R&S®SMA100B
RF and Microwave Analog Signal Generator
Service Manual

1178382802

Service Manual

Version 04

ROHDE&SCHWARZ

This manual describes the following signal generator:

- R&S®SMA100B, order no. 1419.8888K02

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The following abbreviation is used throughout this guide: R&S®SMA100B is abbreviated as R&S SMA100B.

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.

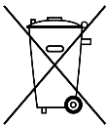
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English.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

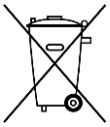
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa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

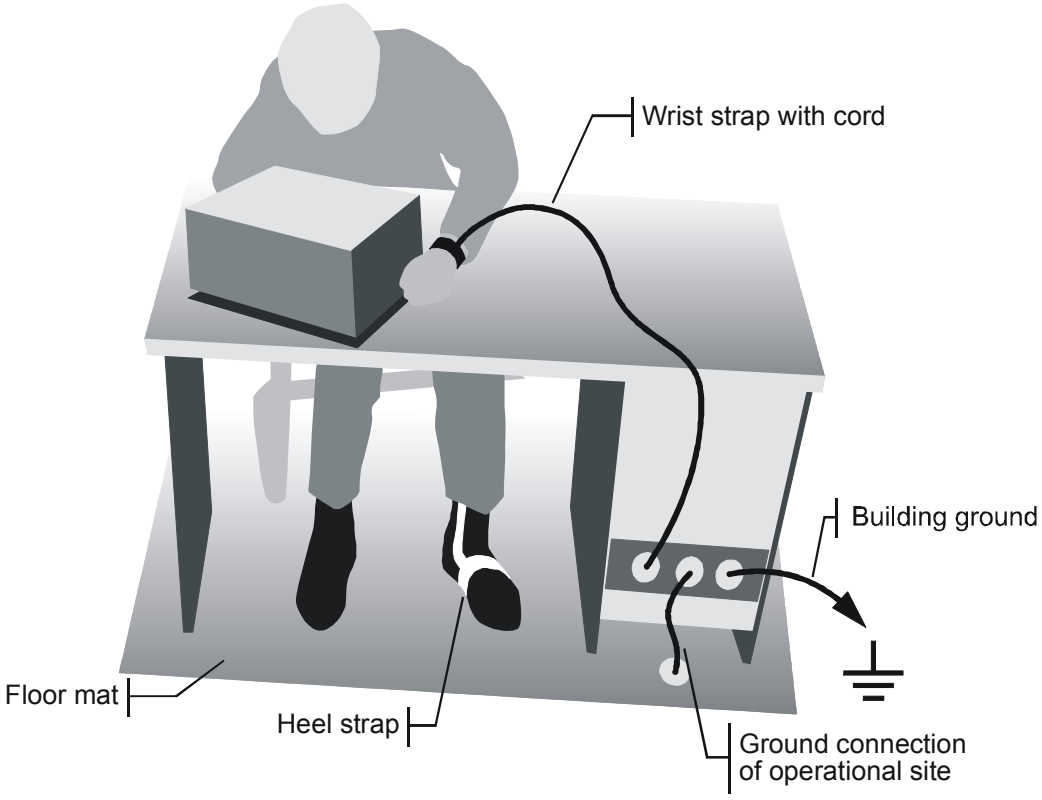
Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

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:

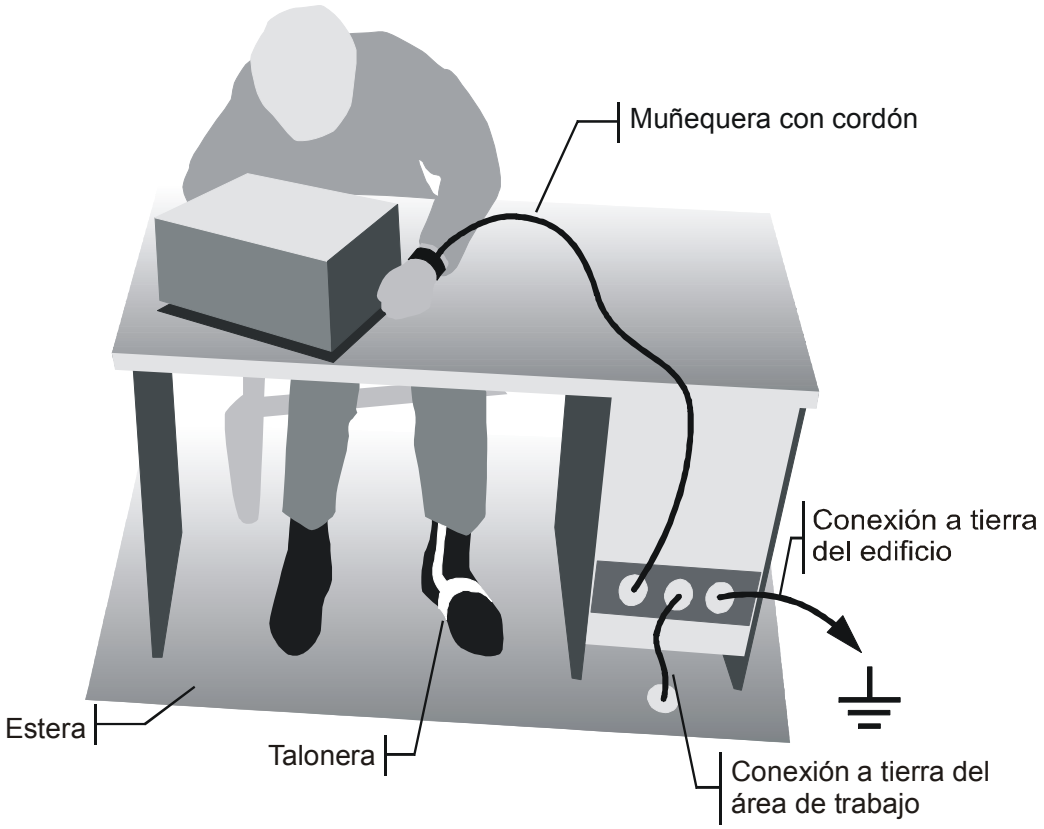
- Wrist strap with cord to ground connection
- Conductive floor mat and heel strap combination

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

To ensure that rated specifications are maintained, the following preparations must be made before checking the rated characteristics:

- Allow for a minimum warm-up time of 30 minutes at ambient temperature.
- Carry out all internal adjustments.
- The values are specified in the data sheet. Additional uncertainties introduced by the measurement equipment must be taken into account when checking the rated values.
  This performance test describes the steps for testing the R&S SMA100B Signal Generator family and the installed options with respect to function and compliance with 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. The values are given in the data sheet of the respective instrument.

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 RFmax, 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 RFmax	R&S SMA100B with R&S SMAB-B710/-B710N R&S SMAB-B711/-B711N	1419.8888.02
4	Controller	Industry standard PC/XT/AT with IEC 60625 interface, USB interface and LAN interface		
5	Signal generator	1 MHz to RFmax	R&S SMW200A R&S SMA100A R&S SMU200A R&S SMBV100A	

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S Order No.
6	Phase noise test assembly	Phase Noise Test Set or Mixer: 10 MHz to RFmax, branching filter 20 MHz, DC decoupling after the mixer For devices with R&S SMAB-B710/-B710N/-B711/-B711N: Phase Noise Test Set with FSWPxx	R&S FSUP 26 or R&S FSUP 50 or Mixer: f < 1 GHz: Minicircuits ZFM2H 1 GHz < f < 13 GHz: Miteq DB0118LA2 R&S FSWP8 R&S FSWP26 R&S FSWP50 with B1, B4, B61, B80, K7	1166.3505.27 1166.3505.51 FSWPxx: 1322.8003.08 1322.8003.26 1322.8003.50
7	Oscilloscope	Bandwidth ≥ 500 MHz, two channels with DC coupling	R&S RTM or similar	
8	RF power meter	9 kHz to RFmax	R&S NRP with R&S NRP Z55 or R&S NRP Z51 or R&S NRP Z91 or R&S NRP Z92 R&S NRP Z57 R&S NRP67T/TN	1143.8500.02 1138.2008.02 1138.0005.0x 1168.8004.02 1171.7005.02 1171.8401.02 1424.6196.02 / 1424.6209.02
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 RFmax, gain > 20 dB, noise figure < 10 dB		
11	VSWR bridge	1 MHz to RFmax, 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 -6 to 10 V		
13	RF power amplifier	10 MHz to RFmax, power > 33 dBm		
15	AC/DC voltmeter	10 Hz to 10 MHz	R&S URE3	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		
18	Zero bias schottky diode	100 MHz to RFmax	Krytar 704A	5029.2484.00

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S Order No.
19	RF analyzer & Demodulator for analog modulations & FM-demodulator	1 MHz to RFmax * 2 For instruments with R&S SMAB-B131 and above, a R&S FSWP50 is mandatory.	R&S FSW8/13/26/40 with R&S FSW-B24 R&S FSW-K7 R&S FSQ26 with R&S FSU-B25 R&S FSQ K7 or R&S FSWPxx if available	 1155.5001.26 1044.9298.02 1141.1796.02
21	Coaxial attenuator	DC to RFmax, max. 40 GHz, 16 to 20 dB attenuation	Weinschel WA-41-16 Weinschel WA-76-18	5029.2478.00 5029.2461.00
22	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 For testing instruments equipped with R&S SMA100B-B167 option	R&S SMA100B with R&S SMAB-B140 R&S SMAB-B710 R&S SMAB-B710N R&S SMAB-B711 R&S SMAB-B711N	1419.8888.02
23	uW down converter (mixer)	50 GHz to 70 GHz		

1.2 Test Assemblies

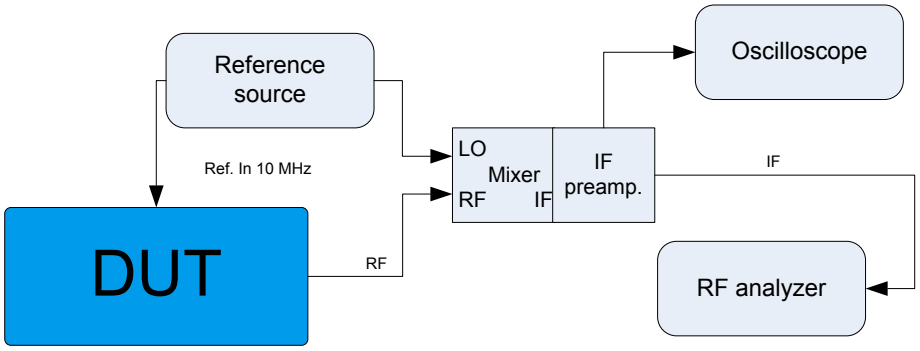
The device under test R&S SMA100B is abbreviated as DUT hereinafter.

1.2.1 Test Assembly for SSB Phase Noise and Jitter

Test equipment:

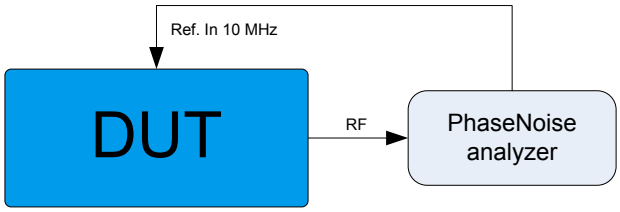
- Reference Source, (see Table 1-1, item 2)
- Phase noise test assembly consisting of mixer with low pass filter and preamplifier, (see Table 1-1, item 6)
- Oscilloscope, (see Table 1-1, item 7)
- RF analyzer, (see Table 1-1, item 19)

Test setup:



Test equipment: For instruments equipped with R&S SMAB-B710/-B710N/-B711/-B711N or frequency >6 GHz:

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

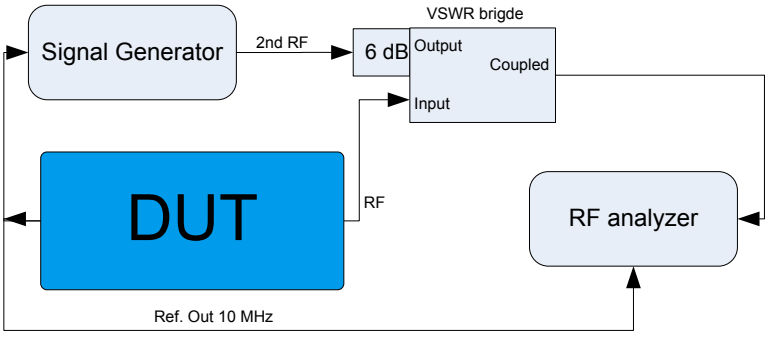


1.2.2 Test Assembly for Output Impedance (VSWR)

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:



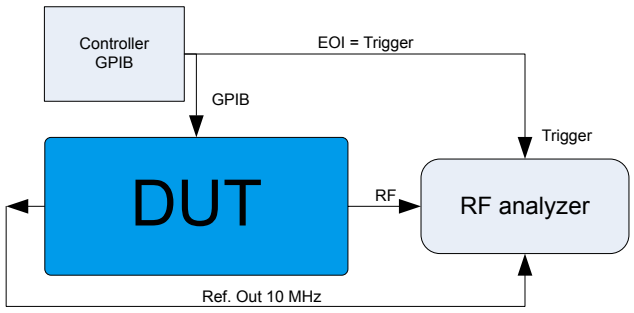
The INPUT of the directional coupler is directly screwed to the DUT. The second signal generator is connected to the line connector (OUTPUT), the analyzer to the coupling output (COUPLED) of the directional coupler.

