. Measurement:
   - Evaluate the down converted pulse-modulated signal on the oscilloscope:
     - Rise time = time between 10 % and 90 % of signal amplitude.
     - Fall time = time between 90 % and 10 % of signal amplitude.
     - Pulse Overshoot: Determine the peak value of demodulated signal V_{peak} and the signal level of settled pulse $V_{settled}$.
     - Pulse Overshoot [in %]

       $$= 100 * \frac{V_{Peak} - V_{settled}}{V_{settled}}$$
   - Repeat the measurement in Pulse Modulation mode **Transition Type** fast.

Recommended test frequencies:

Mode **Transition Type** smoothed: 700 MHz and from 1 GHz to 5 GHz in steps of 1 GHz. With **R&S SMW-B106/-B206/-B1006/-B2006** additionally at 6 GHz.

Mode **Transition Type** fast: 700 MHz and from 1 GHz to RF_{max} in steps of 1 GHz.

1.4.9.3 Video Crosstalk

Accredited calibration: No minimum requirement.

Test equipment:
- Oscilloscope with 50 Ω Feed-through termination on input (see Table 1-1, item 7).
- Pulse generator (see Table 1-1, item 17)

Test setup: ► To determine the Video crosstalk, connect the oscilloscope input to the RF output socket of the DUT and connect the Pulse generator output to the PULSE EXT input of the DUT and the Trigger Input of the Oscilloscope.

Measurement 1:

1. Settings on pulse generator:
   - Square wave pulse sequence with a frequency of 100 kHz
   - TTL level
2. Settings on DUT:
   - **RF** On
   - **Frequency**
     3 GHz, 6.001 GHz and 19.501 GHz,
   - **Level**
     - **RF_{max} ≤ 6 GHz**
       Level: +10 dBm
     - **RF_{max} ≥ 7.5 GHz**
       Level: +5 dBm: 3 GHz
       Level: +10 dBm: 6.001 GHz, 19.501 GHz,
   - **Pulse Modulation** Menu:
     - **State** On
     - **Source** External 1
3. Settings on the oscilloscope:
   - **Amplitude** 150 mV/Div
   - **Sweep Time** 10 ns/Div
   - **Bandwidth** 500 MHz
   - **Trigger Offset** -20 ns
   - **Trigger Source** Trigger Input
   - **Trigger Level** 1.4 V
   - **Trigger Slope** positive
4. Measure the Peak to Peak Signal Level of the rising edge of the pulse. Set Trigger Slope to negative and measure the Peak to Peak Signal Level of the falling edge of the pulse.
   ⇨ The Peak to Peak Value of the rising and the falling Edge of the Pulse have to be below the guaranteed Video Crosstalk.

1.4.10 Checking the I/Q Modulation

1.4.10.1 Input Impedance (VSWR)

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.2, "Test Assembly for Output Impedance (VSWR)", on page 9

Test method:
► Same as for the output impedance of the DUT.

Test setup:
► Connect the test port of the VSWR bridge to the I- or Q-inputs.

Measurement 1:

1. Settings on DUT:
   - **Frequency** 900 MHz
   - **RF** On
   - **Level** 0 dBm (PEP)
   - **I/Q Settings** Menu:
     – **State** On
     – **Source** Analog Wideband I/Q Input
2. Settings on signal generator:
   - **Level** 10 dBm
   - **Frequency** test frequencies
3. Let the measuring port of the VSWR bridge unconnected and measure the level P_{ref} as reference level.
4. Connect the VSWR bridge to the I input and measure the level P_I.
5. Calculate the VSWR:

$$VSWR = \frac{1+\sqrt{P_I / P_{ref}}}{1-\sqrt{P_I / P_{ref}}}$$

6. Repeat the measurement for the Q input.
7. Set SOURCe to "Differential Wideband I/Q Input" and repeat the measurement for the IN- and QN-Inputs (= I- and Q- Inputs of Channel B).
8. For instruments with **12.75 GHz ≤ RF_{max} ≤ 20 GHz**
   Set the Frequency to 10 GHz and repeat the measurements.
   For instruments with **RF_{max} ≥ 31.8 GHz**
   Set the Frequency to 10 GHz and then to 30 GHz and repeat the measurements.

Recommended test frequencies: For frequency options with **RF_{max} ≥ 31.8 GHz** and **WITHOUT** trailing **"N"**:

1 MHz, 10 MHz, 20 MHz, 40 MHz, 60 MHz, 80 MHz and 100 MHz to 1 GHz, or maximum specified I/Q-Modulation-Frequency in steps of 25 MHz.

For frequency options with **RF_{max} ≥ 40 GHz** and **WITH** trailing **"N"**:

1 MHz, 10 MHz, 20 MHz, 40 MHz, 60 MHz, 80 MHz and 100 MHz to 275 MHz or maximum specified I/Q-Modulation-Frequency in steps of 25 MHz.

1.4.10.2 RF Frequency Response due to Modulation

Accredited calibration: No minimum requirement.

Test equipment:
- Spectrum analyzer, (see Table 1-1, item 19).
- Signal generator, (see Table 1-1, item 5).

Test setup:
► Connect the RF output of the DUT to the spectrum analyzer, and connect the signal generator to the I input of the DUT.

Test method: By applying a sinewave AC voltage to I (or Q) input, an amplitude modulation with a suppressed carrier is generated. The modulation frequency response is determined by measuring the sideband power as a function of the frequency of the applied AC voltage. The difference between the highest and the lowest sideband level, found by varying the modulation frequency is the frequency response to be measured.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Frequency** Test frequency
   - **Level** 0 dBm
   - **ALC** Off (Sample & Hold)
   - **I/Q Settings** Menu:
     – **Source** Analog Wideband I/Q Input
     – **Crest Factor** 3 dB
     – **State** On
2. Settings on signal generator:
   - **Level** 4 dBm corresponding to 0.5 V (V_{peak})
3. Settings on spectrum analyzer:
   - **AMPT/REF LEVEL** 5 dBm
   - **SPAN** 1 MHz
   - **Center** carrier frequency ± modulation frequency
4. Measure the sideband levels for these modulation frequencies:
   1 MHz, 5 MHz, from 10 MHz to 100 MHz in 10 MHz steps.
5. Set I/Q-Wideband on and measure the sideband levels for modulation frequencies:
   - For frequency options with **RF_{max} ≥ 31.8 GHz** and **WITHOUT** trailing **"N"**:
     1 MHz, 5 MHz, from 10 MHz to 150 MHz in 10 MHz steps and from 200 MHz to 1 GHz or maximum specified I/Q-Modulation-Frequency in 100 MHz steps.
   - For frequency options with **RF_{max} ≥ 40 GHz** and **WITH** trailing **"N"**:
     1 MHz, 5 MHz, from 10 MHz to 150 MHz in 10 MHz steps and from 200 MHz to 275 MHz or maximum specified I/Q-Modulation-Frequency in 100 MHz steps.

⇨ The modulation frequency response is the difference between the highest and the lowest measured sideband level.

Recommended test frequencies:

SSYNW

- **RF_{max} ≤ 7.5 GHz**
  100 MHz, 200 MHz, 200.1 MHz, 500 MHz, 1 GHz, 2850 MHz, 3900 MHz, 5 GHz, 6.4 GHz and 6.5 GHz.
- **RF_{max} ≥ 12.75 GHz**
  100 MHz, 200 MHz, 200.1 MHz, 500 MHz, 1 GHz, 2850 MHz, 3900 MHz, 5 GHz, 6.4 GHz, 8.5 GHz, 10 GHz, 13 GHz, 17.5 GHz, 19.5 GHz, 19.501 GHz, 27 GHz, 27.01 GHz, 33.7 GHz, 33.701 GHz, 39 GHz, 41 GHz and 43 GHz.

with modulation frequencies up to maximum specified modulation frequencies.

