

R&S® SMCV100B

Vector Signal Generator

Service Manual



1179111202

This service manual describes the following Vector Signal Generator types:

- R&S®SMCV100B, order no.1432.7000K02

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Mühldorfstr. 15, 81671 München, Germany

Phone: +49 89 41 29 - 0

Email: info@rohde-schwarz.com

Internet: www.rohde-schwarz.com

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Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol, e.g. R&S®SMCV100B is indicated as R&S SMCV100B.

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)

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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.



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



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



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



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.

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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 $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ 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.

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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.

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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.

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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.

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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.

Instrucciones de seguridad elementales

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.

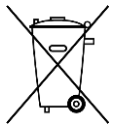
Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. 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)

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Símbolo	Significado	Símbolo	Significado
	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.



Indica una situación de peligro que, si no se evita, causa lesiones graves o incluso la muerte.



Indica una situación de peligro que, si no se evita, puede causar lesiones graves o incluso la muerte.



Indica una situación de peligro que, si no se evita, puede causar lesiones leves o moderadas.



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.

Instrucciones de seguridad elementales

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 $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ 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

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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 $U_{\text{eff}} > 30 \text{ V}$ 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.

Instrucciones de seguridad elementales

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

Instrucciones de seguridad elementales

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.

Instrucciones de seguridad elementales

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.

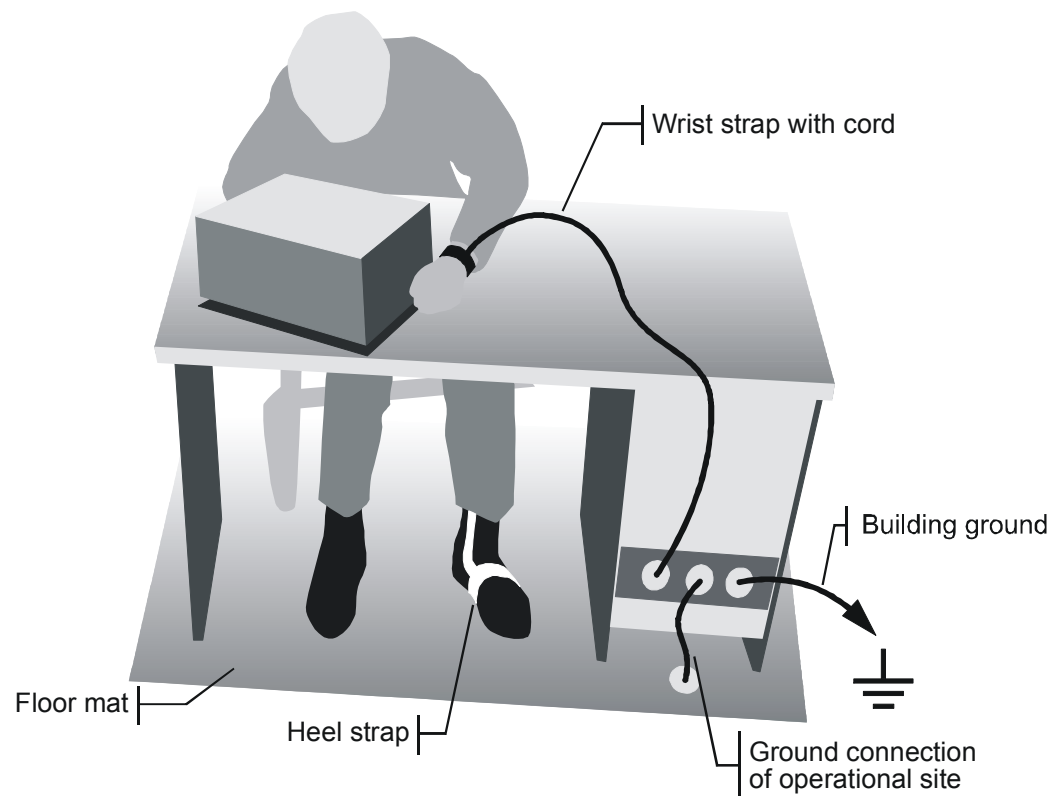
Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

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:

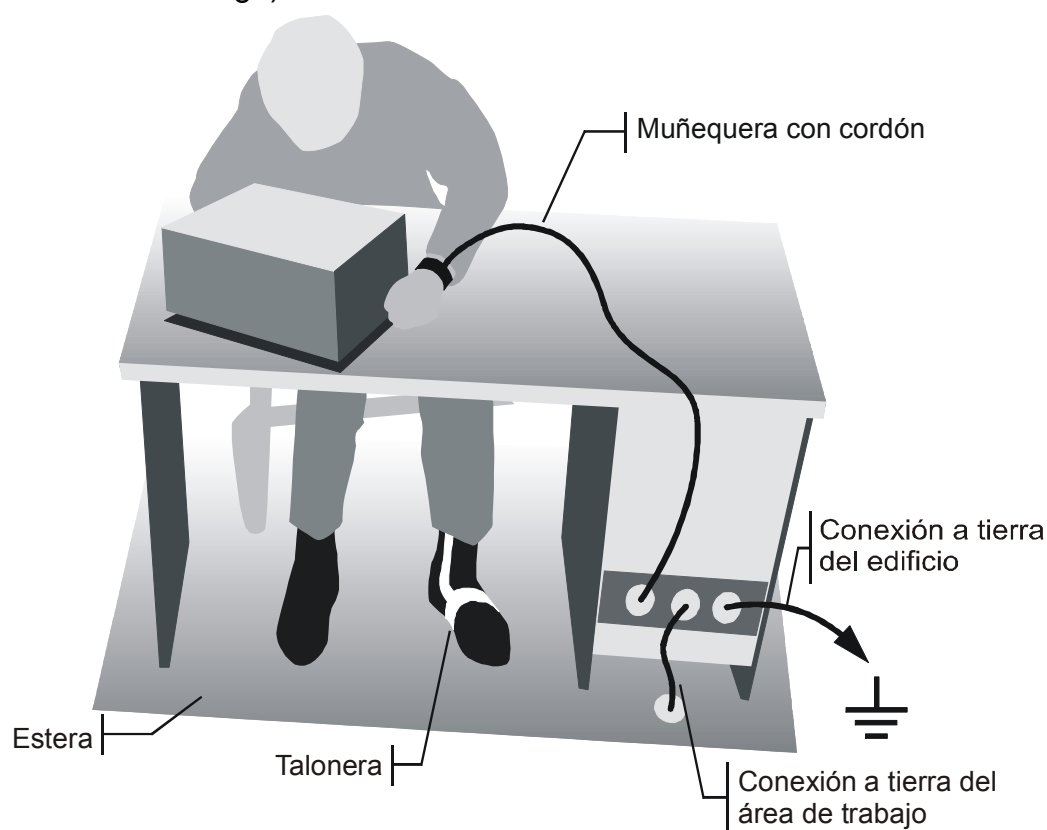
- Wrist strap with cord to ground connection
- Conductive floor mat and heel strap combination

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.

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1 Performance Test

1.1 Preliminary Remarks

1.2 Test Equipment

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 signal analyzer item 5)		
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 SPREF R&S SMA100B	
4	Controller	Industry standard PC/XT/AT with USB interface and LAN interface		
5	Signal analyzer & demodulator for analog modulations & FMdemodulator	1 MHz to RFmax * 2	R&S FSW26/40 with R&S FSW-B24 R&S FSW-K7 R&S FSQ26 with R&S FSU-B25 R&S FSQ K7	1155.5001.26 1044.9298.02 1141.1796.02
6	Phase noise test assembly	Phase Noise Test Set or Mixer: 10 MHz to RFmax, branching filter 20 MHz, DC decoupling after the mixer Phase Noise Test Set with FSWPxx	R&S FSUP 26 or Mixer: f < 1 GHz: Minicircuits ZFM2H 1 GHz: < f < 13 GHz: Miteq DB0118LA2 R&S FSWP8 R&S FSWP26 with B1, B4, B61, B80, K7	1166.3505.27 1166.3505.51 FSWPxx: 1322.8003.08
8	RF power meter	1 MHz to RFmax	NRP18A	1424.6815.02
9	Low-noise preamplifier	10 Hz to 10 MHz, gain > 20 dB, input noise < 4 nV (1 Hz)		