1.2.3 Test Assembly for Setting Time

Test equipment:

- GPIB controller, (see Table 1-1, item 4)
- RF analyzer, (see Table 1-1, item 19)

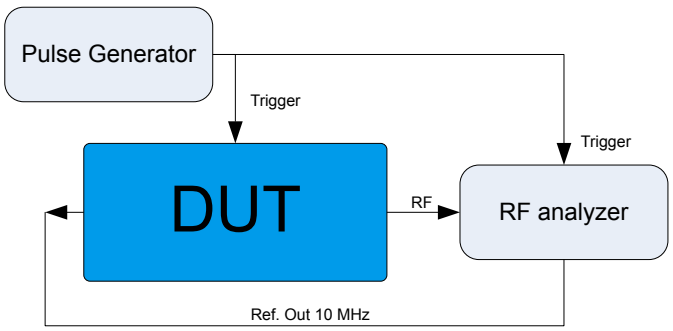
Test setup GPIB:



Test equipment:

- Pulse generator, (see Table 1-1, item 17)
- RF analyzer, (see Table 1-1, item 19)

Test setup list mode:

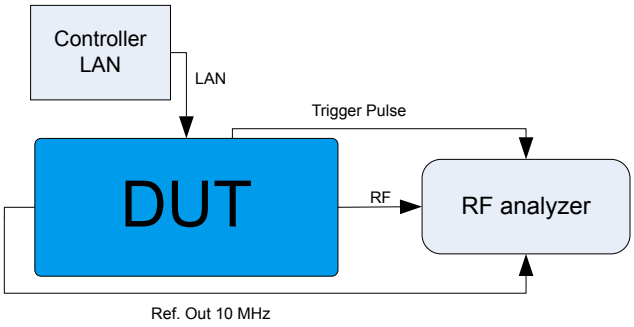


For instruments not equipped with R&S SMAB-B86 (without GPIB interface):

Test equipment:

- LAN controller, (see Table 1-1, item 4)
- RF analyzer, (see Table 1-1, item 19)

Test setup:

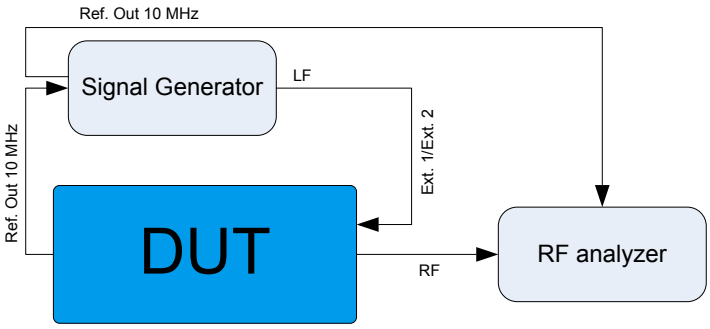


1.2.4 Standard Test Assembly for Analog Modulation

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.

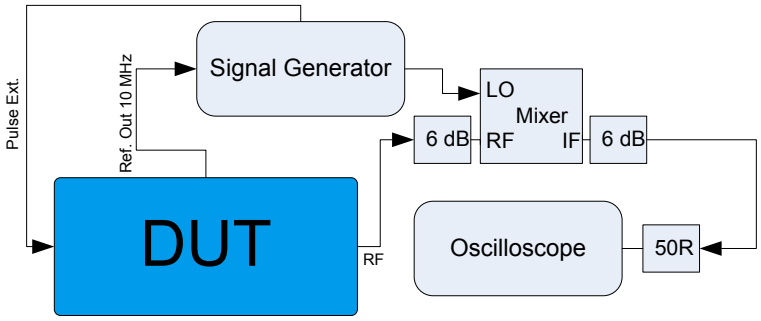


1.2.5 Test Assembly for Pulse Modulation

Test equipment:

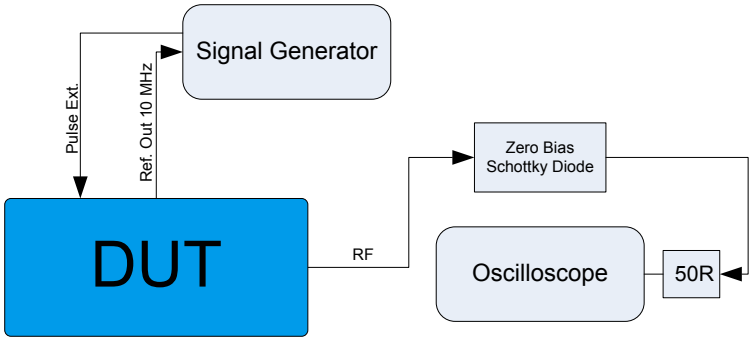
- Oscilloscope, (see Table 1-1, item 7)
- Signal generator, (see Table 1-1, item 5)
- Mixer

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



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

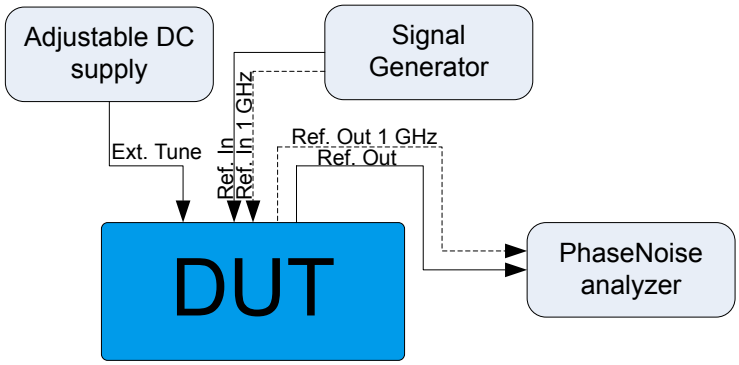


1.2.6 Test Assembly for Reference Measurements

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)

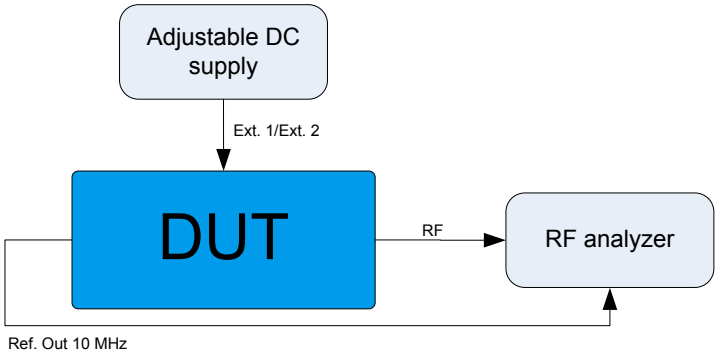
Test setup: The Signal generator is used as reference source for the REF IN input resp. 1 GHz IN input. The RF analyzer is used as frequency counter as well.



1.2.7 Test Assembly for Scan Modulation

Test equipment:
- RF analyzer, (see Table 1-1 , item 17)
- Adjustable DC voltage source, (see Table 1-1, item 12)

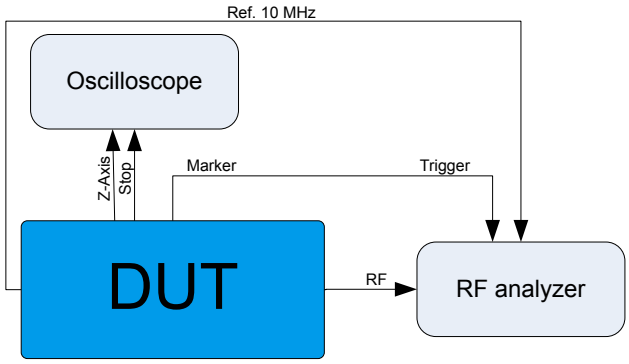
Test setup: The RF analyzer is used for power measurement. A variable DC voltage is fed into EXT1/EXT2 connector.



1.2.8 Test Assembly for Ramp Sweep

Test equipment:
- RF analyzer, (see Table 1-1 , item 19)
- Oscilloscope, (see Table 1-1, item 7)

Test setup: The RF analyzer is used as a modulation analyzer. The Oscilloscope is used to check different HW output signals.



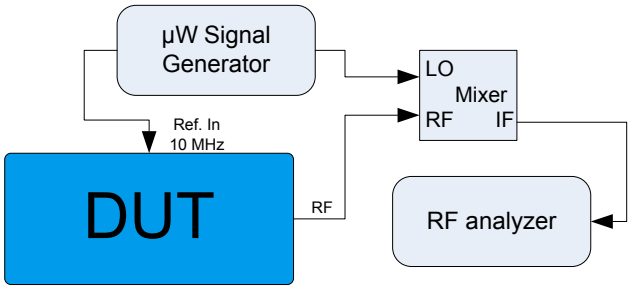
1.2.9 Test Assembly for R&S SMAB-B167

Test equipment:

Use the following test assembly for checking all RF parameters except power measurements with a power meter in the frequency range above 50 GHz. Use a microwave converter and a high quality microwave signal generator as LO-source for that.

- RF analyzer, (see Table 1-1 , item 19)
- uW Signal Generator, (see Table 1-1 , item 22)
- uW Down Converter, (see Table 1-1 , item 23)

Test setup:



General test settings

- Choose a fixed frequency at the uW signal generator (LO), e. g. f_{LO}=40 GHz, with a suitable LO drive level for the microwave converter.
- Measure the RF parameters at the intermediate frequency (IF) with the RF analyzer, e. g. $f_{IF}=f_{RF}-f_{LO}$.
- Pay attention concerning undesired mixing products. Change LO frequency in a small range, if necessary.

1.3 Preparation, Recommended Test Frequencies/Levels

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

- Allow for a minimum warm-up time of 30 minutes at ambient temperature.
- Carry out all internal adjustments.
- Perform Preset to establish a defined initial state before configuring a new measurement.
  The following sections describe the procedures for checking the rated values. The values are specified in the data sheet. Additional uncertainties introduced by the measurement equipment must be taken into account when checking the rated values.
  The following table lists 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.

Table 1-2: Range limits, main test frequencies for CW Mode

Range	Frequency	Hardware switching points	Recommended test frequencies
R&S SMAB-B103	0.008 to 3000 MHz	0.008 MHz, 0.2 MHz, 8 MHz, 12.5 MHz, 13.3 MHz, 15 MHz, 17.8 MHz, 20 MHz, 22.5 MHz, 23.7 MHz, 28 MHz, 32 MHz, 35 MHz, 37.5 MHz, 46.4 MHz, 52 MHz, 60 MHz, 65 MHz, 70 MHz, 82.5 MHz, 85.5 MHz, 115 MHz, 115.5 MHz, 130 MHz, 150 MHz, 162 MHz, 187 MHz, 216 MHz, 254 MHz, 287 MHz, 295 MHz, 375 MHz, 390 MHz, 435 MHz, 450 MHz, 560 MHz, 580 MHz, 630 MHz, 700 MHz, 770 MHz, 975 MHz, 1040 MHz, 1100 MHz, 1360 MHz, 1500 MHz, 1550 MHz, 1800 MHz, 2060 MHz, 2150 MHz, 2200 MHz, 2400 MHz, 2700 MHz, 3000 MHz	0.008 MHz, 0.20 MHz, 0.21 MHz, 8.00 MHz, 8.01 MHz, 12.50 MHz, 12.51 MHz, 13.30 MHz, 13.31 MHz, 15.00 MHz, 15.01 MHz, 17.80 MHz, 17.81 MHz, 20.00 MHz, 20.01 MHz, 22.50 MHz, 22.51 MHz, 23.70 MHz, 23.71 MHz, 28.00 MHz, 28.01 MHz, 32.00 MHz, 32.01 MHz, 35.00 MHz, 35.01 MHz, 37.50 MHz, 37.51 MHz, 46.40 MHz, 46.41 MHz, 52.0 MHz, 52.01 MHz, 60.0 MHz, 60.01 MHz, 65.0 MHz, 65.01 MHz, 70.0 MHz, 70.01 MHz, 82.5 MHz, 82.51 MHz, 85.5 MHz, 85.51 MHz, 115.0 MHz, 115.1 MHz, 115.5 MHz, 115.6 MHz, 130.0 MHz, 130.1 MHz, 150.0 MHz, 150.1 MHz, 162.0 MHz, 162.1 MHz, 187 MHz, 187.1 MHz, 216.0 MHz, 216.1 MHz, 254.0 MHz, 254.1 MHz, 287.0 MHz, 287.1 MHz, 295.0 MHz, 295.1 MHz, 375.0 MHz, 375.1 MHz, 390.0 MHz, 390.1 MHz, 435.0 MHz, 435.1 MHz, 450.0 MHz, 450.1 MHz, 560.0 MHz, 560.1 MHz, 580.0 MHz, 580.1 MHz, 630.0 MHz, 630.1 MHz, 700.0 MHz, 700.1 MHz, 770.0 MHz, 770.1 MHz, 975.0 MHz, 975.1 MHz, 1040.0 MHz, 1040.1 MHz, 1100 MHz, 1101 MHz, 1360 MHz, 1361 MHz, 1500 MHz, 1501 MHz, 1550 MHz, 1551 MHz, 1800 MHz, 1801 MHz, 2060 MHz, 2061 MHz, 2150 MHz, 2151 MHz, 2200 MHz, 2201 MHz, 2400 MHz, 2401 MHz, 2700 MHz, 2701 MHz, 3000 MHz
R&S SMAB-B106	3020 to 6000 MHz	3020 MHz, 3600 MHz, 3700 MHz, 4200 MHz, 4300 MHz, 5400 MHz, 6000 MHz	3001 MHz, 3020 MHz, 3021 MHz, 3600 MHz, 3601 MHz, 3700 MHz, 3701 MHz, 4200 MHz, 4201 MHz, 4300 MHz,

Range	Frequency	Hardware switching points	Recommended test frequencies
			4301 MHz, 5400 MHz, 5401 MHz, 6000 MHz
R&S SMAB-B112	7200 to 12750 MHz	7200 MHz, 8000 MHz, 8500 MHz, 8600 MHz, 8900 MHz, 10700 MHz, 10800 MHz, 11000 MHz, 12000 MHz, 12750 MHz	6001 MHz, 7200 MHz, 7201 MHz, 8000 MHz, 8001 MHz, 8500 MHz, 8501 MHz, 8600 MHz, 8601 MHz, 8900 MHz, 8901 MHz, 10700 MHz, 10701 MHz, 10800 MHz, 10801 MHz, 11000 MHz, 11001 MHz, 12000 MHz, 12001 MHz, 12750 MHz
R&S SMAB-B120	13000 to 20000 MHz	13000 MHz, 14000 MHz, 14400 MHz, 15800 MHz, 17200 MHz, 17800 MHz, 20000 MHz	12751 MHz, 13000 MHz, 13001 MHz, 14000 MHz, 14001 MHz, 14400 MHz, 14401 MHz, 15800 MHz, 15801 MHz, 17200 MHz, 17201 MHz, 17800 MHz, 17801 MHz, 20000 MHz
R&S SMAB-B131/B140	20000 to 40000 MHz	21600 MHz, 21800 MHz, 22720 MHz, 24000 MHz, 25200 MHz, 28000 MHz, 28800 MHz, 31800 MHz, 34400 MHz, 40000 MHz	21600 MHz, 21800 MHz, 22720 MHz, 24000 MHz, 25200 MHz, 25201 MHz, 28000 MHz, 28800 MHz, 31800 MHz, 31801 MHz, 34400 MHz, 40000 MHz
R&S SMAB-B150	40000 to 50000 MHz	43200 MHz, 43600 MHz, 45440 MHz, 48000 MHz	43200 MHz, 43600 MHz, 45440 MHz, 48000 MHz, 49900 MHz, 50000 MHz
R&S SMAB-B167	50000 to 67000(70000) MHz	51800 MHz, 57600 MHz, 68800 MHz, 70000 MHz	51800 MHz, 51801 MHz, 57600 MHz, 67000 MHz, 68800 MHz, 70000 MHz

In the following, RF_{max} is the maximum output frequency of the instrument according to its frequency option.