Recommended test frequencies:

SSYN

- **RF_{max} ≤ 6 GHz**
  100 MHz, 200 MHz, 200.1 MHz, 240 MHz, 240.1 MHz, 475 MHz, 475.1 MHz, 700 MHz, 700.1 MHz, 1 GHz, 2850 MHz, 3900 MHz and 5 GHz
- **RF_{max} = 7.5 GHz**
  100 MHz, 200 MHz, 200.1 MHz, 240 MHz, 240.1 MHz, 475 MHz, 475.1 MHz, 700 MHz, 700.1 MHz, 1 GHz, 2850 MHz, 3900 MHz, 5.5 GHz, 6.4 GHz and 6.5 GHz
- **RF_{max} ≥ 12.75 GHz**
  100 MHz, 200 MHz, 200.1 MHz, 240 MHz, 240.1 MHz, 475 MHz, 475.1 MHz, 700 MHz, 700.1 MHz, 1 GHz, 2850 MHz, 3900 MHz, 5.5 GHz, 6.4 GHz, 8.5 GHz, 10 GHz, 13 GHz, 17.5 GHz, 19.5 GHz, 19.501 GHz, 27 GHz, 27.01 GHz, 33.7 GHz, 33.701 GHz, 39 GHz, 41 GHz and 43 GHz
  with modulation frequencies up to maximum specified modulation frequencies.

1.4.10.3 Static Error Vector

Accredited calibration: No minimum requirement.

Test equipment:

- RF analyzer, (see Table 1-1, item 19).
- Arbitrary waveform generator, (see Table 1-1, item 14).

Test setup:

1. Connect the spectrum analyzer to the RF output of the DUT.
2. Set 10 MHz References of DUT and spectrum analyzer to **internal**!
3. Connect the Arbitrary waveform generator to the DUT baseband input.

Measurement 1: Instead of a static measurement, an equivalent dynamic measurement with a low symbol rate is carried out.

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm (PEP)
   - **I/Q Settings** Menu:

– **State** On
– **Source** Analog Wideband I/Q Input

2. Generate a modulation signal on the ARB generator using the controller and the simulation program:
   - Modulation 16QAM
   - No coding
   - SQR COS filter with α = 0.5
   - PRBS-9 data sequence
   - Pulse width and over sampling 32
   - Length 1000 symbols
   - Symbol clock 100 kHz
3. Check if the amplitude imbalance of both channels on the ARB generator is < 0.05 dB and the DC-Offset is < 0.5 mV. Adjust if necessary.
4. Make the corresponding settings on the demodulator. Result length 800 symbols.
5. Measure the error vector magnitude (peak and rms) at the recommended test frequencies.

Recommended test frequencies:

RF_{max} ≤ 6 GHz

10 MHz, 100 MHz, 250 MHz to 6 GHz in steps of 250 MHz.

RF_{max} ≥ 7.5 GHz

10 MHz, 100 MHz, 250 MHz to 5 GHz in steps of 250 MHz and from 5.5 GHz up to RF_{max} in steps of 500 MHz.

1.4.10.4 Residual Carrier and Leakage I/Q-Modulation (external)

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer, (see Table 1-1, item 19).

Test setup:
1. Connect the spectrum analyzer to the RF output of the DUT.
2. Terminate the analog I/Q-inputs with 50 Ohm terminations.

Test method: The I/Q-inputs of the DUT are terminated with a 50 Ohm termination and no modulation-signal is fed into the instrument.

The Residual Carrier is the level difference between the output signal in CW Mode and with I/Q-modulation switched on at the test frequency.

Measurement 1:
1. Settings on DUT:
   - **RF** On
   - **Frequency** test frequency
   - **Level** +5 dBm
   - **I/Q State** off
   - **I/Q Source** Analog Wideband I/Q Input

2. Settings on analyzer:
   - **FREQ/CENTER** 1 MHz
   - **SPAN** 0 Hz
   - **AMPT/REF LEVEL** +10 dBm
   - **BM/RES BW/MANUAL** 30 kHz
3. Measure the carrier level P_{ref} at the test frequency in CW-mode (**I/Q State** off) as reference and then the carrier level with I/Q-modulation switched on (**I/Q State** on) at the test frequency.
   ⇨ The carrier suppression is:
   $D_{carrier} = P_{ref} - P_{carrier}$ in dBc referred to the carrier.

Recommended test frequencies:

RF_{max} ≤ 6 GHz

12.5 MHz to 5.9875 GHz in 25 MHz steps

RF_{max} ≥ 7.5 GHz

12.5 MHz to 6.9875 GHz in 25 MHz steps, from 7.025 GHz up to 10.975 GHz in steps of 50 MHz, from 11.05 GHz up to 20.45 GHz in steps of 100 MHz, from 20.525 GHz up to 21.475 GHz in steps of 50 MHz and from 21.55 GHz up to RF_{max} in steps of 100 MHz.

1.4.10.5 I/Q Imbalance

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer, (see Table 1-1, item 19).
- Arbitrary waveform generator, (see Table 1-1, item 14).

Test setup:
1. Connect the spectrum analyzer to the RF output of the DUT.
2. Connect the Arbitrary waveform generator to the DUT baseband input.

Measurement 1:
1. Settings on DUT:
   - **RF** On
   - **Frequency** 900 MHz
   - **Level** 0 dBm (PEP)
   - **Level** Menu:
     – **ALC State** Off (Table)
   - **I/Q Settings** Menu:
     – **State** On
     – **Source** Analog Wideband I/Q Input
   - **Impairments State** On
   - **Imbalance** 1.0 dB
2. Settings on analyzer:
   - **Center frequency** test frequency
   - **SPAN** 1 MHz

- **Reference level** test level +3 dB
- **Scale** 1 dB/div

3. Apply a DC voltage of 0.5 V to the I-input and 0 V to the Q-input. Measure the output level P_I. Then apply a DC voltage of 0.5 V to the Q-input and 0 V to the I-input. Measure the level P_Q.
   The Imbalance is: P_I - P_Q
4. According to the frequency options, repeat the measurement at the following frequencies:
   - **RF_{max} = 7.5 GHz**
     Frequency: 7 GHz
   - **12.75 GHz ≤ RF_{max} ≤ 20 GHz**
     Frequency: 10 GHz
   - **RF_{max} ≥ 31.8 GHz**
     Frequency: 10 GHz, 30 GHz,

1.4.10.6 Two Tone Intermodulation

Accredited calibration: No minimum requirement.

Test equipment:
- Spectrum analyzer, (see Table 1-1, item 19).
- Baseband Signal generator.

Test setup:
1. Connect I/Q-Signals from the Baseband Signal Generator to the I/Q Modulation Inputs of the DUT.
2. Connect the spectrum analyzer to the RF output of the DUT.
3. Synchronize the 10 MHz Reference of all instruments.

Test method: A two carrier signal in analog Baseband with symmetrical Carrier Spacing from the RF-carrier is generated by feeding a sinusoidal signal with f_{mod} to the I-Input. The carrier-spacing in the RF-frequency range is two times the frequency of the modulation signal (2* f_{mod}). The Two Tone Intermodulation is the level difference between the two carriers and the unwanted Intermodulation products caused by nonlinearities in the signal chain.

Measurement 1:
1. Settings on Baseband Signal Generator:
   - **ARB**
     - **Create sinusoidal Waveform** with 0.5 V Peak
     - **State** On
   - **Carrier Spacing**
     - 10 MHz, 20 MHz, 40 MHz and 80 MHz
2. Settings on DUT:
   - **RF** On
   - **Frequency** recommended test frequencies
   - **Level** 0 dBm

- **I/Q Settings** Menu:
  - **State** On
  - **Source** Analog Wideband I/Q Input

3. Settings on analyzer:
   - **FREQ CENTER** Measurement Frequency
   - **SPAN** 0 Hz
   - **BW** 1 kHz
   - **Sweep Time** 10 ms
   - **AMPT/REF LEVEL** 3 dBm
4. For every Test Frequency:
   Measure the carrier level at at RF- f_{mod} and RF+ $_{fmod}$.
   Measure the level of the Intermodulation products at RF-n* f_{mod}, with n = -3, -2, +2 and +3.
   The Two Tone Intermodulation Suppression is the difference between the carrier with the lower level and the highest Intermodulation Product.
5. Feed the modulation Signal to the Q-Input and repeat Measurement at 1 GHz.