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S order no.
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

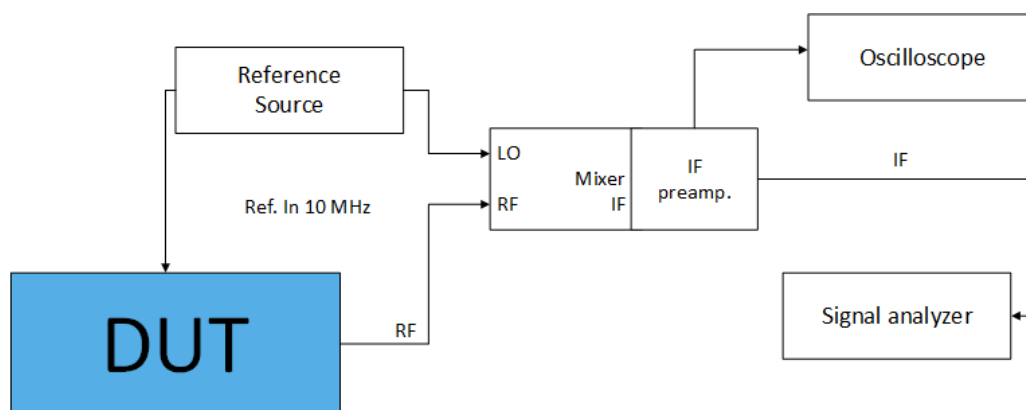
1.2.1 Test Assemblies

The device under test R&S SMCV100B is abbreviated as DUT hereinafter.

1.2.1.1 Test Assembly for SSB Phase Noise and Jitter

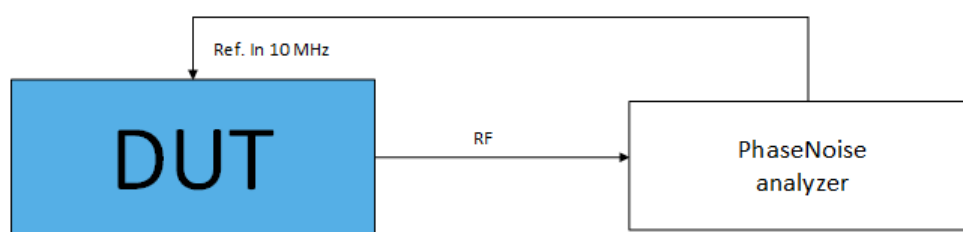
- Test equipment:
- Reference Source, (see [Table 1-1](#) : Recommended equipment [Table 1-1](#) item 2).
 - Phase noise test assembly consisting of mixer with lowpass filter and preamplifier, (see [Table 1-1](#), item 6).
 - Oscilloscope, (see [Table 1-1](#), item 7).
 - Signal analyzer, (see [Table 1-1](#), item 5).

Test setup:



Test equipment: Phase noise test assembly with phase noise analyzer, (see [Table 1-1](#), item 6).

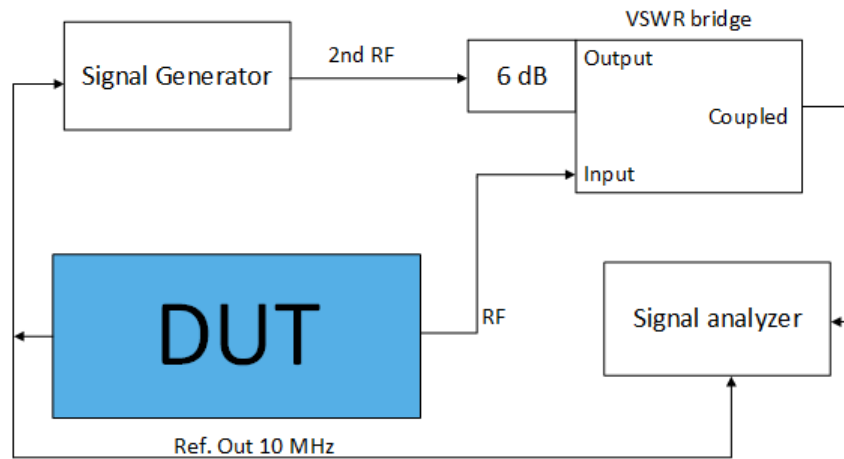
Test setup:



1.2.1.2 Test Assembly for Output Impedance (VSWR)

- Test equipment:
- VSWR bridge, (see [Table 1-1](#), item 11)
 - Signal generator, (see [Table 1-1](#), item 5)
 - Signal analyzer, (see [Table 1-1](#), item 5)

Test setup:

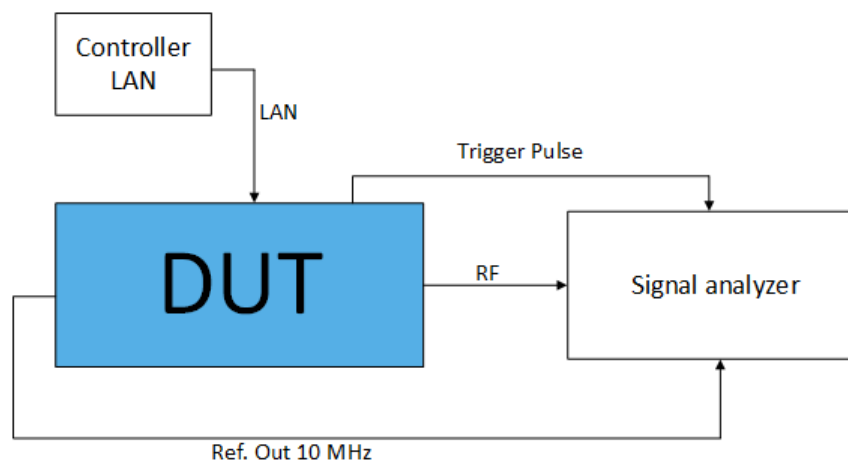


The INPUT of the directional coupler is directly screwed to the DUT. The second signal generator is connected to the line connector (OUTPUT), the analyzer to the coupling output (COUPLED) of the directional coupler.

1.2.1.3 Test Assembly for Setting Time

- Test equipment:
- LAN controller, (see [Table 1-1](#), item 4)
 - Signal analyzer, (see [Table 1-1](#), item 5)

Test setup:



1.3 Instructions / Performance Test (PT) for Instrument

1.3.1 Prepare and Connect Instrument

1. Connect all cables to the UCS test system:
 - a) Power Supply Cord
 - b) LAN
 - c) USB-Mouse
 - d) USB-Keyboard
2. Switch on the instrument.

1.3.2 Initial UCS Tests

1.3.3 Performance Test Report

A performance test report according to PAD-M Ergebnisberichte has to be issued.

1.4 Instructions / Performance Test (PT) for Instrument

1.4.1 Prepare and Connect Instrument

1. Connect all cables to the UCS test system:
 - a) Power Supply Cord
 - b) LAN
 - c) USB-Mouse
 - d) USB-Keyboard
2. Switch on the instrument.

1.4.2 Initial UCS Tests

1.4.3 Performance Test Report

A performance test report according to PAD-M Ergebnisberichte has to be issued.

1.5 Test Instruction for Module

See Product Description of Modules.

1.6 Information on Measurement Uncertainty

If necessary measurement uncertainties are calculated according to QVC111.

1.7 Functional Check

1.7.1 Preparation, Recommended Test Frequencies/Levels

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

1. Allow for a minimum warm-up time of 30 minutes at ambient temperature.
2. Carry out all internal adjustments.
3. 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 SMCVB-B103 with R&S SMCVB-KB106/KB107 or K0	0.004 MHz to 7125 MHz	0.100 MHz 20 MHz 2500 MHz 4500 MHz 6000 MHz	0.004 MHz, 0.100 MHz 0.101 MHz to 20.00 MHz 20.01 MHz to 2500.00 MHz 2500.01 MHz to 4500.00 MHz 4500.01 MHz to 6000.00 MHz 6000.01 MHz to 7125.00 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 SMCVB-B103/-KB106.

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.



Allow the DUT to warm up for at least 0.5 hours before starting the measurement.