For **high-resolution measurements** in the entire frequency range, a logarithmic frequency grid in 1-2-5 sequence is recommended up to 50 MHz; above this value, linear 50 MHz steps should be used up to the upper limit frequency.

The recommended test levels are at the upper and lower switching threshold of the attenuator. The electronic step attenuator of the DUT is switched depending on frequency, modulation parameters and level according to an internal stored table in approximately 5 dB steps for frequency options R&S SMAB-B103, R&S SMAB-B106, R&S SMAB-B112, R&S SMAB-B120.

The mechanical step attenuator used in frequency options R&S SMAB-B13x, R&S SMAB-B140, R&S SMAB-B150 and R&S SMAB-B167 is switched every 5dB.

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 Checking the internal reference

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

Accredited calibration: Same coverage as performance test.

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

Test setup:
► Connect a calibrated frequency counter (see Table 1-1, item 1) to the REF OUT output (on rear panel).

Measurement 1: Measure the frequency.

► Settings on DUT:
- **Source mode** 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.

Service limits: 0.75 * "Error at time of calibration in production".

For higher accuracy, perform the measurement at the 1 GHz OUT output, if R&S SMAB-K703 option is installed.

If the specified accuracy is not met, the internal reference oscillator must be adjusted.

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

Measurement 2: Measure the output level. It should be within the data sheet specifications.

► Settings on DUT:

- **Source mode** Internal Reference
- **Ref Output Frequency** 10 MHz

For instruments equipped with the R&S SMAB-K704 resp. R&S SMAB-K703 option repeat the above measurement with further frequency settings. In case of R&S SMAB-K703 option, choose the 1 GHZ OUT connector as output.

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

1.4.1.2 Electronic Tuning of Reference from EFC input

Accredited calibration: No minimum requirement.

Test equipment:
- DC voltage source (see Table 1-1, item 12)
- 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.
   - **Mode** slope low resp. slope high.
2. Set the DC voltage to -10 V and measure the frequency f1 for both modes.
3. Set the DC voltage to +10 V and measure the frequency f2 for both modes.

The frequency deviation f2-f1 divided by the voltage difference of 20 V is the sensitivity of the EFC input.

For higher accuracy, perform the measurement at the 1 GHz OUT output, if R&S SMAB-K703 option is installed.

1.4.1.3 Checking the external reference

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

Test setup:
1. Connect the Reference Signal generator to REF IN connector (additionally to REF 1 GHZ IN with option R&S SMAB-K703).
2. Connect the calibrated frequency counter to the REF OUT output (on rear panel).

Measurement: Check synchronisation of the DUT for the lower and upper bound of the specified input level range.

1. Settings on DUT:

- **Source mode** External Reference
- **Synchronisation Bandwidth** Wide

2. Settings on Reference Signal Generator:
   - **Frequency** Recommended test frequencies
   - **Level** min. and max. specified input level from data sheet.
3. Check, if the DUT locks on the reference signal for both input levels. Check the locking range at 10 MHz and 10 dBm according to the datasheet.
4. Repeat the measurement for DUT setting **Synchronisation Bandwidth** Narrow.

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

In case of R&S SMAB-K703 option, choose the 1 GHZ OUT connector as output.

Only for instruments with R&S SMAB-K703 option:

Test setup: ► Connect a RF power meter to the 1 GHZ OUT output (on rear panel). Connect the signal generator to the 1 GHz IN input (on rear panel).

Measurement 2: Measure the output level. It should be within the data sheet specifications.

1. Settings on DUT:
   - **Source mode** External Reference
   - **Synchronisation Bandwidth** Narrow
   - **Output mode** Input signal (loop through)
2. Settings on Reference Signal Generator:
   - **Frequency** 1 GHz
   - **Level** min. and max. specified input level from data sheet.
3. Measure the output level at the 1 GHZ OUT output for min. and max. specified input level.

1.4.1.4 Variable Reference input (only with R&S SMAB-K704 option)

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: ► Connect a RF power meter to the REF OUT output (on rear panel). Connect the signal generator to the REF IN input (on rear panel).

Measurement 1: Supply an external reference signal via the signal generator and measure the output level at the REF OUT output. It should be within the data sheet specifications.

1. Settings on DUT:
   - **Reference Source** external

- **Input mode** Variable
- **Synchronisation Bandwidth** Wide
- **External Reference Frequency** recommended test frequencies
- **Reference Frequency Output** Input Signal (Loop through)
- **Synchronisation Bandwidth** Wide

2. Settings on Reference Signal Generator:
   - **Frequency** recommended test frequencies
   - **Level** lower and upper bound of the specified input level.
3. Measure the output level at the REF OUT output for recommended test frequencies.

Measurement 2: Check synchronisation of the DUT for the lower and upper bound of the specified input level range.

1. Settings on DUT:
   - **Reference Source** external
   - **Input mode** Variable
   - **Synchronisation Bandwidth** Wide
   - **External Reference Frequency** recommended test frequencies
   - **Synchronisation Bandwidth** Wide
2. Settings on Reference Signal Generator:
   - **Frequency** Recommended test frequencies
   - **Level** min. and max. specified input level from data sheet.
3. Check, if the DUT locks on the reference signal for both input levels. Check the locking range at 10 MHz and 10 dBm according to the datasheet.
4. Repeat the measurement for DUT setting **Synchronisation Bandwidth** Narrow.

Recommended test frequencies: 1 MHz, 10 MHz, 12.288 MHz, 13 MHz, 30 MHz, 50 MHz, 100 MHz for variable REF IN input.

For **Synchronisation Bandwidth** Narrow: Choose 1 MHz, 10 MHz, 100 MHz for variable REF IN input.

1.4.1.5 Noise floor of internal reference (only with R&S SMAB-K703 option)

Accredited calibration: Same coverage as performance test.

Test assembly: See Chapter 1.2.6, "Test Assembly for Reference Measurements ", on page 13.

Test setup:

1. Connect the noise analyzer to the REF OUT output (on rear panel). If K703 option is installed, perform the measurement also for the 1 GHz OUT output (on rear panel).
2. Connect the signal generator output to the REF IN input (on rear panel).

Measurement 1:

1. Measure the wideband noise of the reference output at 100 MHz carrier resp. at 1 GHz carrier for instruments with R&S SMAB-K703 option at 10 MHz offset frequency.
2. Settings on DUT:
   - **Internal Reference**
   - **Ref Output Frequency** 100 MHz
3. Settings on phase noise analyzer:
   - **Mode** Signal source analyzer.
   - **Center** 100 MHz resp. 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 ⇨ "MSynVco"
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 11.

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 GPIB 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** 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. Measure the setting time for **ALC OFF (Table)**, additionally.

For instruments without R&S SMAB-B86 option (remote control GPIB):

Test assembly: See Chapter 1.2.3, "Test Assembly for Setting Time", on page 11

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

Test method: A controller transmits the start and the stop frequency via the LAN interface by a remote command. The DUT sensor connector on the front panel is programmed as trigger pulse output. The analyzer is triggered by the signal generated on the DUT's sensor Trig+ and Trig- pins. At switch over from start to stop frequency, the setting 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 the trigger connector of the analyzer to the Trig+ and Trig- pins of the DUT's sensor connector.
4. Settings on DUT:
   - Switch on Espresso mode of sensor with command `SYST:PROF:MOD:STAT "Espresso", ON` and all other modes off with command `SYST:PROF:MOD:STAT "ScpiParser", OFF`, `SYST:PROF:MOD:STAT "OrgLayer", OFF`.
   - Check with query `SYST:PROF:MOD:CAT?`
   - Get activated trigger events with query `SYST:PROF:TPO:CAT?`.

- Switch off all activated trigger events (`[event name]`) except 'DataArrives' with command **`SYST:PROF:TPO:STAT "Espresso","[event name]",OFF`**
- Switch on element 'DataArrives' with command **`SYST:PROF:TPO:STAT "Espresso","DataArrives",ON`**
- Activate sensor socket via SCPI command.
- **Frequency** start frequency unmodulated
- **Level Settings/Setting Characteristic** Auto
- **Level** 0 dBm
- **ALC State** on

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 2:

1. Set the analyzer to the stop frequency f_{stop}.
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. Measure the setting time for **ALC OFF (Table)**, additionally.

Recommended test frequencies and modes:

f_{start} in MHz	f_{stop} in MHz	Mode
6.5	700	CW
750	751	CW
1150	1501	CW
1500	1540	CW
3000	3001	CW
3799	3781	CW
4399	4401	CW
4759	6000	CW
6000	6001	CW
6501	6499	CW

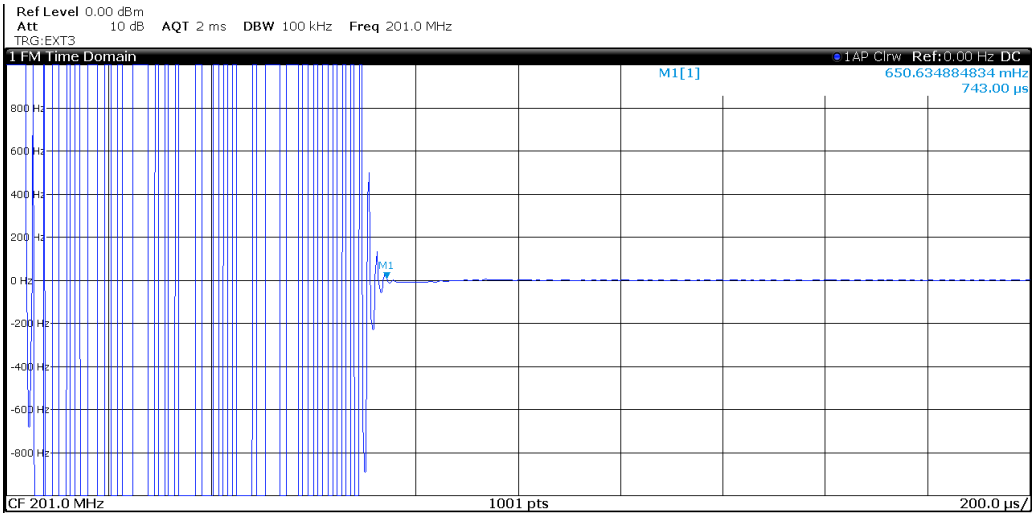
f_{start} in MHz	f_{stop} in MHz	Mode
7199	7201	CW
7799	7801	CW
8899	8901	CW
9999	10001	CW
10699	10701	CW
11699	11701	CW
12999	13001	CW
14399	14401	CW
17799	17801	CW
19499	19501	CW
199	20000	CW
20000	20000.1	CW
21599	21601	CW
21799	21801	CW
22719	22721	CW
23999	24001	CW
25199	25201	CW
27999	28001	CW
28799	28801	CW
31799	31801	CW
34399	34401	CW
39999	40001	CW
43199	43201	CW
43599	43601	CW
45439	45441	CW
47999	48001	CW
51799	51801	CW
57599	57601	CW
68799	68801	CW
199	40000	CW
199	50000	CW
21000	50000	CW

f_{start} in MHz	f_{stop} in MHz	Mode
15000	50000	CW
15000	40000	CW

Repeat the measurement with start and stop frequency interchanged.

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)

Recommended test frequencies and levels:

► Test frequencies:
Recommended test frequencies according to Table 1-2 and from RF_{min} to RF_{max} in steps of 100 MHz.
R&S SMAB-B120 option: For f > 6.67 resp. 13.33 GHz the third harmonic is outside the specified Frequency Range and has not to be measured.
R&S SMAB-B140 option: For f > 6.67 resp. 13.33 GHz the third harmonic is outside the specified Frequency Range and has not to be measured.
R&S SMAB-B150: For f > 16.7 GHz the third harmonic is outside the specified Frequency Range and has not to be measured.
R&S SMAB-B167: For f > 22.33 GHz the third harmonic is outside the specified Frequency Range and has not to be measured.
Test levels: Maximum specified level for harmonics and 0 dBm.

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
- 0.5* and 1.5*test frequency for instruments equipped with R&S SMAB-B103/B106 option.
- at 0.125*, 0.25*, 0.5*, 0.75*, 0.875*, 1.125, 1.25* and 1.5*test frequency for instruments equipped with R&S SMAB-B112/B120 option or higher frequency options.

⇨ The subharmonic spacing is the measured level referred to the reference level (dBc = referred to the carrier).