Recommended test frequencies: 200.1 MHz, 500 MHz, 1 GHz to RF_{max} in 1 GHz steps.

1.4.11 Checking the Phase Coherence Levels (Option R&S SMW-B90)

Accredited calibration: No minimum requirement.

Test equipment:
- The second Signal generator (see Table 1-1, item 5) is connected to the LO IN-connector.
- The RF power meter (see Table 1-1, item 8) is connected to LO OUT-connector.

Test method: A LO-Signal from the second signal generator is fed into the LO input. With LO-Coupling set to external and the LO-output switched on the power at the LO-out SMA-connector is measured with the power meter.

Measurement 1:

1. Settings on DUT:
   - **RF** State ON
   - **Level** -30 dBm
   - **Frequency** recommended test frequencies or RF_{max}, whichever is lower
   - **Frequency/Phase** Menu:
     - **LO Coupling ⇨ Mode** A External & A → B coupled
     - **LO Coupling ⇨ Out State** On
2. Settings on second signal generator:
   - **Level** + 10 dBm
   - **Frequency** recommended test frequencies
   - **RF** State ON

3. Set the frequency of the DUT and the second generator to the recommended test frequencies.
   Measure the output level at the LO OUT connector to be within the guaranteed level limits.
4. Repeat Measurement with DUT setting:
   - **LO Coupling** ⇨ **Mode** A internal and A -> B coupled

Recommended test frequencies:

RF_{max} ≤ 6 GHz

200.1 MHz and from 300 MHz to 6 GHz in steps of 100 MHz.

RF_{max} ≥ 7.5 GHz

LO Coupling ⇨ Mode A External & A → B coupled:

200.1 MHz and from 300 MHz to 6 GHz in steps of 100 MHz.

LO Coupling ⇨ **Mode** A internal and A -> B coupled:

200.1 MHz and from 300 MHz to 6.5 GHz in steps of 100 MHz.

1.4.12 Checking the Differential I/Q Output

Before the measurement, Signal Analyzer R&S FSQ must be calibrated as follows by means of a reference measurement at the measurement frequency in question:

1. Connect the RF output of the DUT to the power meter and measure the output level.
2. Include the measured level as a reference value/calibration value in the R&S FSQ.

1.4.12.1 Differential Signal Balance

Accredited calibration:

No minimum requirement.

Test-generator functionality is available with protection level 1.

Test equipment:

- RF analyzer, (see Table 1-1, item 19).
- Arbitrary waveform generator, (see Table 1-1, item 14).

Test setup:

► Connect the signal analyzer to the I-, Q-, I Bar- and Q Bar-output of the DUT.

Test method:

A single sideband signal is generated using the test generator functionality within the DAC BOARD. Positive or negative frequency offsets are set by the **Frequency** parameter. The test frequencies are set one after the other.

Measurement 1:

1. Settings on DUT:
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency test frequency`

- `:TEST:BB:GENerator:GAIN 0.9`
- `:TEST:BB:GENerator:STATe ON`
- **I/Q Out** Menu:
  - **Output Type** Differential
  - **Mode** Normal

2. Settings on analyzer:
   - **FREQ CENTER** 1 MHz
   - **SPAN** 0 Hz
   - **AMPT/REF LEVEL** + 10 dBm
   - **BW /RES BW MANUAL** 30 kHz

Recommended test frequencies: 1 MHz, 10 MHz

Exit test generator: :TEST:BB:GENerator:STATe OFF

1.4.12.2 Output Voltage

Accredited calibration: No minimum requirement.

Test-generator functionality is available with protection level 1.

Test equipment:
- AC/DC Voltmeter, (see Table 1-1, item 15).

Test setup:
► Connect the signal analyzer to the I-, Q-, I Bar- and Q Bar-output of the DUT.

Test method: A single sideband signal is generated using the test generator functionality within the DAC BOARD. Positive or negative frequency offsets are set by the **Frequency** parameter. The test levels are set one after the other.

Measurement 1:

1. Settings on DUT:
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency 100 kHz`
   - `:TEST:BB:GENerator:GAIN 0.9`
   - `:TEST:BB:GENerator:STATe ON`
   - **I/Q Out** Menu:
     - **Output Type** Single Ended
     - **Mode** Variable
     - **I/Q I Level EMF** 1 V

2. Settings on multimeter:
   - **COUPLING** AC
   - **DETECTOR** RMS

   Multiply measured voltage with √2.

Recommended test level:

R&S SMW-B13/-B13T

Measurement level: 2 V, 1 V, 0.4 V and 0.2 V.

R&S SMW-B13XT

Measurement level: 1 V, 0.4 V and 0.2 V.

Exit test generator: `:TEST:BB:GENerator:STATe OFF`

1.4.12.3 Bias Voltage

Accredited calibration: No minimum requirement.

Test-generator functionality is available with protection level 1.

Test equipment:
- AC/DC Voltmeter, (see Table 1-1, item 15).

Test setup:
► Connect the signal analyzer to the I-, Q-, I Bar- and Q Bar-output of the DUT.

Test method: The bias voltage is measured for different values.

Measurement 1:
1. Settings on DUT:
   - `:TEST:BB:GENerator:SOURce CONStant`
   - `:TEST:BB:GENerator:GAIN 0.0`
   - `:TEST:BB:GENerator:STATe ON`
   - **I/Q Out** Menu:
     - **Output Type** Single Ended
     - **Mode** Variable
     - **I/Q I Level EMF** 0.1 V
     - **Couple I/Q Bias** On
     - **I Bias EMF** measurement bias
2. Settings on multimeter:
   - **COUPLING** AC

Recommended test level:

R&S SMW-B13/-B13T

Check bias: -3.6 V, -1 V, -0.3 V, -0.1 V, -0.03 V, -0.01 V, 0 V, +0.002 V, 1 V and 3.6 V

R&S SMW-B13XT

Check bias: -0.2 V, -0.03 V, -0.01 V, 0 V, +0.002 V, 1 V and 2.5 V

Exit test generator: `:TEST:BB:GENerator:STATe OFF`

1.4.12.4 Offset Voltage

Accredited calibration: No minimum requirement.

Test-generator functionality is available with protection level 1.

Test equipment:
- AC/DC Voltmeter, (see Table 1-1, item 15).

Test setup:
► Connect the signal analyzer to the I-, Q-, I Bar- and Q Bar-output of the DUT.

Test method: The I and I Bar (or Q and Q Bar) voltage are measured for different offset values. The differential offset is obtained from the differences between I and I Bar (or Q and Q Bar) at a particular offset.

Measurement 1:

1. Settings on DUT:
   - `:TEST:BB:GENerator:SOURce CONStant`
   - `:TEST:BB:GENerator:GAIN 0.0`
   - `:TEST:BB:GENerator:STATe ON`
   - **I/Q Out** Menu:
     - **Output Type** Differential
     - **Mode** Variable
     - **I/Q I Level EMF** 1 V
     - **Couple I/Q Bias** On
     - **I Bias EMF** 0 V
     - **I (or Q) Offset EMF** measurement offset
2. Settings on multimeter:
   - **COUPLING** DC

Recommended test level:

R&S SMW-B13/-B13T

Check offset: -300 mV, -150 mV, -30 mV, -10 mV, -3 mV, -1 mV, 0 mV, +0.1 mV, 30 mV, 150 mV and 300 mV

R&S SMW-B13XT

Check offset: -200 mV, -100 mV, -30 mV, -10 mV, -3 mV, -1 mV, 0 mV, +0.1 mV, 30 mV, 100 mV and 200 mV

Exit test generator: `:TEST:BB:GENerator:STATe OFF`

1.4.13 Checking the Internal Baseband Generator

1.4.13.1 Modulated RF Frequency Response over the Complete Unit

Accredited calibration: No minimum requirement.