1.7.2 Instrument Data

Mat. no. of printed version:

1.7.2.1 Modules and Options

In the header of the protocol list the modules with product number, serial number, change index and hardware code.

Test assembly: None

Test method: Read data

Preparation of measurement:	Select menu setup → <i>Info Hardware</i>
Measurement	Read the data of the modules.

1.7.2.2 Firmware Version

The firmware version has to be documented in the protocol.

Test assembly:	None
Test method:	Read data
Preparation of measurement:	Select menu setup → <i>Instrument Assembly</i>
Measurement	Note the data of: <i>Hardware Config, Version / Options</i>

1.7.3 Selftest

SMCV100B provides internal selftest routines, which are activated here.

Preparation of measurement: Select System Config → Setup → Maintenance → Selftest

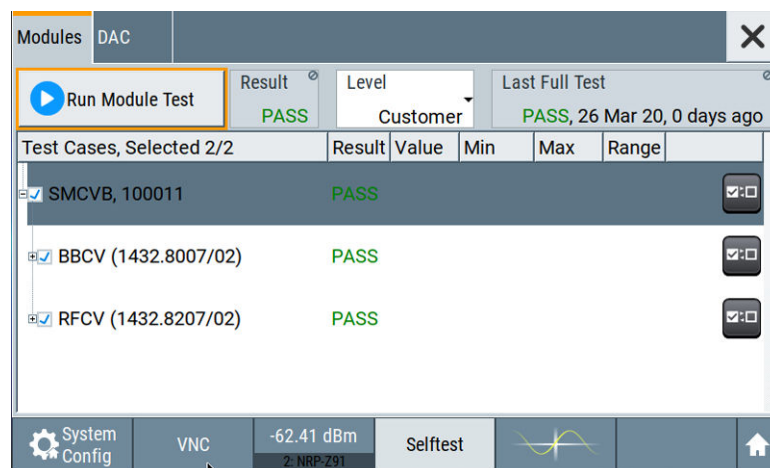


Figure 1-1: GUI Selftest

1.7.4 Checking the Front Unit

The R&S SMCV100B is equipped with a front unit, comprising a keyboard, LEDs, display and touch screen.

1.7.4.1 Keyboard

Test assembly:	None
Test method:	An internal test program is used to check all keys and the knob.

Preparation of measurement:	Settings on DUT: Setup → Maintenance → Check Front Panel
Measurement	Follow the advice on the screen, every key must be pressed once.

1.7.4.2 Touch Panel

Test assembly:	None
Test method:	An internal test program and visual inspection are used to check the touch panel.
Preparation of measurement:	Settings on DUT: Setup → Maintenance → Check Touch Panel
Measurement	Type several points on the display. A circle should appear, diameter depending on pressing force. Type points in all edges of the display. Draw a circle on the display with moderate speed and pressing force. No interruption of the line should be visible.

1.7.4.3 USB Interface

Test assembly:	None
Test method:	Connect an R&S NRP power sensor to one of the USB sockets and check, if the integrated power meter works.

1.7.5 RF Tests

1.7.5.1 Reference Frequency Accuracy

Internal Reference

Accredited calibration:	Same coverage as performance test.
Test equipment:	Frequency counter (see Table 1-1 , item 1).
Test setup:	► Connect a frequency counter (see Table 1-1 , item 1) to the REF OUT output (on rear panel).
Measurement	Measure the frequency. Settings on DUT: ► Source mode internal reference 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:	$0.80 * \text{"Error at time of calibration in production"}$

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

External Reference

Test equipment:	• RF power meter (see Table 1-1, item 8) • Signal generator (see Table 1-1, item 2) • Frequency counter (see Table 1-1, item 1)
Test setup:	▶ Connect an RF power meter to the REF OUT output (on rear panel). Connect the signal generator to the REF IN (on rear panel).
Measurement	Measure the output level. It should be within the data sheet specifications. 1. Settings on DUT: Output mode 10 MHz 2. Settings on reference signal generator: • Frequency recommended test frequencies • Level min. and max. specified input level from data sheet.
Recommended test frequencies:	10 MHz