Recommended test frequencies and levels:

► Test frequencies:
Recommended test frequencies according to Table 1-2 and from RF_{min} to RF_{max} in steps of 100 MHz.
Set the first test frequency RF_{min} to 3 GHz. Choose RF_{min} to 12 GHz for instruments equipped with R&S SMAB-B711 option.
Level: 10 dBm

1.4.3.3 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:
► 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.

The measurement has to be performed with an analyzer span of 1 kHz at least.

Recommended settings and sampling frequencies:

Table 1-3: 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

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
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
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

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
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
23565.62431	23565.892442
38422.1887	38422.001462
38422.1887	38422.375938
39193.96494	39193.872677
39193.96494	39194.057203
45320.09938	45319.873471
45320.09938	45320.325289
48410.1176	48409.867387
48410.1176	48410.367813
59317.95928	59317.621636
59317.95928	59318.296924
59317.95928	59317.790458
59317.95928	59318.128102
63653.44621	63653,321305
63653.44621	63653,571115
63653.44621	63653,309668
63653.44621	63653,582752
63653.44621	63653,298024
63653.44621	63653,594396
63653.44621	63653,184764

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
63653.44621	63653,707656
63653.44621	63653,173125
63653.44621	63653,719295
63653.44621	63653,161484
63653.44621	63653,730936

Table 1-4: Additionally test Nonharmonics of the synthesis with option R&S SMAB-B711 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

1.4.3.4 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** 10 dBm
   - **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 10 MHz offset from carrier.
4. Start searching at the positive frequency deviation.

Recommended test frequencies and levels:

► Test frequencies (CW-mode, RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120):
5 MHz, 40 MHz, 520 MHz, 1499 MHz, 1501 MHz, 2000 MHz, 2700 MHz, 3001 MHz, 4 GHz and 6 GHz.
Additional measurement at 10 MHz and a level of 18 dBm at DUT.
6001 MHz, 10 GHz, 15 GHz and 20 GHz.
20.001 GHz, 29 GHz, 29.001 GHz, 35 GHz and 40 GHz.
40.001 GHz, 49.9 GHz, 60 GHz and 67 GHz.

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.

1.4.3.5 Wideband Noise

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 10 MHz (30 MHz for frequencies >6 GHz) 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
   - Set **Level** to +10 dBm
   - **Level Settings Characteristic** auto
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
   - Switch on channel power measurement with 100 kHz bandwidth
3. Measure the channel power P_{ref} with the center frequency of the analyzer set to the test frequency.
4. Increase the analyzer center frequency by 10 MHz (30 MHz for frequencies >6 GHz).
5. Inhibit the switching of the attenuator with AMPT RF ATTEN MANUAL without entering a value so that the input mixer is not overdriven.
6. Lower the reference level of the analyzer by 20 dB, measure the new channel power P_{noise}
7. 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 certainly 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.
   For a more precise evaluation in case 2 respectively mandatory for the low noise options R&S SMAB-B709/-B710/-B710N/-B711/-B711N use the following test method with a suited noise analyzer (R&S®FSWP recommended).

Use the following method for instruments equipped with R&S SMAB-B709/-B710/-B710N/-B711/-B711N option:

Test equipment:
- PhNoise/AM Noise analyzer, R&S® FSWP recommended (see Table 1-1, item 6)

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

Test method: Measure the noise power (the sum of phase noise and amplitude noise) with the analyzer.

Measurement 1:
1. Settings on DUT:
   - **Frequency** recommended test frequencies.
   - **Level** recommended test levels.
2. Settings on analyzer:
   - **Mode:** Signal source analyzer
   - **Center:** recommended test frequencies
   - **Offset frequency:** 1 MHz to 40 MHz
   - **Number of Correlations:**for example 1e5
   - **Attenuator:** 5 dB
   - **Bandwidth** 1% to 10%
3. Measure the total noise power at an offset frequency of 10 MHz or 10% of carrier frequency, whichever is lower, for frequencies ≤6 GHz. For frequencies form 6 GHz to ≤16 GHz at an offset frequency of 30 MHz and for frequencies >16 GHz at an offset frequency of 40 MHz.

Recommended test frequencies and levels:
► Recommended test frequencies:
Recommended test frequencies according to Table 1-2 ≥1 MHz and from 1 MHz to RF_{max} in steps of 500 MHz.
Recommended test level:
+10 dBm

1.4.3.6 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. A 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 10 dBm. For the measurment at 67 GHz set the Level of the DUT to 13 dBm. 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, "Test Assemblies", on page 9.

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).
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 becomes 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 have been 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 a R&S®FSWP is in use, choose the reference bandwidth of the analyzer to 100 MHz for all phase noise measurements.

Recommended test frequencies:

1. For instruments without option R&S SMAB-B709/-B710/-B710N and/or R&S SMAB-B711/-B711N:
   Measurement at 10 MHz, 100 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz, 6 GHz, 10 GHz, 20 GHz
   40 GHz
   49.9 GHz

67 GHz
with 20 kHz Offset (RF_{max} depending on installed frequency option of R&S SMAB).

2. Perform the above measurement beginning at 10 MHz 100 MHz with Offsets from 10 Hz to 10 MHz for instruments with option R&S SMAB-B709/-B710/-B710N and/or R&S SMAB-B711/-B711N.

1.4.3.7 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 9.

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. The Residual FM 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 can be used to determine the Residual FM value. If not available, perform the following procedure.

Measurement 1:

1. Settings on DUT:
   - **Frequency** 1 GHz
   - **Level** Level P_{max}, unmodulated
2. Settings on RF 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 spectrum 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 a RBW of 3 Hz and then sweep from 1 kHz to 23 kHz with a 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:

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

1.4.3.8 Residual AM

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation ", on page 12.

The RF-Signal is demodulated by an AM demodulator integrated in the spectrum analyzer. Alternatively, the RF-signal of the DUT can be demodulated with a zero Bias Schottky Detector. The demodulated signal from the detector is fed to the Spectrum analyzer RF input.

Test method: The described method is valid for demodulation 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
2. Settings on sprectrum 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 off AM
2. Settings on spectrum analyzer:
   - **RBW** 3 Hz
   - ***F*start** *20 Hz*
   - ***F*stop** *1 kHz*
   - **DETECTOR** SAMPLE

► Read Trace T(µ) with *µ ε[1, N]* and *N = 625* from spectrum 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: RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120:

or R&S SMAB-B131/-B140/-B150/-B167:

5 MHz, 50 MHz, 100 MHz, 1 GHz, 1.8 GHz, 1.801 GHz, 2.7 GHz, 2.701 GHz, 3 GHz, 3.001 GHz, 3.6 GHz, 3.601 GHz, 4.3 GHz, 4.301 GHz, 5.4 GHz, 5.401 GHz and 6 GHz

6.001 GHz, 8 GHz, 10 GHz, 12 GHz, 12.75 GHz, 14.4 GHz, 15.8 GHz, 17.8 GHz and 20 GHz

24 GHz, 25.2 GHz, 28 GHz, 28.8 GHz and 40 GHz

41 GHz

1.4.4 Checking the Level Data

1.4.4.1 Level Accuracy

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 9/10)

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:
   - **Level** test levels
   - **ALC mode** Auto
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.

Recommended test levels for frequency response measurement:
►
- **Level** 0 dBm and 20 dBm or maximum specified level, whichever is lower.
- Frequency response measurement with maximum specified level, additionally.

Recommended test frequ. for level frequency response measurement:
► 8 kHz, 20 kHz, 100 kHz, 200 kHz, 1 MHz, 3 MHz, 8 MHz, 10 MHz, 20 MHz, 52 MHz, 52.01 MHz and 12.5 MHz to 6 GHz in 25 MHz steps.
And from 6.025 GHz to RF_{max} in steps of 100 MHz.

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** 20 dBm or maximum specified level, whichever is lower, unmodulated
2. Settings on analyzer:
   - **Test frequency**
   - **SPAN** 10 Hz
   - **FILTER TYPE** FFT
   - **RES BW** 5 Hz
   - Set Marker to test frequency
   - **Reference level Pref** +21 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. As soon as 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 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 minimum specified level in 5 dB steps.

Recommended test frequencies:

► 8 kHz, 101 kHz, 8 MHz, 51 MHz, 99 MHz, 487.5 MHz and from 987.5 MHz to 5987.5 MHz in steps of 1 GHz.
From 5987.5 MHz to 11987.5 MHz in steps of 2 GHz.
From 13987.5 MHz to 19987.5 MHz in steps of 2 GHz.
From 21987.5 MHz to 29987.5 MHz in steps of 2 GHz and 31800.0 MHz .
From 33987.5 MHz to 39987.5 MHz in steps of 2 GHz.
From 41987.5 MHz to 49987.5 MHz in steps of 2 GHz.
57.987.5 MHz, 65987.5 MHz (with microwave converter at output of the DUT)

1.4.4.2 Maximum Level

Test equipment:

For instruments equipped with R&S SMAB-B103, R&S SMAB-B106:

- RF analyzer (see Table 1-1, item 19)
- Coaxial attenuator (see Table 1-1, item 21)

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

Measurement 1:

1. Settings on DUT:
   - **Frequency** recommended test frequencies
   - **Level** 20 dBm or maximum specified level, whichever is lower, unmodulated
   - **Level Limit** Set the internal level limit of the R&S SMA100B to its maximum value.
2. Settings on analyzer:
   - **Test frequency**
   - **SPAN** 10 Hz
   - **FILTER TYPE** FFT
   - **RES BW** 5 Hz
   - Set Marker to test frequency
   - **Reference level Pref** +21 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 increase the DUT level to max. settable and calculate the output power P by adding the Correction factor C to the marker readout.
5. Apply the following maximum levels.

   Table 1-5: For instruments equipped with options R&S SMAB-B103 or R&S SMAB-B106

Frequency in MHz	P_{max} in dBm without options R&S SMAB-K31/B32	P_{max} in dBm with option R&S SMAB-K31	P_{max} in dBm with option R&S SMAB-B32
0.008	≥18	≥18	≥18
0.1	≥18	≥23	≥23
1	≥19	≥27	≥27
1.000001	≥19	≥30	≥33
2	≥19	≥31	≥33
8	≥19	≥31	≥33
1000	≥19	≥30	≥33
2000	≥19	≥29	≥33
5000	≥19	≥27	≥33
6000	≥19	≥27	≥33

   Interpolate linearly between the applied limits.
6. Reset the **Level Limit** to its default value or perform a factory preset.

For Instruments equipped with R&S SMAB-B112/-B120:

Test equipment:
- RF power meter with attenuator (see Table 1-1, item 8/21)

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

Measurement 1:

1. Settings on DUT:
   - **Level** max. settable
   - **Level Limit** Set the internal level limit of the R&S SMA100B to its maximum value.
2. Settings on power meter with attenuator:
   - Enable S-parameter correction with calibration data of attenuator.
3. Measure the level P_{max} at the recommended test frequencies up to RF_{max}.
4. Apply the following maximum levels.

Table 1-6: For Instruments equipped with options R&S SMAB-B112 or R&S SMAB-B120

Frequency in MHz	P_{max} in dBm without options R&S SMAB-K33/B34	P_{max} in dBm with option R&S SMAB-K33	P_{max} in dBm with option R&S SMAB-B34 without -B81	P_{max} in dBm with option R&S SMAB-B34 with -B81
0.008	≥17	≥18	≥18	≥18
0.1	≥17	≥23	≥23	≥23
1	≥18	≥25	≥25	≥25
1.000001	≥18	≥29	≥31	≥31
2	≥18	≥30	≥31	≥31
8	≥18	≥30	≥31	≥31
1000	≥18	≥28	≥31	≥31
2000	≥18	≥27	≥31	≥31
5000	≥18	≥25.5	≥30.25	≥30.25
6000	≥18	≥25	≥30	≥30
6000.000001	≥18	≥21.65	≥27	≥26.65
8000	≥18	≥21.6	≥27	≥26.6
8000.000001	≥18	≥21.6	≥28	≥27.6
12600	≥18	≥21.485	≥28	≥27.485
13000	≥18	≥21.475	≥28	≥27.475
13000.000001	≥17	≥21.475	≥28	≥27.475
18000	≥17	≥21.35	≥28	≥27.35
19000	≥17	≥21.325	≥26.75	≥26.075
20000	≥17	≥21.3	≥25.5	≥24.8

- For Instruments equipped with optionsR&S SMAB-B131, R&S SMAB-B140(N),R&S SMAB-B150(N) or R&S SMAB-B167(N) measure the level P_{max}based on the maximum specified level of the data sheet + 1dB.

Interpolate linearly between the applied limits.

5. Reset the **Level Limit** to its default value or perform a factory preset.

Recommended test frequencies:

► Recommended test frequencies according to Table 1-2, 1.001 MHz, 2 MHz, 3 MHz, 4 MHz and from RF_{min} to RF_{max} in steps of 100 MHz.

Alternatively: Perform the maximum level measurement in pulsed mode:

Test equipment:

- See above.

Test setup:

► Connect power meter or RF analyzer with attenuator to RF output socket.

Measurement 2:

1. Settings on DUT:
   - **RF** On
   - **Level** 40 dBm
   - **Level Limit** Set the internal level limit of the R&S SMA100B to its maximum value.
   - **Frequency** recommended test frequencies
   - **Pulse Modulation** Menu:
     - **State** On
     - **Source** Internal
   - **Pulse Generator** Menu:
     - **Pulse Period** 500 µs
     - **Pulse Width** 50 µs
     - **Pulse Output State** On
2. Measure the level P_{meas} at the recommended test frequencies.
3. Calculate the maximum output level according to $P_{max}=P_{meas}+10$ dB for power meter measurements. Also consider a correction value due to the used attenuator.
4. Calculate the maximum output level according to $P_{max}=P_{meas}+20$ dB for measurements with spectrum analyzer in zerospan mode. Also consider a correction value due to the used attenuator.

1.4.4.3 Interruption-free level setting range

Test equipment:

- RF analyzer (see Table 1-1, item 19)
- Coaxial attenuator (see Table 1-1, item 21)

Test setup:

► Connect the analyzer with Coaxial attenuator to the RF output of the DUT.