Test equipment: RF power meter (see Table 1-1, item 8)

Test setup: ► Connect the RF output of the DUT to the RF signal analyzer or RF power meter.

Test method: The internal Test-Generator is generating a sine single-side-band signal. The modulation frequency response is determined by measuring the sideband power as a function of the frequency of the applied single-sideband signal. The difference between the highest and lowest sideband level, found by varying the modulation frequency, is the frequency response to be measured.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Frequency** measurement frequencies
   - **Level** 0 dBm

- **I/Q Mod** Internal Baseband, Wideband I/Q On
- **ACL OFF (Sample & Hold)**
- `:TEST:BB:GENerator:SOURce SINE`
- `:TEST:BB:GENerator:FREQuency test frequency`
- `:TEST:BB:GENerator:GAIN 1.0`
- `:TEST:BB:GENerator:STATe ON`

2. Settings on the RF power meter:
   Set **frequency correction** to measurement frequency + test frequency.

   The modulation frequency response is the difference from the highest to the lowest sideband.

Recommended test frequencies:

R&S SMW-B13/-B13T

Measurement frequencies / GHz f_{RF}	Frequency-Options:	Test frequencies ± / MHz
0.85, 1.75, 2.2	all	0 (reference), 1, 10:10:80
5.0	**RF_{max} ≤ 6 GHz**	
3.501, 5.5, 7.2, 10, 12.5, 17	**RF_{max} ≥ 7.5 GHz**	
19.5, 19.501, 27, 27.001, 30, 34, 39.5	**31.8 GHz ≤ RF_{max} ≤ 40 GHz**	
41, 43	**RF_{max} = 44 GHz**	

R&S SMW-B13XT

Measurement frequencies / GHz f_{RF}	Frequency-Options:	Test frequencies ± / MHz
0.85	all	0 (reference), 1, 10, 20:20:80, 100:50:300, 340
1.75	all	0 (reference), 1, 10, 20:20:80, 100:50:700
2.1	all	0 (reference), 1, 10, 20:20:80, 100:50:850, 880
3.501	**7.5 GHz ≤ RF_{max} ≤ 31.8 GHz**	0 (reference), 1, 10, 20:20:80, 100:50:1000
5.0	**RF_{max} = 6 GHz**	
5.5, 7.2, 10, 11.75	**7.5 GHz ≤ RF_{max} ≤ 31.8 GHz**	
17, 19.0	**20 GHz ≤ RF_{max} ≤ 40 GHz**	
19.501, 27, 27.001, 30, 34, 39.0	**31.8 GHz ≤ RF_{max} ≤ 40 GHz** only frequeny options **without** trailing "N"	

41, 43	**RF_{max} = 44 GHz** only frequeny options **without** trailing "N"	0 (reference), 1, 10, 20:20:80, 100:50:250, 275
19.501, 27, 27.001, 30, 34, 39.5	**RF_{max} = 40 GHz** only frequeny options **with** trailing "N"	
41, 43	**RF_{max} = 44 GHz** only frequeny options **with** trailing "N"	

Measurement frequencies / GHz f_{RF}	**Frequency-Options:**	**Test frequencies ± / MHz**
0.85, 1.75, 2.1, 3.5, 5.0	all	0 (reference), 1, 10, 20:10:90, 100:25:250

The maximum test frequency is limited by $f_{RF}/4$.

Exit test generator: `:TEST:BB:GENerator:STATe OFF`

1.4.13.2 Suppression of Image Sideband in Mode Internal Baseband I/Q

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19).

Test setup:
► Connect the RF output of the DUT to the signal analyzer.

Test method: The internal Test-Generator is generating a single-side-band sine signal. The image rejection is the difference between the sine signal and its mirror on the opposite side of the center frequency.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Frequency** measurement frequency
   - **Level** 0 dBm
   - **I/Q Mod** Wideband I/Q On
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency test frequency`
   - `:TEST:BB:GENerator:GAIN 1.0`
   - `:TEST:BB:GENerator:STATe ON`
2. Settings on analyzer:
   - **FREQ CENTER** measurement frequency
   - **SPAN** 3 x test frequency
   - **BW COUPLING RATIO SPAN / RBW MANUAL** 300
   - **AMPT/REF LEVEL** 5 dBm
   - **MKR /MARKER 1** Set to peak

In the displayed spectrum, use MARKER DELTA to measure the image rejection.

Recommended test frequencies:

Test frequencies

R&S SMW-B13/-B13T

Measurement frequencies / GHz	Frequency-Options:	Test frequencies ± / MHz
1.0	all	0.001, 1, 10:10:80
10.0	**12.75 GHz ≤ RF_{max} ≤ 40 GHz**	
30.0	**31.8 GHz ≤ RF_{max} ≤ 44 GHz**	

R&S SMW-B13XT

Measurement frequencies / GHz	Frequency-Options:	Test frequencies ± / MHz
3.0	**RF_{max} ≤ 3 GHz**	0.001, 1, 10, 20:20:80, 100:50:750
4.0, 10.0, 30.0	**RF_{max} ≥ 6 GHz**	0.001, 1, 10, 20:20:80, 100:50:1000

Measurement frequencies / GHz	Frequency-Options:	Test frequencies ± / MHz
3.0, 5.0	all	0 (reference), 1, 10, 20:10:90, 100:25:250

Exit test generator: `:TEST:BB:GENerator:STATe OFF`

1.4.13.3 I/Q Output, DC-Offset, Wideband Noise

Accredited calibration: No minimum requirement.

Test equipment:
- RF analyzer (see Table 1-1, item 19).
- Multimeter (see Table 1-1, item 15).

Test setup: ► Connect the signal analyzer to the I/(and Q)-output of the DUT.

Test method: The internal Test-Generator is generating a single-side-band sine signal at 10 MHz. Subsequently, the noise power (all carriers switched off) is measured at 11 MHz.

Measurement 1:

1. Settings on DUT:
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency 10 MHz`
   - `:TEST:BB:GENerator:GAIN 0.9`
   - `:TEST:BB:GENerator:STATe ON`
2. Settings on analyzer:
   - **FREQ CENTER** 10 MHz
   - **SPAN** 0 Hz

- **AMPT/REF LEVEL** 5 dBm
- **BW /RES BW MANUAL** 100 kHz
- **MKR / MARKER** 1

3. Measure carrier level at 10 MHz in dBm (reference measurement).
4. Settings on DUT:
   - **Carrier 1 State** Off
5. Settings on analyzer:
   - **FREQ CENTER** 11 MHz
   - **AMPT/REF LEVEL** -40 dBm
   - **AMPT/RF ATTEN MANUAL** 0 dBm
   - **TRACE / DETECTOR** RMS
   - **BW /SWEEP TIME MANUAL** 50 ms
   - **MKR FCT / NOISE MEAS**
6. Measure the noise level at 11 MHz in dBm and calculate the wideband noise.
   Calculation:
   Wideband noise = noise level - (carrier level + 3 dB), (add +3 dB, as it is sine).

Test setup: ► Connect the multimeter to the I and Q output of the DUT.

Measurement 1: ► Check DC-offset.

1.4.13.4 IQ Output, Spurious Free Dynamic Range (SFDR)

Accredited calibration: No minimum requirement.

Make sure that the measured spurious signal does not come from the analyzer. The following tests can be performed for this purpose:

- Switch off the signal from the DUT and repeat the measurement; if the signal remains, it may come from the analyzer.
- Output the signal from the DUT with a slight frequency offset; if the signal remains, it may come from the analyzer.