1.7.5.2 Spectral Purity

Harmonics

Test equipment:	Signal analyzer (see Table 1-1 , item 5)
Test setup:	1. Connect the signal analyzer to the RF output of the DUT. 2. Synchronize the reference frequencies of analyzer and DUT.
Measurement	1. Settings on analyzer • Reference level +13 dBm, 10 dB/div • Span 0 Hz • Resolution bandwidth 1 kHz 2. Settings on DUT: • Frequency test frequencies • Level test levels • I/Q Mod. State Off 3. First measure the level of the fundamental P_f at the test frequency f as a reference. 4. Measure the signal levels P_{2*f} and P_{3*f} at twice and three times of 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.
Test levels: Maximum specified level for harmonics.
- In mode CW only:
Test frequencies:
200 MHz, 1 GHz, 3 GHz.
Test levels: from -10 dBm to maximum specified level in steps of 0.333 dB.

Nonharmonics

Test equipment:

Signal analyzer (see [Table 1-1](#), item 5).

Test setup:

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

Measurement

► 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)

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

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



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 sampling frequencies:

Table 1-3: Nonharmonics of the synthesis at test level 10.0 dBm, unmod.

Setting on DUT (Frequency in GHz)	Analyzer search frequency (in GHz)
2.5	0.25 (fs/4-f), 0.5 (fs/3-f), 1.5 (fs-3f), 2.0 (fs/2-f), 4.0 (fs-2f)
2.51	7.25, 2.26 (f-0.25), 2.76 (f+0.25)
4.5	7.25, 6.25 (2R-L), 3.125 (L/2-R2), 4.25 (f-0.25), 4.75 (f+0.25)
4.51	7.25, 2.74 (2R-L), 5.88 (f_dds*6), 4.26 (f-0.25), 4.76 (f+0.25)

Setting on DUT (Frequency in GHz)	Analyzer search frequency (in GHz)
6.0	7.25, 5.75 (f-0.25), 6.25 (f+0.25)
6.01	7.25, 4.74 (2R-L), 5.76 (f-0.25), 6.26 (f+0.25), 5.58 6 ((f+R)/3), 7.0575 (f+f_dds)
7.12	7.25, 3.63 (2R-L), 6.87 (f-0.25), 7.37 (f+0.25), 5.95 6 ((f+R)/3)

Note: In Table 1-3, the expressions in round brackets describe the origin of the spur.

Wideband Noise

- Test equipment: Signal analyzer (see Table 1-1, item 5).
- Test setup:
1. Connect the signal analyzer to the RF output of the DUT.
 2. Synchronize the reference frequencies of analyzer and DUT.
- Test method:
- The carrier power is measured first. Then the center frequency of the analyzer is increased by 30 MHz and the noise power in a small bandwidth is measured. The difference of the carrier power and the noise power in 1 Hz bandwidth, which is calculated from the measurement, is defined as wideband noise. Because wideband noise degrades with lower electronic levels at the output step attenuator input, the output level of the generator has to be set to the lowest level before switching the step attenuator.
- Measurement
1. 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 $D_{\min} = \text{Reference level} - P_{1\text{dB}} \rightarrow$ round to next larger available attenuation of the analyzer ($P_{1\text{dB}} =$ 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.
 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:

$$W_{Noise} = -Pref + 10 \cdot \log_{10}(10^{P_{noise}/10} - 10^{P_{res}/10}) - 50 \text{ dB}$$

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:

$$W_{Noise} = -Pref + P_{noise} - 50 \text{ dB} - 10 \text{ dB}$$

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

Recommended test frequencies and levels:

1. Recommended test frequencies:
20 MHz, 50 MHz, 100 MHz, 200 MHz, 500 MHz, 1000 MHz, 2000 MHz, 2500 MHz, 2500.001 MHz, 4500 MHz, 4500.001 MHz, 6000 MHz, 6000.001 MHz, 7125 MHz
Recommended test level:
+10 dBm
Factory only: additionally check at 3 dBm and additionally check with carrier offset 10 MHz.
2. Repeat the measurement with I/Q-Modulation switched on:
3. I/Q settings menu:
 - Source: internal baseband, generate full scale DC signal in baseband (i. e. MCCW-signal with 1 carrier)
 - Mode: IQ wideband on
 - State: On
4. For each test frequency:
 - a) Set level settings characteristic auto
 - b) Determine P_{min} as described above
 - c) Set level settings characteristic strictly monotone
 - d) Set level 10 dBm
 - e) Measure the wideband noise

SSB Phase Noise

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

Measurement: Set the level of the DUT to 10 dBm and measure the phase noise at recommended offset with the analyzer in phase noise mode.