Measurement 1:

1. Settings on DUT:

- **Frequencies** 5 MHz, 51 MHz, 400 MHz, 1.1 GHz, 2.2 GHz, From 3 GHz to 6 GHz in steps of 1 GHz, unmodulated.
  From 8 GHz up to RF_{max} in steps of 2 GHz and 67 GHz.
- **Level** 5.1 dBm (= Reference)
- **Level** 5.0 dBm (= Reference for R&S SMA100B with RF-Frequencies > 20 GHz)
- **Level/EMF** menu
  – **Level Settings characteristic** Uninterrupted Level Settings

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 dB	Reference
-5 dB	For Instruments equipped with R&S SMAB-B103 or R&S SMAB-B106: 0.10 dB for f < 51 MHz. 0.05 dB for 51 MHz ≤ f ≤ 6 GHz For Instruments equipped with R&S SMAB-B112, R&S SMAB-B120: 0.10 dB for f < 51 MHz. 0.05 dB for 51 MHz ≤ f ≤ 40 GHz 0.10 dB for f > 40 GHz
-10 dB	For Instruments equipped with R&S SMAB-B103 or R&S SMAB-B106: 0.15 dB for f < 51 MHz. 0.10 dB for 51 MHz ≤ f ≤ 6 GHz For Instruments equipped with R&S SMAB-B112, R&S SMAB-B120: 0.15 dB for f < 51 MHz. 0.10 dB for 51 MHz ≤ f ≤ 40 GHz 0.15 dB for f > 40 GHz
-15 dB	0.25 dB for f < 51 MHz. 0.20 dB for f ≥ 51 MHz. 0.25 dB for f > 40 GHz.
-20 dB	0.30 dB for f < 51 MHz. 0.25 dB for f ≥ 51 MHz. 0.40 dB for f > 40 MHz.

1. Repeat the measurement with the **high dynamic uniterrupted Mode** R&S SMAB-K724.
   - **Settings on DUT:**
   - **Frequencies** 52.001 MHz, 3 GHz, 6 GHz, 10 , 20 GHz, 30 GHz, 40 GHz, 41 GHz and 50 GHz.
   - **Level/EMF** menu
     - **Level Settings characteristic** High Dyn. Uninterrupted
     - **ALC-mode** Table &On
   - **Level** 0 dBm (= Reference)
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 as described in the following table and measure the deviations from the nominal level difference.

Level Difference to P_{ref}	Tolerance in dB
0	Reference
-10	<0.25 dB
-10.1	<1 dB
-20	<1 dB
-20.1	<2 dB (typ.)
-30	<2 dB (typ.)
-40	<2 dB (typ.)
-40.1	<3 dB (typ.)
-50	<3 dB (typ.)
-50.1	<4 dB (typ.)
-60	<4 dB (typ.)

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 10.

Test method: For the VSWR measurement of a source the effect of the level control must be taken into account. 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: For frequencies ≤ 6GHz

Test assembly with second signal generator and VSWR bridge.

1. Settings on DUT:

Mode	**Ampl. Stage** `cal:lev:ampl:stag`	**Ampl. Substage** `cal:lev:ampl:stag:sub`	**f_{min} in MHz**	**f_{max} in MHz**	**Level in dBm**	**LCON** `cal:lev:opu:lcon:mode`	**Detector** `Cal:lev:det:mode`	**Corr. data** `cal:lev:stat`
Active	4	3	1	3000	0	AM	AMPL	On
Passive	5	1	1	3000	10	AM	OPU	Off
Passive	5	9	1	3000	10	AM	OPU	Off
Active	4	3	3000	6000	0	AM	AMPL	On
Passive	5	1	3000	6000	10	AM	OPU	Off
Passive	5	9	3000	6000	10	AM	OPU	Off

   - **Frequency** Test frequencies
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 for each configuration in the above table. Calculate the VSWR $VSWR = V_{max} / V_{min}$.

Recommended test frequencies and levels:

► For Instruments equipped with R&S SMAB-B103 or R&S SMAB-B106:
Test frequencies: 1.01 MHz, 7.9 MHz, 10 MHz and from 50 MHz every 50 MHz up to RF_{max}

For Instruments equipped with R&S SMAB-B112, R&S SMAB-B120:
Test frequencies: 1 MHz,10 MHz, 25 MHz, from 100 MHz up to 3 GHz in steps of 100 MHz

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 11.

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 setting 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.
3. Measure the recommended steps in List Mode.
   Connect a Trigger source to External Trigger input of the spectrum analyzer and the trigger input **Inst. Trig.** of the DUT.
   Setting on DUT:
   - **ALC** Auto

   List Mode Menu:

- Generate List with recommended frequencies and levels.
- **Run Mode** Learned (frozen RF settings)
- Learn list mode data
- **Mode** Extern step
- **State** on
- **Attenuator** Auto
- Generate trigger pulses and measure the setting time.

For instruments without R&S SMAB-B86 option (remote control GPIB):

Test assembly: See Chapter 1.2.3, "Test Assembly for Setting Time", on page 11

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

Test method: A controller transmits the start and the stop frequency via the LAN interface by a remote command. The DUT sensor connector on the front panel is programmed as trigger pulse output. The analyzer is triggered by the signal generated on the DUT's sensor Trig+ and Trig- pins. At switch over from start to stop level, the setting 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 the trigger connector of the analyzer to the Trig+ and Trig- pins of the DUT's sensor connector.
4. Settings on DUT:
   - Switch on Espresso mode of sensor with command **`SYST:PROF:MOD:STAT "Espresso", ON`** and all other modes off with command **`SYST:PROF:MOD:STAT "ScpiParser", OFF`**, **`SYST:PROF:MOD:STAT "OrgLayer", OFF`**.
   - Check with query **`SYST:PROF:MOD:CAT?`**
   - Get activated trigger events with query **`SYST:PROF:TPO:CAT?.`**
   - Switch off all activated trigger events (`[event name]`) except 'DataArrives' with command **`SYST:PROF:TPO:STAT "Espresso","[event name]",OFF`**
   - Switch on element 'DataArrives' with command **`SYST:PROF:TPO:STAT "Espresso","DataArrives",ON`**
   - Activate sensor socket via SCPI command.
   - **Frequency** test frequency
   - **Level Settings/Setting Characteristic** Auto
   - **Level** start level
   - **ALC State** on
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 2:

1. Set the analyzer to the test frequency.
2. Set the DUT to the start level.
3. Send the stop level from the controller to the DUT.
   ⇨ 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.
4. Measure the recommended steps.
5. Measure the recommended steps in List Mode.
   Connect a Trigger source to External Trigger input of the spectrum analyzer and the trigger input **Inst. Trig.** of the DUT.
   Setting on DUT:
   List Mode Menu:
   - Generate List with recommended frequencies and levels.
   - **Run Mode** Learned (frozen RF settings)
   - Learn list mode data
   - **Mode** Extern step
   - **State** on
   - Generate trigger pulses and measure the setting time.

Recommended test frequencies and levels:

► Frequencies: 1 MHz, 8 MHz, 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 and 20 GHz
25 GHz, 31 GHz, 40 GHz, 50 GHz, 55 GHz, 60 GHz, 67 GHz
For instruments equipped with options R&S SMAB-B103/-B106/-B112/-B120:

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** for Instruments equipped with R&S SMAB-B120:

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

For instruments equipped with options R&S SMAB-B131/-B140/-B150/-B167:

Frequency <= 20 GHz (List-Mode and ALC Auto)		
Instruments in standard configuration		
Start level	**Stop level**	**Type of switching***
-120 dBm	5 dBm	mechanical
5 dBm	-28 dBm	mechanical
5.01 dBm	7 dBm	electronic
7 dBm	5.01 dBm	electronic
Instruments equipped with options R&S SMAB-B35/-B36/-B37/-B39		
Start level	**Stop level**	**Type of switching***
-120 dBm	13 dBm	electronic
-27.3 dBm	2.7 dBm	electronic
2.7 dBm	-27.3 dBm	electronic
Frequency > 20 GHz (ALC Auto only)		
Instruments in standard configuration		
Start level	**Stop level**	**Type of switching***
-120 dBm	7 dBm	mechanical
7 dBm	2 dBm	mechanical
7 dBm	-3 dBm	mechanical
7 dBm	-13 dBm	mechanical
7 dBm	-28 dBm	mechanical
5.01 dBm	7 dBm	electronic
7 dBm	5.01 dBm	electronic
Frequency > 20 GHz (ALC Auto only)		
Instruments equipped with options R&S SMAB-B35/-B36/-B37/-B39		
Start level	**Stop level**	**Type of switching***
-120 dBm	13 dBm	mechanical
7 dBm	2 dBm	mechanical
7 dBm	-3 dBm	mechanical
7 dBm	-13 dBm	mechanical
7 dBm	-28 dBm	mechanical
5.01 dBm	13 dBm	electronic
13 dBm	5.01 dBm	electronic

*For appropriate specified setting times see datasheet.

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 a 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 Output Voltage Accuracy and Frequency Response

Output Voltage 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** Menu:
  - **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 , 2 V, 3 V and 4 V.

Frequency Response

Accredited calibration:

No minimum requirement.

Test equipment:

- Power sensor for lower frequencies (see Table 1-1, item 8)

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Test method:

The output level of the LF Generator is measured directly with the power sensor.

Test setup:

► Connect the power sensor to the LF socket of the DUT.

Measurement of frequency response:

1. Settings on DUT:
   - **LF Output** Menu:
     - **LF Output Voltage** 1 V
     - Set **LF Gen Frequency** to recommended test frequencies and measure the output level.
2. Determine the highest and the lowest level V_{max} and V_{min}
   The frequency response in dB is defined as:
   $D = 20*\log_{10}(V_{max}) - 20*\log_{10}(V_{min})$

Recommended test frequencies:

10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

For instruments with R&S SMAB-K24 option additionally check

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 (THD) 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** Menu:
     – **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.

1.4.6 Checking the Amplitude Modulation

1.4.6.1 AM depth error

Accredited calibration:

No minimum requirement.

Test assembly:

See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation ", on page 12.

Measurement of accuracy versus modulation depth:

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
- **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.
   The AM depth error must be within the datasheet limits.

Recommended test frequencies:

5 MHz, 150 MHz, 1 GHz, 6 GHz, 10 GHz (Option R&S SMAB-B112 or higher) , 20 GHz (Option R&S SMAB-B120)

26 GHz (Option R&S SMAB-B13x or higher), 40 GHz (Option R&S SMAB-B140 or higher), 50 GHz (Option R&S SMAB-B150 or higher), 67 GHz (Option R&S SMAB-B167).

Recommended modulation depths:

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

Repeat measurement at 150 MHz with AM Depth 30% and Modulation Source **Ext. 1** and **Ext. 2**.

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: 100 kHz, 200 kHz, 1 MHz, 8 MHz, 20 MHz, 51 MHz, 100 MHz, 1 GHz, 2 GHz, 3 GHz, 4 GHz up to RF_{max} in steps of 2 GHz.

1.4.6.2 AM Distortion

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation ", on page 12.

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 spectrum analyzer:
   - **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 %.

Recommended test frequencies: 100 kHz; 200 kHz; 8 MHz; 20 MHz; 51 MHz; 100 MHz; 1 GHz; 2 GHz; 3 GHz, 4 GHz up to 50 GHz in steps of 2 GHz.

1.4.6.3 AM Frequency Response

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation ", on page 12.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Frequency** 1 GHz
   - **Level** 0 dBm
   - **Amplitude Modulation** Menu:
     - **AM Path 1 Source** External 1
     - **AM Path 1 depth** 60 %
   - **Modulation Sources** Menu:
     - **External 1 Coupling** DC
     - **Impedance** High
2. Settings on spectrum analyzer:
   - **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	5 kHz	10 kHz	30 kHz	50 kHz	80 kHz	100 kHz
MEAS TIME	0.8 s	0.2 s	0.2 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
     - **Impedance** High
5. Repeat the measurement with the External 2 connector as modulation source and with the internal modulation generator.

- **Amplitude Modulation** Menu:
  - **External 2 Coupling** AC
    Impedance High
  - **AM Path 2 Source** LF Generator 1

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 12.

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**

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

Recommended test frequencies: 100 kHz, 200 kHz, 8 MHz, from 10 MHz to 100 MHz in steps of 10 MHz, from 200 MHz to 900 MHz in steps of 100 MHz, from 1 GHz to 6 GHz in steps of 200 MHz,

and from 6 GHz up to 20 GHz in steps of 2 GHz.

1.4.7 Checking the Frequency Modulation (Option R&S SMAB-K720)

Test assembly: See Chapter 1.2.4, "Standard Test Assembly for Analog Modulation ", on page 12.

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 spectrum analyzer:
   - **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 12.

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.

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

Recommended settings:

1. Measurement in **FM Mode** High Bandwidth

Center Frequency in MHz	LF Gen Frequency in kHz	FM Deviation in kHz
8	10	2500
350	10	2500
350.1	10	1250
750.1	10	5000
1000	10	5000
1500	10	5000

For higher frequencies perform the measurement according to the following table (RF_{max} depending on installed frequency option:

Center Frequency in MHz	LF Gen Frequency in kHz	FM Deviation in kHz
3000	10	100
6000	10	100
8000	10	100
10000	10	100
12000	10	100

Center Frequency in MHz	LF Gen Frequency in kHz	FM Deviation in kHz
15000	10	100
20000	10	100
40000	10	100
67000	10	100

2. Measurement in **FM Mode** Low Noise

Center Frequency in MHz	LF Gen Frequency in kHz	FM Deviation in kHz
8	10	50
750.1	10	50
1000	10	50
1500	10	50

For higher frequencies perform the measurement according to the following table (RF_{max} depending on installed frequency option:

Center Frequency in MHz	LF Gen Frequency in kHz	FM Deviation in kHz
3000	10	100
6000	10	100
8000	10	100
10000	10	100
12000	10	100
15000	10	100
20000	10	100
40000	10	100
67000	10	100

3. Repeat the measurement in **FM Mode** High Bandwidth with FM source **external** and the follwoing settings.

Center Frequency in MHz	LF Gen Frequency in kHz	FM Deviation in kHz
1000	10	5000

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 12.