Test equipment:
- RF analyzer (see Table 1-1, item 19).

Test setup: ► Connect the signal analyzer to the I- and to the Q output of the DUT.

Test method: The internal test generator is generating a single-side-band sine signal for every test frequency. The next highest signal in the spectrum outside the carrier is measured.

Measurement 1:
1. Settings on DUT:
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency test frequencies`
   - `:TEST:BB:GENerator:GAIN 1.0`
   - `:TEST:BB:GENerator:STATe ON`

2. Test frequencies
   R&S SMW-B13/-B13T
   2 MHz, 5 MHz, 10 MHz, 20 MHz, 40 MHz
   2 MHz, 5 MHz, 10 MHz, 20 MHz, 40 MHz, 80 MHz, 125 MHz
   R&S SMW-B13XT
   2 MHz, 5 MHz, 10 MHz, 20 MHz, 40 MHz, 100 MHz, 300 MHz, 500 MHz

3. Settings on analyzer:
   R&S SMW-B13/-B13T

   - **FREQ CENTER** 61 MHz
   - **SPAN** 120 MHz
   - **FREQ CENTER** 126 MHz
   - **SPAN** 250 MHz
   - **AMPT/REF LEVEL** 5 dBm
   - **AMPT / RF ATTEN MANUAL** 25 dB
   - **BW /RES BW MANUAL** 300 kHz
   - **BW / SWEEP TIME MANUAL** 50 ms
   - **TRACE / DETECTOR** RMS
   - **MKR / MARKER** 1
   - **MKR → PEAK**
   - **MKR / MARKER** 2
   - **MKR → NEXT PEAK**

   R&S SMW-B13XT

   - **FREQ CENTER** 601 MHz
   - **SPAN** 1200 MHz
   - **AMPT/REF LEVEL** 5 dBm
   - **AMPT / RF ATTEN MANUAL** 25 dB
   - **BW /RES BW MANUAL** 300 kHz
   - **BW / SWEEP TIME MANUAL** 500 ms
   - **SWEEP POINTS** 10000
   - **TRACE / DETECTOR** RMS
   - **MKR / MARKER** 1
   - **MKR → PEAK**
   - **MKR / MARKER** 2
   - **MKR → NEXT PEAK**

4. If a delta occurs, read off the spacing of the spurious signals on the RF signal analyzer.

Exit test generator: `:TEST:BB:GENerator:STATe OFF`

R&S SMW-B13/-B13T

R&S SMW-B13XT

1.4.13.5 Aliasing Filter – D/A Converter, Interpolation Spectra

Accredited calibration:

No minimum requirement.

Make sure that the measured spurious signal does not come from the analyzer. The following tests can be performed for this purpose:

- Switch off the signal from the DUT and repeat the measurement; if the signal remains, it may come from the analyzer.
- Output the signal from the DUT with a slight frequency offset; if the signal remains, it may come from the analyzer.

Test equipment:

- RF analyzer (see Table 1-1, item 19).

Test setup:

1. Connect the signal analyzer to the RF output of the DUT.
2. Synchronize the reference frequencies of the DUT and the analyzer.

Test method:

The internal Test-Generator is generating a single-side-band sine signal for every test frequency. The level measured at the measurement frequency gives the value for the suppression of the interpolation.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Level** 0 dBm
   - `:TEST:BB:GENerator:SOURce SINE`
   - `:TEST:BB:GENerator:FREQuency test frequencies`
   - `:TEST:BB:GENerator:GAIN 1.0`
   - `:TEST:BB:GENerator:STATe ON`
2. Settings on analyzer:
   - **FREQ CENTER** measurement frequency
   - **SPAN** 0 Hz
   - **AMPT/REF LEVEL** -10 dBm
   - **BW /RES BW MANUAL** 30 kHz
   - **BW / SWEEP TIME MANUAL** 200 ms
   - **TRACE / DETECTOR** RMS
   - **MKR / MARKER** 1

Recommended test frequencies:

R&S SMW-B13/-B13T

Frequency 1 GHz

Frequency 4 GHz

Test frequencies (MHz)	Measurement frequencies (MHz)
10.1	810.1
10.1	1189.9
39.9	839.9

Test frequencies (MHz)	Measurement frequencies (MHz)
39.9	1160.1
79.9	879.9
79.9	1120.1

Test frequencies (MHz)	Measurement frequencies (MHz)
39.9	3439.9
39.9	4560.1
239.9	3649.9
239.9	4350.1

R&S SMW-B13XT

RF_{max} ≤ 3 GHz:

Frequency 3 GHz

Test frequencies (MHz)	Measurement frequencies (MHz)
100.1	700.1
100.1	5299.9
699.9	1299.9
699.9	4700.1

RF_{max} ≤ 6 GHz:

Frequency 4 GHz

Test frequencies (MHz)	Measurement frequencies (MHz)
100.1	1700.1
100.1	6299.9
499.9	2099.9
499.9	5900.1
999.9	2599.9
999.9	5400.1

1.4.13.6 GSM Edge and GSM Edge Burst

Accredited calibration:

No minimum requirement.

The equipment layout for generating GSM/EDGE signals includes the options R&S SMW-B10 (Baseband Generator) and R&S SMW-K40 (Digital Standard GSM/EDGE).

Test equipment:

- RF analyzer with options R&S FSQ-K70 or R&S FSW-K70 or (Vector Signal Analysis) and R&S FS-K5 or R&S FSW-K10 (GSM/EDGE Measurements), (see Table 1-1, item 19).

Test setup:

► Connect signal analyzer to RF output of DUT.

Measurement method:

1. Set Custom Digital Mod in the baseband; set standard GSM/EDGE here. Perform the measurements with the GSM/EDGE measurement setting of the R&S FSQ or R&S FSW.
2. Set standard GSM/EDGE in the baseband. Perform the measurements with the GSM/EDGE measurement setting of the R&S FSQ or R&S FSW.

Measurement 1

1. Settings on DUT:
   - **Level** max. level -3 dB, refer to data sheet (depending on options)
   - **Frequencies** 910 MHz, 1850 MHz and 5 GHz
   - **R&S SMW-B13/-B13T**
     Custom Digital Mod
     – **State** ON
     – **Set acc. To Standard** GSM/EDGE
   - **R&S SMW-B13XT**
     ARB
     – **State** ON
     – **Load Waveform** GSM_Edge.wv
   - **I/Q Modulator**
     Digital Predistortion > Frequency Response
     – **Optimization Mode** High Quality
     – Activate **Optimize for current setting**
2. Settings on analyzer:
   - **VSA**
   - **FREQ CENTER** 910 MHz, 1850 MHz and 5 GHz
   - **DIGITAL STANDARD GSM/EDGE** EDGE NB
   - **ADJUST REF** LVL
3.
4. Settings on analyzer:
   - **FREQ CENTER** 910 MHz, 1850 MHz and 5 GHz
   - **MEAS CHAN PWR** ACP
   - **CP /ACP** CONFIG
     – **NO. OF ADJ CHAN** 3
     – **CHANNEL BANDWIDTH** 30 kHz (all entries)
     – **CHANNEL SPACING** 200 kHz (all entries)
     – **ADJUST SETTINGS**
   - **MEAS CHAN PWR** ACP
   - **ADJUST REF** LVL
   - **NOISE CORR** ON

5. Check ACP (take the smaller of the two measurement values UPPER/LOWER in each case):
   Adjacent Channel, Alternate Channel, 2nd Alternate Channel.