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.

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
   - **Modulation sources** Menu.
     - **LF Generator 1 Frequency** 10 kHz
2. Settings on spectrum analyzer:
   - **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 ^ (THD_{dB}/20)

Recommended settings:

1. Measurement in **FM Mode** High Bandwidth:

Center Frequency in MHz	FM Deviation in kHz
8	500
350	500
350.1	250
750.1	1000
1000	1000
1350.01	1000
1500	1000
3000	2000
6000	4000
8000	8000
12000	8000
20000	10000
40000	10000
49900	10000
67000	10000

2. Measurement in **FM Mode** Low Noise (RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120/-B131/-B140(N)/-B150(N)/-B167(N)):

Center Frequency in MHz	FM Deviation in kHz
750.1	100
1000	100
1500	100
3000	200
6000	400
8000	800
12000	800
20000	1600
40000	3200
49900	3200
67000	3200

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 12.

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.

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.
   - It is recommended to use an AC voltmeter (see Table 1-1, item 15) 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 spectrum analyzer:

- 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. Measurement in **FM Mode** High Bandwidth (RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120/-B131/-B140(N)/-B150(N)/-B167(N)):

Center Frequency in MHz	Mod-Source	F mod	FM Deviation in kHz
8	Int., Ext. DC	10 Hz … 1 MHz	100
8.1	Ext. AC	10 Hz … 1 MHz	2500
46.8	Ext. AC	1 kHz … 5 MHz	5000
350	Ext. AC	1 kHz … 10 MHz	5000
375	Ext. AC	1 kHz … 10 MHz	2500
630	Ext. AC	1 kHz … 10 MHz	5000
1000	Int.	1 kHz … 10 MHz	5000
1500	Ext. AC	1 kHz … 10 MHz	5000
3000	Ext. AC	1 kHz … 10 MHz	5000
4800	Ext. AC	1 kHz … 10 MHz	5000
5400	Ext. AC	1 kHz … 10 MHz	5000
6000	Ext. AC	1 kHz … 10 MHz	5000
8000	Ext. AC	1 kHz … 10 MHz	8000
10000	Ext. AC	1 kHz … 10 MHz	8000
12000	Ext. AC	1 kHz … 10 MHz	8000
15000	Ext. AC	1 kHz … 10 MHz	8000
20000	Ext. AC	1 kHz … 10 MHz	10000
40000	Ext. AC	1 kHz … 10 MHz	10000
49900	Ext. AC	1 kHz … 10 MHz	10000
67000	Ext. AC	1 kHz … 10 MHz	10000

3. Measurement in **FM Mode** Low Noise (RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120/-B131/-B140(N)/-B150(N)/-B167(N)):

Center Frequency in MHz	Mod-Source	F mod	FM Deviation in kHz
8	Int., Ext. DC	10 Hz … 1 MHz	50
350	Ext. AC	1 kHz … f_{stop}	25
350.1	Ext. AC	1 kHz … f_{stop}	25
750.1	Ext. AC	1 kHz … f_{stop}	100
1000	Ext. AC	1 kHz … f_{stop}	100
4800	Ext. AC	1 kHz … f_{stop}	100
5600	Ext. AC	1 kHz … f_{stop}	200
6000	Ext. AC	1 kHz … f_{stop}	400
8000	Ext. AC	1 kHz … f_{stop}	800
10000	Ext. AC	1 kHz … f_{stop}	800
12000	Ext. AC	1 kHz … f_{stop}	800
15000	Ext. AC	1 kHz … f_{stop}	800
20000	Ext. AC	1 kHz … f_{stop}	1600
40000	Ext. AC	1 kHz … f_{stop}	3200
49900	Ext. AC	1 kHz … f_{stop}	3200
67000	Ext. AC	1 kHz … f_{stop}	6400

f_{stop} = 100 kHz.

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 12.

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** High Bandwidth
     - **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.

Test frequencies: 8.001 MHz, 350 MHz, 350.001 MHz, 750.1 MHz, 1000 MHz, 1500 MHz, 3 GHz, 6 GHz, 8 GHz, 12 GHz and 20 GHz.

26 GHz, 40 GHz, 50 GHz and 67 GHz.

(RF_{max} depending on installed frequency option).

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 12.

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

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 12.

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.

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 (Option R&S SMAB-K720)", on page 58.

Recommended settings:

1. Measurement in **PhiM** High Dev

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad
8	10	5
350	10	5
350.1	10	2.5
750.0	10	2.5
1000	10	10
1500.1	10	20

For higher frequencies perform the measurement according to the following table (RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120/B131/B140(N)/B150(N)/B167(N):

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad
3000.1	10	40
3500	10	40
4900	10	40
5400	10	40
6000	10	40
8000	10	80
12000	10	80
20000	10	160
40000	10	320
49900	10	320
60000	10	640

2. Measurement in **PhiM Mode** High BW

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad
500	10	0.001
500	10	0.01
500	10	0.1
500	10	0.5

3. Measurement in **PhiM Mode** Low Noise

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad
8	10	0.0625
1000	10	0.125
1500.1	10	0.25

For higher frequencies perform the measurement according to the following table (RF_{max} depending on installed option R&S SMAB-B103/-B106/-B112/-B120/B131/B140(N)/B150(N)/B167(N):

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad
3000.1	10	0.5
6000	10	0.5
8000	10	1
12000	10	1

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad
20000	10	2
40000	10	4
49900	10	4

4. Repeat the measurement with PhiM source **external** and the follwoing settings.

Center Frequency in MHz	LF Gen Frequency in kHz	PhiM Deviation in rad	PhiM Mode
70.687	10	0.5	High BW
1000	10	0.125	Low Noise
3000	10	40	High Dev

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 12.

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.

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 spectrum analyzer:
   - See Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.
   - **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 ^ (THD_{dB}/20)

Recommended settings:

1. CF sweep:

- Instruments equipped with R&S SMAB-B103 or R&S SMAB-B106:
  8 MHz, 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.
  Instruments equipped with R&S SMAB-B112 or R&S SMAB-B120:
  8 MHz, 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, 10 GHz, 12.75 GHz and 20 GHz.
  Instruments equipped with R&S SMAB-B131 or R&S SMAB-B140(N):
  8 MHz, 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, 10 GHz, 12.75 GHz, 20 GHz, 27 GHz, 33 GHz (only B140(N)) and 40 GHz (only B140(N)).
  Instruments equipped with R&S SMAB-B150 :
  8 MHz, 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, 10 GHz, 12.75 GHz, 20 GHz, 27 GHz, 33 GHz and 40 GHz, 49,9 GHz.
  Instruments equipped with R&S SMAB-B167 :
  8 MHz, 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, 10 GHz, 12.75 GHz, 20 GHz, 27 GHz, 33 GHz and 40 GHz, 49,9 GHz, 67 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 12.

Test method: FFT Demodulation, see Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.

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) 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 spectrum analyzer:
   - See Chapter 1.4.7, "Checking the Frequency Modulation (Option R&S SMAB-K720)", on page 58.
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 kHz 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.:
     Instruments equipped with R&S SMAB-B103 or R&S SMAB-B106:
     RF = 187.4 MHz, deviation = 0.125 rad, f_{mod} = 10 kHz … 5 MHz
     RF = 3001 MHz, 4 GHz and 5.4 GHz, deviation = 0.125 rad, f_{mod} = 10 kHz … 10 MHz
     Instruments equipped with R&S SMAB-B112 or R&S SMAB-B120:
     RF = 187.4 MHz deviation = 0.125 rad, f_{mod} = 10 kHz … 5 MHz
     RF = 3001 MHz, 4 GHz, 5.4 GHz, 6.5 GHz, 10 GHz, 12.75 GHz, 15 GHz (only B120) and 20 GHz (only B120), deviation = 0.125 rad, f_{mod} = 10 kHz … 10 MHz
     Instruments equipped with R&S SMAB-B131 or R&S SMAB-B140(N):
     RF = 187.4 MHz deviation = 0.125 rad, f_{mod} = 10 kHz … 5 MHz
     RF = 3001 MHz, 4 GHz, 5.4 GHz, 6.5 GHz, 10 GHz, 12.75 GHz, 15 GHz, 20 GHz, 27 GHz, 33 GHz (only B140) and 40 GHz (only B140), deviation = 0.125 rad, f_{mod} = 10 kHz … 10 MHz
     Instruments equipped with R&S SMAB-B150(N), R&S SMAB-B167(N):
     RF = 187.4 MHz deviation = 0.125 rad, f_{mod} = 10 kHz … 5 MHz
     RF = 3001 MHz, 4 GHz, 5.4 GHz, 6.5 GHz, 10 GHz, 12.75 GHz, 15 GHz, 20 GHz, 27 GHz, 33 GHz, 40 GHz, 49,9 GHz, deviation = 0.125 rad, f_{mod} = 10 kHz … 10 MHz
   - in Mode Low Noise
     RF = 500 MHz, deviation = 0.125 rad, f_{mod} = 1 kHz … 100 kHz

1.4.9 Checking the Pulse Modulation

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, 50 MHz, 150 MHz, 400 MHz and from 1 GHz to RF_{max} in steps of 100 MHz.

From 20 GHz to RF_{max} in steps of 250 MHz.

Recommended test level: P_{min}

Factory limits: Increase datasheet limit by 2 dB.

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 12.

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

For the options R&S SMAB-B131/-B140/-B150/-B167 connect a low barrier schottky diode to the RF output socket of the DUT to measure the pulse modulation as outlined in Measurement 2.

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 phase using menu RF Mod / Frequency / 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.

Measurement 2: For the R&S SMAB-B131/-B140/-B150/-B167 options use a low barrier schottky diode instead of the mixer.

1. Setting on pulse generator:

- For measurement square wave pulse sequence with a frequency of 1 MHz, TTL level

2. Settings on DUT:
   - **RF** On
   - **Level** 20 dBm or max. spec. level, whichever is lower.
   - **Frequency** recommended test frequencies
   - **Pulse Modulation** Menu:
     - **State** On
     - **Transition Type** Smoothed
3. Settings on oscilloscope:
   - Adjust V/div according to the diode in use.
   - Time base 20 ns/div
   - Trigger: 50 % of signal amplitude, rising and falling edge
4. Measurement:
   - Evaluate the envelope of the pulse-modulated signal on the oscilloscope like above.
   - Repeat the measurement in Pulse Modulation mode **Transition Type** fast.

Recommended test frequencies:

Mode **Transistion Type** smoothed: 700 MHz and from 1 GHz to 6 GHz in steps of 1 GHz.

Mode **Transistion Type** fast: 700 MHz and from 1 GHz to 6 GHz in steps of 1 GHz

8 GHz to RF_{max} in steps of 2 GHz.

(RF_{max} depending on installed frequency option, max. 50 GHz). For the R&S SMAB-B131 options or higher use a low barrier schottky diode instead of the mixer.

1.4.9.3 Video Feedthrough

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** recommended test frequencies

- **Level** +10 dBm or maximum specified level, whichever is lower.
- **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.

Recommended test frequencies:

Options R&S SMAB-B103/-B106: 2.0 GHz, 3.0 GHz, 3.000001 GHz and 6.0 GHz.

Option R&S SMAB-B112: Additionally 6.000001 GHz and 12.0 GHz.

Option R&S SMAB-B120: Additionally 20.0 GHz.

Options R&S SMAB-B140/B150: Additionally 40.0 GHz.

Option R&S SMAB-B167: Additionally 67.0 GHz.

1.4.10 Checking the Scan Modulation (Option R&S SMAB-K721)

Accredited calibration:

No minimum requirement.

Test assembly:

See Chapter 1.2.7, "Test Assembly for Scan Modulation ", on page 14.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Frequency** Recommended test frequencies
   - **Level** -10 dBm, +10/+15 dBm for devices without/with R&S SMAB-B32/B34
   - **Scan Modulation Menu:**
     - **AM Mode** Scan
     - **AM State** On
     - **Modulation Source** External EXT1
     - **Sensitivity** Exponential 10 dB/V
2. Settings on adjustable DC supply:
   - **DC voltage** 0 V, -0.3 V, -0.5 V to -6 V in steps of -1.0 V.
3. Settings on spectrum analyzer:

- **AMPTD** ⇨ **REF LEVEL** Level setting +5 dB
- **FREQ** ⇨ **CENTER** test frequency
- **ATT** ⇨ **Auto**
- **SPAN** ⇨ **ZeroSpan** 0 Hz
- **BW** ⇨ 100 Hz

4. Measure the RF power level in zero span mode for all frequencies depending on the applied DC voltage beginning with 0 V.
5. Repeat the measurement with modulation source EXT2, Input Sensitivity 100 dB/V and DC Voltage 0 V to -1 V in steps of -0.1 V.
6. Repeat the measurement with internal modulation source PULSE, period 200 ms, width 100 ms and depth settings 10 dB, 60 dB and read the upper and lower RF power levels.

Evaluation: Check the attenuation error according to the datasheet specifications. The displayed RF power on the analyzer should change exponentially scaled (linearly in dB) according to the applied DC voltage.

Example: DC voltage changed from 0 V to -6 V on EXT1, with a sensitivity of 10 dB/V the relative change in the displayed RF power on the analyzer should be -60 dB.

Recommended test frequencies:

For internal modulation:

52.001 MHz, 100 MHz, 190 MHz to 5.99 GHz in steps of 200 MHz, 6.01 GHz

and from 6.99 GHz up to RF_{max} in steps of 1 GHz

For external modulation:

52.001 MHz, 100 MHz, 200 MHz, 350 MHz, 351 MHz, 500 MHz, 1.01 GHz, 1.5 GHz, 2 GHz, 3 GHz, 4 GHz, 6 GHz

6.01 GHz and from 8 GHz to RF_{max} in steps of 2 GHz.

Factory limits: Attenuation control 0...10 dB: ±0.2 dB,

>40 GHz ±0.5 dB.