Measurement 2:

1. Settings on DUT:
   - **Level** max. level, refer to data sheet (depending on options)
   - **Frequencies** 910 MHz and 1850 MHz and 5 GHz
   - **GSM/EDGE**
     - **State** ON
     - **Slot** 0
       Burst Type Edge
   - **R&S SMW-B13/-B13T**
     GSM/EDGE
     - **State** ON
     - **Slot** 0
       Burst Type Edge
   - **R&S SMW-B13XT**
     ARB
     - **State** ON
     - **Load Waveform** GSM_Edge_Burst.wv
   - **I/Q Modulator**
     Digital Predistortion > Frequency Response
     - **Optimization Mode** High Quality
     - Activate **Optimize for current setting**
2. Settings on analyzer:
   - **GSM/EDGE**
   - **FREQ CENTER** 910 MHz, 1850 MHz (and 5 GHz)
   - **GSM/EDGE**
     - **DEMOD SETTINGS**
       MODULATION EDGE
       AUTO LEVEL&TIME
   - **GSM/EDGE**
     - **POWER VS TIME**
       START REF MEAS

   LIMIT CHECK PASSED has to be indicated on the analyzer.
3. Settings on analyzer:
   - **GSM/EDGE**
     - **TRANSIENT SPECTRUM**
       START REF MEAS

   LIMIT CHECK PASSED has to be indicated on the analyzer.
4. Settings on analyzer:
   - **GSM/EDGE**

– **MODULATION SPECTRUM**
START REF MEAS

LIMIT CHECK PASSED or MARG has to be indicated on the analyzer.

1.4.13.7 Modulation Error for WCDMA - 3GPP

Accredited calibration:

No minimum requirement.

The equipment layout for generating the digital modulation signals includes the option R&S SMW-B10 (Baseband Generator).

Test equipment:

- RF analyzer with option R&S FSQ-K70 or R&S FSW-K70 (Vector Signal Analysis), (see Table 1-1, item 19).

Test setup:

► Connect signal analyzer to RF output of DUT.

Test method:

► Set Custom Digital Mod to standard WCDMA-3GPP in the baseband. Perform the measurements with the 3GPP measurement setting of the R&S FSQ or R&S FSW.

Measurement 1:

1. Settings on DUT:
   - **Level** max. level, refer to data sheet (depending on options)
   - **Frequencies** 2160 MHz

   R&S SMW-B13/-B13T

   - **Custom Digital Mod**
     – **State** ON
     – **Set acc. To Standard** WCDMA-3GPP

   R&S SMW-B13XT

   - **ARB**
     – **State** ON
     – **Load Waveform** 3GPP_1CH.wv
2. Settings on analyzer:
   - **VSA**
   - **FREQ CENTER** 2160 MHz and 5 GHz
   - **DIGITAL STANDARD 3G-WCDMA** 3G WCDMA FWD
   - **ADJUST REF** LVL
3. Check EVM in Modulation Accuracy Table.

1.4.13.8 Adjacent Channel Power for 3GPP FDD

Accredited calibration:

No minimum requirement.

The equipment layout for generating GSM/EDGE signals includes the options R&S SMW-B10 (Baseband Generator) and R&S SMW-K42 (Digital Standard 3GPP FDD).

Test equipment:
- Signal analyzer with option R&S FSQ-K70 or R&S FSW-K70 (Vector Signal Analysis), (see Table 1-1, item 19).

Test setup:
► Connect signal analyzer to RF output of DUT.

Test method:
► Set standard 3GPP FDD in the baseband. Perform the measurements with the 3GPP measurement setting of the R&S FSQ or R&S FSW.

Measurement 1:

1. Settings on DUT:
   - **Level** +5 dBm RMS
   - **Frequencies** 2160 MHz and 5 GHz

   R&S SMW-B13/-B13T
   - **3GPP FDD**
     – **Test Setups** Test_Model_1_64channels
     – **State** ON

   R&S SMW-B13XT
   - **ARB**
     – **State** ON
     – **Load Waveform** 3GPP_TM1_64.wv
   - **I/Q Settings**
   - **Manual Gain Unicod** 3GPP ACP optimized 3 dB
   - **I/Q Modulator**
     Digital Predistortion > Frequency Response
     – **Optimization Mode** High Quality
     – Activate **Optimize for current setting**
2. Settings on analyzer:
   - **FREQ CENTER** 2160 MHz
   - **MEAS CHAN PWR** ACP
   - **CP /ACP STANDARD WCDMA** 3GPP FWD
   - **ADJUST REF** LVL
   - **NOISE CORR** ON
   - **SWEEP SWEEP TIME** MANUAL 1 s
3. Check ACLR:
   Alternate Channel (take the smaller of the two measurement values UPPER/LOWER).

1.4.13.9 Additive White Gaussian Noise (R&S SMW-K62)

Accredited calibration:
No minimum requirement.

Test equipment:
- Signal analyzer (see Table 1-1, item 19).

Test setup:
► Connect signal analyzer to RF output of DUT.

Test method: A digital modulated signal is generated and noise is added. Using the channel power measurement facility of the spectrum analyzer, the carrier power and the power of a section of the noise spectrum is determined. By expanding the result to the system bandwidth, the carrier to noise ratio can be reconstructed.

The noise generator is a firmware option, realized in an FPGA. The functionality of this FPGA is tested with one measurement, data are guaranteed by design.

Measurement 1:

1. Settings on DUT:
   - **Level** 0 dBm
   - **Frequency** 1 GHz
   - **RF** State On
2. Settings on DUT if Unicod is installed:
   - **Baseband Custom Digital Modulation**
     - **Set to default (GSM), Symbol Rate** 500 Hz
     - **State** On
   - **AWGN/IMP AWGN**
     - **Additive Noise, System Bandwidth** 1 MHz
     - **Carrier/Noise Ratio** 20.00 dB
     - **State** On
3. Settings on analyzer:
   - **FREQ CENTER** 1 GHz
   - **MEAS CHAN PWR** ACP
     - **CP /ACP CONFIG CHANNEL BANDWIDTH** 100 kHz
   - **AMPT REF LEVEL** 10 dBm
   - **BW RES BW MANUAL** 30 kHz
     - **VIDEO BW MANUAL** 300 kHz
   - **TRACE DETECTOR** RMS
   - **SWEEP SWEEP TIME MANUAL** 2 s
4. Measure carrier power and denote as a reference.
5. Settings on DUT if Unicod is not installed:
   - **AWGN/IMP AWGN**
     - **Noise only, System Bandwidth** 1 MHz
     - **Noise Level** -20.00 dB
     - **State** On
6. Now retune center frequency of the analyzer to 1.0003 GHz.
7. Measure the noise power.
   Since the measurement bandwidth is a tenth of the system bandwidth, the result is to be corrected by 10 dB.
   ⇨ The result is carrier power – noise power – 10 dB.

1.4.14 Checking the Baseband

Accredited calibration: No minimum requirement.

The equipment layout for baseband generation and fading includes the options R&S SMW-B13 (Baseband Main Module), R&S SMW-B10 (Baseband Generator) and R&S SMW-B14/-B15.

A first test is performed by internal means, divided into two parts: selftest of baseband board (includes memory test) and connection test between boards.

Internal Test 1, Self Test of Base Band Board:

Test equipment: Not needed

Test setup: No connection required, internal test

Test method: All connections, data paths and memory inside the Baseband boards are tested with PRBS data; Voltage levels of internal digital power supplies are checked against valid limits.

Measurement 1: Run remote command `TEST:BAS?` Result: 0 → OK, 1 → FAIL

Internal Test 2, Connection test of Baseband:

Test equipment: Not needed

Test setup: No connection required, internal test

Test method: The digital data paths between the BBM module (DAC board) and all coder / fader are tested with internal PRBS signal. Each connection is tested for 3 seconds.

Measurement 1: Run remote command `TEST:BB:CONN?` Result: 0 → OK, 1 → FAIL. Depending on the number of coder / fader, the test takes up to 144 seconds (SCPI timeout needs to be set accordingly).

x denotes the appropriate Baseband Board, Range 1...6

External Test 1, BNC Connectors of Baseband:

Test equipment: -

Test setup:

1. Perform the following connections:
   - FRONT BNC USER 1 - FRONT BNC USER 2
   - FRONT BNC USER 3 - REAR BNC USER 4
   - REAR BNC USER 5 - REAR BNC USER 6
   - FRONT BNC USER 1 - REAR BNC INST TRIG A
   - FRONT BNC USER 1 - REAR BNC INST TRIG B
2. The test has to be performed once for every connection described above.