Attenuation control 10...20 dB: ±0.9 dB

Attenuation control 20...40 dB: ±2.0 dB

Attenuation control 40...50 dB: ±3.0 dB

Attenuation control 50...70 dB: ±4.0 dB

1.4.11 Checking the Ramp sweep (Option R&S SMAB-B28)

1.4.11.1 Marker accuracy

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.8, "Test Assembly for Ramp Sweep ", on page 14. Connect the STOP output of the DUT to the 2nd channel of the oscilloscope, additionally.

Measurement method: Measurement of the frequency/marker accuracy via FM demodulation. The ramp sweep at the DUT is activated and the marker frequency is defined. When the sweep reaches the set marker frequency, the analyzer is triggered measuring the frequency deviation via the FM demodulator.

Measurement 1:

1. Settings on DUT:
   - **RF** On
   - **Modulation** Off
   - **Level** 0 dBm
   - **Frequency** Frequency sweep
   - **Frequency sweep** Menu:
     - **State** On
     - **Sweep Type** Ramp
     - **Mode** Single
     - **Start frequency** see table
     - **Stop frequency** see table
     - **Sweep time** see table
     - **Trigger Slope** Pos
     - **Edit Marker**
       Marker 1 State on
       Marker 1 Freq. see table
2. Settings on spectrum analyzer:
   - **Center frequency** Marker 1 frequency (see table)
   - **Mode** Analog Demod
   - **Meas Menu** FM Time Domain
   - **Trigger source** External
   - **Trigger Delay** -12.5µs
   - **Trigger level** 1.5 V
   - **Trigger slope** Positive
   - **Meas time** 25 µs
   - **Demod bandwidth** 28 MHz
   - **Deviation per div** 2 MHz
   - **Trace1:** Max. hold
   - **Trace2:** Min. hold
   - **Sweep** Single
   - **Number of sweeps** 5
3. Settings on oscilloscope:
   - **Y-Scale** 2V/div
   - **Time base** 50ms/div
   - **Trigger** Norm, rising slope
4. Measure the greatest frequency deviation (absolute value, min. or max.).

Evaluation:

Frequency/marker accuracy: (0.005% of span) / (Sweep time in sec).

Example: Span 1.5 GHz, sweep time 12 ms ⇨ frequency/marker accuracy = 75 kHz / 12 ms = 6.25 MHz.

Recommended test frequencies:

Test sweep	Start Frequency	Stop Frequency	Sweep Time	Marker Frequencies
All instruments	8.001 MHz	3 GHz	96 ms	52.001 GHz, 100 MHz, 375 MHz, 375.001 MHz, 1 GHz, 1.5 GHz, 1.501 GHz, 3 GHz
All instruments	1.5 GHz + 1 Hz	3 GHz	12 ms	1.5 GHz + 1 Hz, 1.6 GHz to 3 GHz in steps of 100 MHz
All instruments	1.5 GHz + 1 Hz	3 GHz	200 ms	1.5 GHz + 1 Hz, 1.6 GHz to 3 GHz in steps of 100 MHz
Instruments with f_{max}=12.75 GHz	3 GHz + 1 Hz	12.75 GHz	39 ms	3 GHz + 1 Hz, 4 GHz to 12 GHz in steps of 1 GHz, 12.75 GHz
Instruments with f_{max}=20 GHz	3 GHz + 1 Hz	20 GHz	68 ms	3 GHz + 1 Hz, 4 GHz to 20 GHz in steps of 1 GHz
Instruments with f_{max}=31.8 GHz	3 GHz + 1 Hz	31.8 GHz	115 ms	3 GHz + 1 Hz, 4 GHz to 31.8 GHz in steps of 1 GHz
Instruments with f_{max}=40 GHz	3 GHz + 1 Hz	40 GHz	115 ms	3 GHz + 1 Hz, 4 GHz to 40 GHz in steps of 1 GHz
Instruments with f_{max}=50 GHz	3 GHz + 1 Hz	50 GHz	188 ms	3 GHz + 1 Hz, 4 GHz to 50 GHz in steps of 1 GHz
Instruments with f_{max}=67 GHz	3 GHz + 1 Hz	50 GHz	256 ms	3 GHz + 1 Hz, 4 GHz to 50 GHz in steps of 1 GHz

1.4.11.2 x-Axis

Accredited calibration:

No minimum requirement.

Test equipment:

- Oscilloscope (see Table 1-1, item 7)

Test setup:

Apply connection from x-Axis socket on the rear of the DUT to a channel of oscilloscope and establish connection from Marker socket on the rear of the R&S SMA100B to a trigger input of the oscilloscope.

Test method:

The function of the signal is tested by selecting a linear frequency sweep on the DUT.

Measurement 1:

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

- **Level** 0 dBm
- **Frequency** Frequency sweep
- **Frequency sweep** Menu:
  - **State** On
  - **Sweep Type** Ramp
  - **Mode** Auto
  - **Start frequency** 1 GHz
  - **Stop frequency** 3 GHz
  - **Marker 1 frequency** recommended test marker frequencies
  - **Sweep time** 100 ms
  - **Connector Mode** X-Axis

2. Settings on oscilloscope:
   - **Y-Scale** 2 V/div
   - **Time base** 50 ms/div
   - **Trigger** Norm, rising slope
   - **Trigger level** 1 V
3. Check the x-Axis output signal on the oscilloscope at the marker signal edge. The nominal voltage range is 0 V … 10 V. The measured voltage shall derive from the nominal value by ±2 % of nominal value ±50 mV max.
4. Repeat the measurement with DUT setting
   - **Frequency Sweep** Menu:
     - **Connector Mode** 1 V/GHz

   The measured voltage shall derive from the nominal value by ±2 % of nominal value ±50 mV max.
5. Repeat the measurement with DUT setting
   - **Frequency Sweep** Menu:
     - **Connector Mode** 0.5 V/GHz

   The measured voltage shall derive from the nominal value by ±2 % of nominal value ±50 mV max.
6. Repeat the measurement with DUT setting
   - **Frequency Sweep** Menu:
     - **Connector Mode** 0.25 V/GHz

   The measured voltage shall derive from the nominal value by ±2 % of nominal value ±50 mV max.

Recommended test frequencies: 1 GHz, 2 GHz, 3 GHz.

1.4.12 Checking Avionics VOR/ILS Modulation (Option R&S SMAB-K25)

Accredited calibration: No minimum requirement.

Test equipment: RF analyzer FSW with FSW-K15

1.4.12.1 VOR

1. Settings on Analyser:
   - **Frequency** 113 MHz
   - **Mode:** Avionics
2. Settings on DUT:
   - **Frequency** 113 MHz
   - **Level** 2 dBm
   - **RF** On
   - **Avionic Standards** Menu:
     - **VOR** State On
     - **Bearing Angle** 0 to 360 deg in 45° steps
     - **Operating Mode** Norm
3. Check the signal for:
   - **Var (30 Hz)** Depth
   - **Subcarr. 9.96 kHz** Depth
   - **COM / ID (1020 Hz)** Depth
   - **Subcarr. 9.96 kHz** Deviation
   - **Bearing Angle** 0 to 360 deg in 45° steps

1.4.12.2 ILS LOC

1. Settings on Analyser:
   - **Frequency** 113 MHz
   - **Mode:** Avionics
2. Settings on DUT:
   - **Frequency** 113 MHz
   - **Level** 2 dBm
   - **RF** On
   - **Avionic Standards** Menu:
     - **ILS** State On
     - **Operating Mode** Norm
3. Check the signal for:
   - **COM / ID (1020 Hz)** Depth
   - **SDM 40** %
   - **SDM 80** %
   - **DDM 0.0**
   - **DDM +0.4**

- **DDM -0.4**
- **Left / Right Phase**0 deg

1.4.12.3 ILS GS

1. Settings on Analyser:
   - **Frequency** 333 MHz
   - **Mode:** Avionics
2. Settings on DUT:
   - **Frequency** 333 MHz
   - **Level** 2 dBm
   - **RF** On
   - **Avionic Standards** Menu:
     - **ILS** State On
     - **ILS Componente** Glide Slope
     - **Operating Mode** Norm
3. Check the signal for:
   - **SDM 40** %
   - **SDM 80** %
   - **DDM 0.0**
   - **DDM +0.8**
   - **DDM -0.8**
   - **Left / Right Phase**0 deg

1.4.12.4 Marker Beacon

1. Settings on Analyser:
   - **Frequency** 75 MHz
   - **Mode:** Analog Demodulation
2. Settings on DUT:
   - **Frequency** 75 MHz
   - **Level** 2 dBm
   - **RF** On
   - **Avionic Standards** Menu:
     - **ILS** State On
     - **ILS Componente** Marker Beacons
     - **Operating Mode** Norm
3. Check the signal for:
   - **COM / ID (1020 Hz)** Depth
   - **Marker 400 Hz** Depth

- **Marker 1300 Hz** Depth
- **Marker 3000 Hz** Depth

1.4.12.5 VOR / ILS External AM

1. Settings on Analyser:
   - **Frequency** 113 MHz
   - **Mode:** Avionics
2. Settings on LO:
   - **LF-Generator** On
   - **Output Voltage** 1kHz / 0.5 Vpeak (to the Ext 1 Input of the DUT)
3. Settings on DUT:
   - **Frequency** 113 MHz
   - **Level** 2 dBm
   - **RF** On
   - **Avionic Standards** Menu:
     - **Ext** Mode AM
     - **Operating Mode** Norm
4. Check the signal for:

1.4.13 Checking the Pulse Generator

1.4.13.1 PULSE VIDEO Signal

Accredited calibration: No minimum requirement.

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

Test setup:
1. Connect the PULSE VIDEO socket on the rear of the DUT to the oscilloscope.
2. Connect the PULSE SYNC output socket of the DUT to the second channel of the oscilloscope.

Measurement 1:
1. Settings on DUT:
   - **Pulse Modulation menu**
     - **State** On
     - **Source** Pulse Generator
   - **Pulse Generator** Menu:
     - **State** On
     - **Pulse Period** 100 ns
     - **Pulse Width** 50 ns

2. Settings on oscilloscope:
   - **Amplitude** 1 V/Div
   - **Time base** 25 ns/Div
   - **Trigger Level** 2 V
   - **Trigger Slope** rising edge
   - **Trigger source** Channel with VIDEO signal
3. Check the signal for
   - 50 ns ± 3 ns pulse width
   - 100 ns ± 2 ns pulse period
   - 2 V to 3.3 V amplitude
   - Rise and fall time < 5 ns.
4. Check the PULSE SYNC output for synchronous timing with the start of the VIDEO signal.

1.4.14 Clock Synthesis (R&S SMAB-B29 option)

Valid for R&S SMA100B equipped with R&S SMAB-B29 option.

1.4.14.1 Checking the Frequency Accuracy

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 ⇨ "CSynVco"
There must be no error message.

Setting Time

Accredited calibration: No minimum requirement.

Test assembly: See Chapter 1.2.3, "Test Assembly for Setting Time", on page 11.

Test setup: Connect analyzer to clock synthesis output socket CLK_SYN.

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. At switch over from start to stop frequency, the setting 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 GPIB and RF connections.
3. Connect spectrum analyzers trigger connector to EOI line (pin 5) of IEC/IEEE bus.

4. Settings on DUT:
   - **Clock Synthesis Frequency** start frequency f_{start}
   - **Output Type:** Single ended sinus
5. Settings on spectrum analyzer:
   - **AMPT/REF LEVEL** 0 dBm
   - **FREQ/CENTER** stop frequency f_{stop}
   - **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:

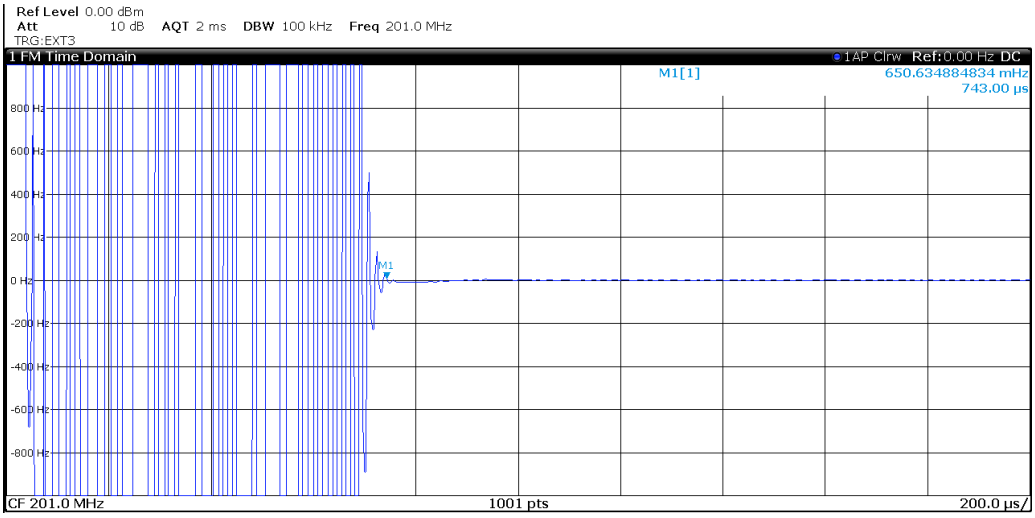
1. Set the analyzer to the stop frequency f_{stop}.
2. Set the clock synthesis to the start frequency f_{start} .
3. Send the stop frequency f_{stop} from the controller to the DUT.
   ⇨ The externally triggered analyzer displays the settling curve. The setting time is defined as the time required to 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.