Test method: The physical BNC connectors are tested to be used as input and output. Furthermore, threshold and impedance are verified.

Measurement 1: Set up connection, e.g. `TEST1:BB:BNC:SOUR USER1` and `TEST1:BB:BNC:DEST USER2`

Run remote command `TEST:BB:BNC:CONN?` Result: 0 → OK, 1 → FAIL

1.4.15 Checking the Fader (R&S SMW-B14/-B15)

Accredited calibration: No minimum requirement.

Test equipment:
- Signal analyzer with option R&S FSQ-K70 or R&S FSW-K70 (Vector Signal Analysis), (see Table 1-1, item 19).

Test setup:
► Connect signal analyzer to RF output of DUT.

Test method:
A digital modulated Signal is generated and its error vector magnitude and EVM is measured as a reference. Then the signal is faded with pure doppler shift. Using frequency shift of the same amount in the opposite direction, center frequency is put back to the displayed value. Then the signal is measured again and compared to the reference. No degradations may occur.

Before starting the measurement, set the proper system configuration for the fading:

1. Perform "Preset" to establish a defined initial state.
2. For instruments equipped with R&S SMW-B13/-B13T and R&S SMW-B10/-B14 (narrowband):
   Use the default system configuration mode "Standard".
3. For instruments equipped with R&S SMW-B13XT and R&S SMW-B9/-B15 (wideband):
   Set the system configuration mode to "Advanced":
   a) Select "System Config" > "System Configuration" > "Baseband"
   b) Select "Mode" > "Advanced".
   c) Confirm with "Apply".

Measurement 1:
1. As a reference perform the measurement 1 of chapter “GSM and GSM Normal Burst” at RF = 910 MHz. Denote results of phase error and EVM.
2. Now the Baseband has to shift its output in frequency. Source1:bb:foff 1000 Hz.
3. Now the Fader has to be set to Pure Doppler Shift in one channel of one path to counteract the above shift.
   Formula: f(doppler) = f(RF) * speed / c ; c = speed of light = 299792458 m/s

- For instruments equipped with R&S SMW-B13/-B13T and R&S SMW-B10/-B14 (narrowband):
  - If R&S SMW-B10 is installed, use this internal baseband source for the test.
  - If no R&S SMW-B10 is installed, perform this test with an external digital baseband source.
- For instruments equipped with R&S SMW-B13XT and R&S SMW-B9/-B15 (wideband):
  - If R&S SMW-B9 is installed, use this internal baseband source for the test.
  - If no R&S SMW-B9 is installed, the test is omitted, as option R&S SMW-B15 is not supported without R&S SMW-B9.

Settings on DUT:

1. Execute the fading test using the following settings:
   a) `Source1:fsim:path1:stat off`
   b) `Source1:fsim:rout famaxa`
   c) `Source1:fsim:speed:unit mps`
   d) `Source1:fsim:del:group1:path1:speed 272.8111`
   e) `Source1:fsim:del:group1:path1:prof pdopp`
   f) `Source1:fsim:del:group1:path1:stat on`
   g) `Source1:fsim:stat on`
2. Repeat the measurement.

   No signal degradations may occur, same readings in the limits of measurement uncertainty are to be obtained.

1.4.16 Checking the Front Unit

TheR&S SMW is equipped with a front unit, compromising a keyboard, leds, display and touch screen and BNC front connectors.

1.4.16.1 BNC

Accredited calibration: No minimum requirement.

Test setup: Perform following connections:

- FRONT BNC USER 1 - REAR BNC USER 4
- FRONT BNC USER 2 - REAR BNC USER 5
- FRONT BNC USER 3 - REAR BNC USER 6

Test method: An internal test program is used to generate test signals on the front BNCs and perform a receive check on the rear BNCs and vice versa.

Measurement 1:
- Settings on DUT (functionality is available with protection level 1):
  - **Setup → Maintenance → → Selftest → Connection → BNC Connection Test**

Follow the advices on the screen.

1.4.16.2 Keyboard

Accredited calibration: No minimum requirement.

Test setup: None.

Test method: An internal test program is used to check all keys and the knob.

Measurement 1:

- Settings on DUT:
  - **Setup → Test → Check Front Panel ...**
    Follow the advices on the screen, every key must be pressed once.

1.4.16.3 LEDs

Accredited calibration: No minimum requirement.

At power up, all three LEDs at the front are driven white and then dimmed down. This is a short test on the function.

Test setup: None.

Test method: An internal test program is used to enable the LEDs independent of the setting.

Measurement 1:

- Settings on DUT:
  - **Setup → Test → Check Front Panel ...**
    Hit the menu buttons for appropriate LED and check manually whether LED has gone white.

1.4.16.4 Touchpanel

Accredited calibration: No minimum requirement.

Test setup: None.

Test method: An internal test program is used to check and calibrate the touch panel.

Measurement 1:

- Settings on DUT:
  - **Setup → Environment → Touch Panel Calibration ...**
    Start the calibration, all points must be accepted.

2 Troubleshooting

USB Cable Test

USB cables of good quality are required for EMI suppression and stable connections.

However, according to our experience USB cables are of varying and often poor quality. This concerns the connection between the cable shield and the shield contacts of the connectors.

Cables of poor quality may cause EMI interference and poor connection quality. EMI interference, among other things, may ultimately lead to measurement errors. Poor connection quality may create problems like increased latencies that are due to retransmissions because of data corruption or may even lead to a complete loss of data connection.

Therefore, we recommend checking every USB cable using the following easy method:

Measure the electrical resistance from the shield contact of one connector to the shield contact of the other connector. For correct measurement results, consider the contact resistance at your probe tips. Good cables have a value of less than 0.6Ω according to USB standards.

Also check, whether the resistance is stable when you bend the cable.

3 Software Update / Installing Options

This chapter contains information on firmware update, Linux operating system update and installing options to the R&S SMW. Additional manuals obtained together with a firmware update or with subsequently acquired options can be filed here.

NOTICE

Possible impairment of the functioning of the instrument!

The instrument is equipped with the Linux operating system. It is thus possible to install COTS software in the instrument. The use and installation of commercial off-the-shelf (COTS) software may impair the instrument function. For this reason, we recommend that you only execute programs tested by Rohde & Schwarz with regard to their compatibility with the instrument software. In certain cases, the use of these programs can impair the performance of the instrument.

The drivers and programs used in the instrument under Linux have been adapted to the test instrument. Existing instrument software must only be modified with update software released by Rohde & Schwarz.

3.1 Installation of new R&S SMW Firmware

Your R&S SMW is delivered with the latest firmware version available. Firmware updates as well as the Release Notes describing the improvements and modifications are provided on the Internet at the download site of the R&S SMW homepage http://www.rohde-schwarz.com/product/SMW200A. This homepage always offers the latest information on your signal generator, e.g. also on changes of the firmware update procedure.

Firmware updates always are delivered in one single file with a filename starting with "SMW_" and ending in ".rsu". The version numbers in the filename vary with each update.

Firmware update: `SMW_x.xx.xxx.xx.rsu`

The installation of a new firmware version is performed via the USB interface. A deinstallation of the old firmware is not necessary.

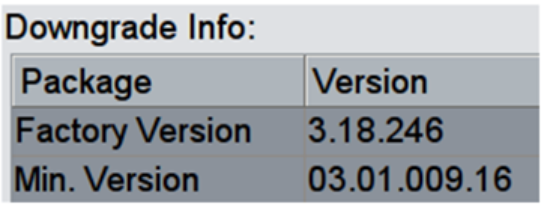
The update file has to be downloaded from the Internet to a PC. From there the file should be transferred to a memory stick which will later be plugged into the USB interface of the instrument. The firmware update is performed while the instrument is running. The new firmware will be loaded right after the update process.

If the instrument "sees" a memory stick at its USB interface, it offers all versions stored on the memory stick for selection. Thus, an upgrade or downgrade of the firmware is possible at any time.

3.1.1 Downgrade

Generally it is not recommended to use an earlier version than the latest version available. In some cases the older versions do not support the hardware used in your instrument. Before installing this firmware, check if this could happen:

1. Start System Config / Setup / Instrument Assembly / Software/Options.
2. In the tab "Firmware", you find the "Downgrade Info" (Example):



3. If the version to be installed is greater or equal than the "Min.Version", the hardware will be supported after downgrading (however, this cannot be guaranteed for all software options).
4. If the version to be installed is lesser than the "Min.Version", not all of the modules will be supported. You instrument will not work after downgrading!
5. Downgrading may fail using standard rsu-Files (eg. due to changes in the instrument configuration file). In this case, press PRESET-Button during power-on or install ISO image.

3.1.2 Update Information

The update procedure requires that the instrument is operational. There is no need to uninstall the current firmware. Instrument settings are preserved during the update, including user data and network settings.

NOTICE

USB Storage must be enabled in security settings

Press the SETUP key, select Security and check USB Storage setting.

3.1.3 Updating the Firmware

Required equipment

- **Software:** Firmware update file `SMW_x.xx.xxx.xx.rsu`
- **Hardware:** USB memory stick with enough free space to save the update file (about 240 MByte).

The memory stick does not need to be bootable and previous data on the stick is not affected. Several update files may reside on the stick in parallel. During update procedure the stick is not modified by the instrument.

Prepare Memory Stick

1. Download update file to a PC.
2. Connect USB stick to PC and copy the update file to the root directory.
3. Wait until copy procedure has finished and remove USB stick.

Install new firmware on R&S SMW

1. Connect USB stick to instrument.
2. Switch on instrument, if instrument is powered off.
3. Wait a few seconds until "Process Software Update?" message box appears. Confirm by touching the YES Button or pressing the rotary knob.
4. Select firmware version using the arrow keys and press knob to start update.
5. Wait until "Software update successful" message box appears. This may take several minutes.
6. Remove USB stick and touch the Reboot button.
7. The instrument now reboots.

Execute internal adjustments (only if indicated)

Internal adjustments can be initiated manually (e.g. after warming up) by performing the followings steps:

1. Press PRESET on the instrument front panel.
2. Press SETUP, select "Internal Adjustments…" and execute "Adjust All". This procedure updates all internal instrument adjustments and will take several minutes.

Adjustments requiring external measurement equipment are not affected by the firmware update and need not to be performed.

3.1.4 Alternative update procedures

The USB firmware update is recommended for most situations. However, alternative methods for updating the firmware are available.

3.1.4.1 Firmware update over LAN

Instrument settings are preserved during the update, including user data and network settings.

1. Get access to the file system of the instrument using ftp (other methods like samba share is also supported, see application note 1GP72 for details).

   Enter `ftp://<ip address or host name>` in the file manager.

2. Copy **`SMW_x.xx.xxx.xx.rsu`** to directory /var/user/update.
3. The update procedure starts immediately.
4. Execute internal adjustments, if indicated.

3.1.4.2 Firmware update using ISO image

NOTICE

Potential loss of data!

User data and user specific instrument settings will be lost during this procedure. Instrument serial number, software license keys and all adjustments requiring external measuring equipment are not affected.

Required equipment

Software:

- ISO image for firmware update **`SMW_x.xx.xxx.xx.iso`**. **Please contact the service department to get this file!**

Hardware:

- **External** USB CD or DVD ROM burner with USB cable.
- 1 CD Recordable.
- PC with burn program that can burn ISO images onto CD.

About ISO image

This is a standardized file format for creating CD images. A CD image is a single file encapsulating the whole data of a CD including directories and files. Unpacking the image to a CD restores the original data. Almost any CD burning program is able to write CDs based on ISO images.

Update procedure

Burn ISO image onto CD

On most computers, burning an ISO image can be initiated by simply double clicking the ISO image file. If this is not the case, the manual procedure is similar to the following instructions. Nero Burning ROM (StartSmart) is used in this example.

1. Connect the external USB CD/DVD drive to the PC.
2. Insert CD recordable.
3. Start Nero StartSmart.

4. Select medium "CD".
5. Select "Create Data CD".
6. From the **Files menu**, open file `SMW_x.xx.xxx.xx.iso`.
7. Click "Burn".
8. When finished, close Nero and disconnect external USB CD/DVD drive.

Install new firmware on R&S SMW

1. Instrument must be switched off.
2. Connect the external USB CD/DVD drive to the R&S SMW.
3. Switch on Instrument.
4. The instrument boots from external drive.
5. Follow the instructions on screen.
6. Disconnect the external USB device.
7. Reboot instrument.
8. Execute internal adjustments, if indicated.

NOTICE

Burn the ISO-image as an "image"

If the CD refuses to boot please ensure that you have burned the ISO-image as an "image" and not as a single file. Check the CD regarding presence of several files.

3.2 Installing Options

A list of all available R&S SMW options is provided in the data sheet and on the internet http://www.rohde-schwarz.com/product/SMW200A.

3.2.1 Installing Hardware Options

Please note the mounting instructions enclosed with the options. These mounting instructions can be filed at this place in the service manual and are thus easily available whenever they are required.

DANGER

Danger of shock hazard!

- For module replacement, ensure that the instrument is switched off and disconnected from the power supply by removing the plug from the AC and DC power connector.
- Read all safety instructions at the beginning of this manual carefully before module replacement!

NOTICE

Danger of damage to components of the module!

Protect the operational site against electrostatic discharge to avoid damage to electronic components of the modules. For details refer to the safety instructions at the beginning of this manual.

3.2.2 Installing Software Options

All available software options are already included in the latest firmware. They are ready to operate after they are enabled by means of a key code supplied with the option.

Only if the R&S SMW is equipped with an older firmware version, a firmware update prior to enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option.

3.3 Options Overview

A list of all available hardware and software options is provided on the Rohde & Schwarz Internet site at www.rohde-schwarz.com.

4 Documents

This chapter provides an overview of the available power cables and how to obtain information on spare parts.

4.1 Available Power Cables

Rohde & Schwarz provides power cables with different properties, to be used in different countries.

Table 4-1: List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 0006.7013.00	BS1363: 1967' 10 A 250 V complying with IEC 83: 1975 standard B2	Great Britain
DS 0006.7020.00	Type 12 , 10 A 250 V complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 0006.7036.00	Type 498/13 10 A 125 V complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 0041.4752.00	GB2099 , GB1002 10 A 250 V approvals CCC	China
DS 0041.6232.00	JIS C 8303 7A 125 V AC approvals PSE (JET)	Japan
DS 0006.7107.00	Type SAA3 10 A, 250 V complying with AS C112-1964 Ap.	Australia
DS 0025.2365.00	DIN 49 441, 10 A, 250 V, **straight** approvals VDE, ÖVE, CEBEC, KEMA, S, D, N, FI, LCIE, IMQ, UCIEE	Europe (except Switzerland)
DS 0086.4400.00	DIN 49 441, 10 A, 250 V, **angular** approvals VDE, ÖVE, CEBEC, KEMA, S, D, N, FI, LCIE, IMQ, UCIEE	

4.2 Spare Parts

For general information on spare parts for products of Rohde & Schwarz, refer to the sheet "Procedure in Case of Service and Ordering of Spare Parts" at the beginning of this manual.

CAUTION

Risk of shock hazard and instrument damage

When shipping a module, be careful to provide for sufficient mechanical and antistatical protection.

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