Recommended test frequencies and modes:

f_{start}	f_{stop}	Mode
5 MHz	1500 MHz	Single ended sine wave
1500 MHz	5 MHz	Single ended sine wave
950 MHz	1500 MHz	Single ended sine wave
1500 MHz	950 MHz	Single ended sine wave
1214 MHz	950 MHz	Single ended sine wave
950 MHz	1214 MHz	Single ended sine wave
1500 MHz	6000 MHz	Single ended sine wave
6000 MHz	1500 MHz	Single ended sine wave
3001 MHz	6000 MHz	Single ended sine wave
6000 MHz	3001 MHz	Single ended sine wave

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.

1.4.14.2 Checking the Level Data

Level Uncertainty

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

Test method: The level uncertainty is measured with a power meter.

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

Test setup:
► Connect power meter to CLK_SYN resp. CLK_SYN_N output socket. Connect a 50Ω termination to the unused output CLK_SYN_N resp. CLK_SYN.

Measurement 1:

1. Settings on DUT:
   - **Clock Synthesis Level** test levels
   - **Clock Synthesis Frequency** recommended test frequencies
   - **Output Type**
     – Differential sinus.
     – Single ended sinus.
2. Measure the level $P_{absolute}$ at the recommended test frequencies up to 6 GHz for each of the stated output types.
   ⇨The level error is the deviation of the measured level from the set value.

Recommended test levels for frequency response measurement:
► 8 dBm, 0 dBm, -10 dBm for output type "Differential"
10 dBm, 0 dBm, -10 dBm for output type "Single Ended"

Recommended test frequ. for level frequency response measurement:
► in logarithmic spacings of 4 per decade. 10 MHz to 6 GHz for output type "Differential"

100 kHz to 6 GHz for output type "Single Ended"

Frequency response

Accredited calibration: No minimum requirement.

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

Test method: The output level over frequency of the clock synthesis output is measured directly with the power meter.

Test setup: See "Level Uncertainty" on page 84.

Measurement of frequency response:
1. Settings on DUT:
   - **Clock Synthesis Frequency:** Recommended test frequencies.
   - **Clock Synthesis Level:** Max. spec. output level.
   - **Output Type:** Single ended sinus.
2. The frequency response shall be < 1.0dB for frequencies ≤ 3 GHz and < 3.0 dB for frequencies > 3 GHz.

Recommended test frequencies: 100 kHz to 6 GHz in logarithmic spacings of 4 per decade.

DC offset

Accredited calibration: No minimum requirement.

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

Test setup:
► Connect AC/DC voltmeter to clock synthesis output socket CLK_SYN.

Measurement 1:
1. Settings on DUT:
   - **Clock Synthesis Frequency:** 100 kHz.
   - **DC offset:** recommended test voltages
   - **DC offset state** On
   - **Output Type:** single ended sinus.
2. Settings on AC/DC voltmeter:
   - **Mode:** DC voltage
   - **Range:** ±5 V
3. Measure the DC offset with the voltmeter.

Recommended test voltages for DC offset:

0 V, ±(0.2, 0.5, 1, 2, 5) V; tolerance ±50 mV.

1.4.14.3 Checking the Spectral Purity

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 clock synthesis output socket CLK_SYN of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.
3. Settings on DUT:
   - **Clock Synthesis Frequency:** recommended test frequencies
   - **Clock Synthesis Level:** Max. output voltage.
   - **Output Type:** Single ended sinus.
4. Recommended settings on analyzer:
   - **Detector:** Max peak.
   - **Filter type:** FFT.
   - **Average count:** 10.

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 1-7: Nonharmonics of the clock synthesis

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

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
1009.0	1000.0
1143.57492185	1143.65170185
2687.65901751	2663.78891560
2753.64970188	2778.26354444
2817.60902012	2842.19411835
2850.18852044	2874.97540419
2883.10219411	2908.20519646
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
5382.20763422	5407.39004074
5448.79148190	5423.13661472
5456.07632442	5456.20952442
5456.07632442	5455.94312442
5509.62388183	5534.67018543
5642.15482047	5616.30848948
5798.85829906	5799.01574906
5828.28943589	5803.53524936
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

Setting on DUT (Frequency in MHz)	Analyzer search frequency (in MHz)
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

Non-systematic nonharmonics:

Measurement 2: Measure the non-systematic nonharmonics with the following settings:

1. **Settings on DUT:**
   - **Clock Synthesis Frequency:**Test frequencies: 10.0; 275.1; 766.1; 1333.1 MHz, for extensive tests use random frequencies.
   - **Clock Synthesis Level:** Max. output voltage.
   - **Output Type:** Single ended sine wave.
2. **Measurement range:** 10 kHz to 20 MHz from carrier
3. **Recommended settings for span and resolution bandwith:**

Offset in kHz	Span in kHz	RBW in Hz	Partitions
10...103	93	10	1
103...303	100	20	2
303...603	100	50	3

Offset in kHz	Span in kHz	RBW in Hz	Partitions
603...1103	500	200	1
1103...2103	1000	1000	1
2103...20000	1000	1000	6

During the scan, you should use an overlap of at least 1% for the measurement partitions.

4. Additional measurement at 10 MHz and a level of 15 dBm at clock synthesis.

Wideband Noise

Accredited calibration: No minimum requirement.

Test equipment:
- PhNoise/AM Noise analyzer, R&S® FSWP recommended (see Table 1-1, item 6)

Test setup:
1. Connect the Noise analyzer to the clock synthesis output socket CLK_SYN of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Test method: Measure the noise power (the sum of phase noise and amplitude noise) with the analyzer for each of the DUT's output types.

Measurement 1:
1. Settings on DUT:
   - **Clock Synthesis Frequency** test frequency
   - **Clock Synthesis Level:** 10 dBm
   - **Output Type:**
     - Single ended sinus.
     - Differential square.
2. Settings on analyzer:
   - **Mode:** Signal source analyzer
   - **Center:** test frequency
   - **Offset frequency:** 1 MHz to 30 MHz
   - **Number of Correlations:** 1e5
   - **Attenuator:** 5 dB
   - **Bandwidth** 10%.
3. Measure the total noise power at an offset frequency of 10 MHz or 10% of carrier frequency, whichever is lower.

► Recommended test frequencies:
10 MHz to 6 GHz in logarithmic spacings of 4 per decade.

SSB Phase Noise

Accredited calibration: No minimum requirement.

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.

Test equipment:
- Phase noise analyzer (see Table 1-1, item 6).

Test setup:
1. Connect the Phase noise analyzer to the clock synthesis output socket CLK_SYN of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.

Measurement 1: Measure the phase noise at recommended offset with the analyzer in phase noise mode.

1. Settings on DUT:
   - **Clock Synthesis Frequency** test frequency
   - **Clock Synthesis Level:** Max. output level
   - **Output Type**
     - Single ended sinus.
     - Differential square.
2. Settings on analyzer:
   - **Mode:** Signal source analyzer
   - **Center:** test frequency
   - **Offset frequency:** 1 kHz to 100 kHz
   - **Number of Correlations:** 1e3
   - **Attenuator:** 5 dB
3. Measure the phase noise at an offset frequency of 20 kHz.

Recommended test frequencies: Measurement at 10 MHz, 100 MHz, 1 GHz, 2 GHz, 3 GHz, 6 GHz (only in single ended sinus mode) with 20 kHz Offset.

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 clock synthesis output socket CLK_SYN of the DUT.
2. Synchronize the reference frequencies of analyzer and DUT.
3. Settings on DUT:
   - **Output Type:** Sine wave

Measurement 1:
► First the level of the fundamental is measured as reference, then a signal is searched for
   - 0.25*, 0.5*, 0.75*, 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:

► Test frequencies:
Recommended test frequencies according to Table 1-2 and from RF_{min} to RF_{max} in steps of 100 MHz.
Level: 10 dBm

1.4.15 Checking the Front Unit

The R&S SMA100B is equipped with a front unit, compromising a keyboard, leds, display and touch screen.

1.4.15.1 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 → Maintenance → Check Front Panel ...**
    Follow the advices on the screen, every key must be pressed once.

1.4.15.2 Touchpanel

Accredited calibration: No minimum requirement.

Test setup: None.

Test method: An internal test program and visual inspection are used to check the touch panel.

Measurement 1:
- Settings on DUT:
  - **Setup → Maintenance→ Check Touch Panel...**
    Start the calibration, all points must be accepted.

Measurement 2: Check the touch screen for absence of streaks, using a platic rod. Apply usual pressing force.

1.4.15.3 Digital interfaces

Accredited calibration: No minimum requirement.

Connect a R&S®NRP power sensor to the sensor socket and check, if the sensor trigger works.

For optional Remote-Control via GPIB and USB-In: check connection.

For instruments equipped with R&S SMAB-B85:

Test setup: Insert a SD mass memory card into the SD slot at the front panel.

Test method: Check, if the SD card is recognized and perform a read and write operation to check the card slot's functionality.

1.4.15.4 Selftest

Accredited calibration: No minimum requirement.

Test setup: None.

Test method: Internal Selftest

Measurement 1: Execute the internal Selftest. Check the output result for "pass".

2 Maintenance

The R&S SMA100B does not require regular maintenance. It only requires occasional cleaning. It is however advisable to check the nominal data from time to time.

See the R&S SMA100B User Manual for information on recommended basic maintenance.

In addition, take care that the RF connectors applied to the port are clean, mechanically compatible and not damaged.

Although the 1.85 mm adapter is designed to withstand several hundred mating cycles, it can reach the end of life or be damaged. Therefore, the adapter port is exchangeable. See Chapter 2.1, "Changing the 1.85 Adaptor F-F", on page 93 for information on how to replace the adapter port.

See also:

- "Procedure in Case of Service and Ordering of Spare Parts" at the beginning of this manual for general information on spare parts.
- "Guidance on Selecting and Handling Coaxial RF Connectors used with Rohde & Schwarz Test Equipment ", application note 1MA99.
- "Interchangeable Port Connector System, Test Port Adapter System", applicaton note 1MA100.

2.1 Changing the 1.85 Adaptor F-F

1. Switch off the R&S SMA100B and disconnect it from power.
2. Unscrew the Adaptor Bell.
3. Unscrew the four counter sunk screws and remove carefully the Adaptor Clamp.
4. Hold with an opened-ended spanner 7 mm the 1.85 Adaptor f-f. Do never rotate the 1.85 Adaptor F-F!
5. Use the opened-ended spanner 8 mm and rotate only the hexagonal nut. Turn it clockwise.
6. Remove the 1.85 Adaptor F-F and replace it.
7. Hold with an opened-ended spanner 7mm the 1.85 Adaptor F-F. Do never rotate the 1.85 Adaptor F-F!
8. Rotate the hexagonal nut counter-clockwise and fix it with the Mounting Wrench SMA (3553.6307.00).
9. Clean the 1.85 Adaptor F-F: The cylindrical faces must be free of grease. Grease could be covered only by touching.

10. Move the Adaptor Clamp carefully over the 1.85 Adaptor F-F, adjust it´s holes to the M2.5 - threads and screw with the four counter sunk screws the Adaptor Clamp to the instrument.
11. Screw the Adaptor Bell onto the Adaptor Clamp. Tighten the Adaptor Bell with a torque of 200 Ncm.

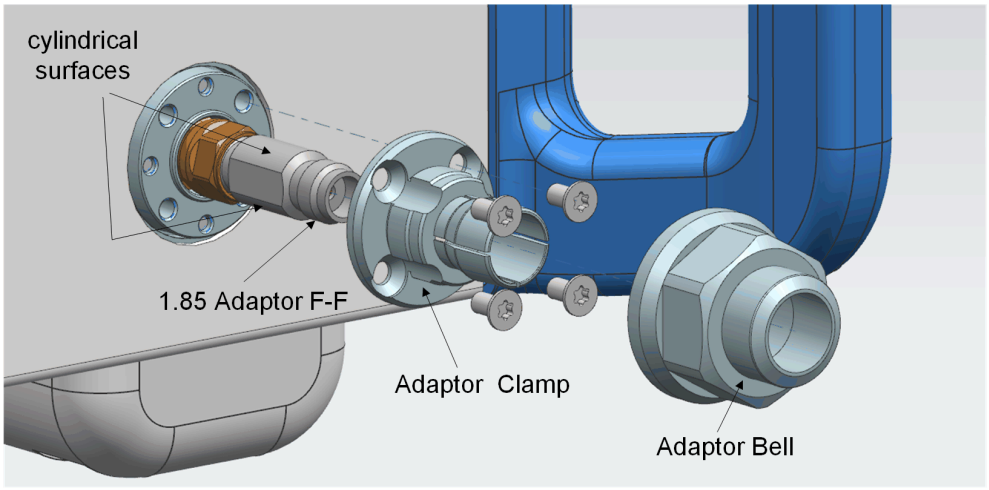


Figure 2-1: Changing the R&S SMAB 1.85 Adaptor f-f

3 Installing Options

This chapter contains information on how to install options on the R&S SMA100B.

3.1 Options Overview

A list of all available R&S SMAB-xxx hardware and software options is provided in the data sheet and on the product page, see https://www.rohde-schwarz.com/product/sma100b.

3.2 Installing Hardware Options

Installing of hardware options is done only by service center experts of Rohde & Schwarz in the service plants. On hardware topics, contact http://www.services.rohdeschwarz.com for information.

3.3 Installing Software Options

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

If the R&S SMA100B is equipped with an older firmware version, a firmware update can be necessary before you can enable the software option, see Chapter 4, "Firmware / Software Update and Installation", on page 96.

Information on the firmware version required for the purchased software option is provided with the option.

4 Firmware / Software Update and Installation

This chapter contains information on how to update or install the firmware on the R&S SMA100B, and how to update the Linux operating system. 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.

4.1 Installation of New R&S SMA100B Firmware

For information on how to update the firmware refer to the release notes. The most recent version of the release notes, and the latest firmware version are provided on the Rohde & Schwarz website of the product, see:

https://www.rohde-schwarz.com/firmware/sma100b

The release notes describe in detail the requirements and the various options for updating the firmware.

5 Documents

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

5.1 Available Power Cables

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

Table 5-1: 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	

5.2 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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