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

- Test equipment:
- Signal analyzer (see [Table 1-1](#), item 5).
 - 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 1.2.1.1, "Test Assembly for SSB Phase Noise and Jitter"](#), on page 6.
- 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. Set the levels of the two generators in accordance with the specifications of the mixer used (unmodulated or I/Q modulation with max. level).
 2. For calibration, reduce the level of the DUT by 40 dB and detune one signal generator by 20 kHz. Check the signal for harmonics; the 2nd and 3rd harmonic should be more than 30 dB below the fundamental. Measure the reference value at 20 kHz at the analyzer and note it down.
 3. Set the detuned signal generator to the previous frequency and set the signal generators for phase quadrature. To this end, raise the level of the DUT to the previous level and call "Delta Phase" in the "Frequency/Phase" menu. Observe the output voltage of the mixer on the oscilloscope and vary the phase until the voltage 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.

- Recommended test frequencies:
- 2.5 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz with 20 kHz Offset in mode CW.

Reduce data sheet limits by 2 dB for all other measurement frequencies at 20 kHz offset.

Carrier frequencies ≤ 2.5 GHz are generated directly by the RF-DAC. The phase noise of the RF-DAC scales perfectly with $20 \cdot \log_{10}(f/f_0)$. Therefore, it is sufficient to measure phase noise at a single carrier frequency (here: $f_0 = 2.5$ GHz). Phase noise at other output frequencies f (100 MHz, 1 GHz, 2 GHz,...) is guaranteed by design.

Residual FM

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

Measurement: set the Level of the DUT to 10 dBm and measure the phase noise at recommended offset with the analyzer in phase noise mode.

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

Test equipment:	• Signal analyzer (see Table 1-1, item 5). • 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 1.2.1.1, "Test Assembly for SSB Phase Noise and Jitter" , on page 6.
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. Settings on DUT: • Frequency 1 GHz • Level Level $P_{\max}$, unmodulated 2. Settings on signal 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 $F_{\text{start}} = 300 \text{ Hz}$ and $F_{\text{stop}} = 3 \text{ kHz}$
2. Read Trace Data $T(\mu)$ with $\mu \in [1, N]$ and $N = 625$ from spectrum analyzer and calculate the summed residual FM of the DUT and the reference signal generator

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

with P_{ref} being the reference level from the "SSB Phase Noise Measurement" with 40 dB reduced level with 20 kHz detuned frequency.

The sum of the residual FM of the DUT and the reference signal generator should be well below the guaranteed value of the DUT, so no correction of the measurement result is necessary.

3. Repeat measurement with a test bandwidth of 20 Hz to 23 kHz in two steps: First sweep from 20 Hz to 1 kHz with an RBW of 3 Hz and then sweep from 1 kHz to 23 kHz with an RBW of 100 Hz. Calculate the residual FM for both measurements with the formula given above. The residual FM from 20 Hz to 23 kHz is:

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

Residual AM

Test equipment:	Signal analyzer (see Table 1-1 , item 5).
Test setup:	1. Connect the signal analyzer to the RF output of the DUT. 2. Synchronize the reference frequencies of analyzer and DUT.
Test method:	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. The described method is valid for demodulation with a zero "Bias Schottky Detector".
Measurement	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 spectrum 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 $T(\mu)$ with $\mu \in [1, N]$ and $N = 625$ from spectrum analyzer and calculate the summed power.

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

- Repeat measurement with:

- **RBW** 100 Hz
- **F_{start}** 1 kHz
- **F_{stop}** 23 kHz
- Calculate power as above

- Calculate the residual AM:

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

Test frequencies: 1 MHz, 10 MHz, 50 MHz, 100 MHz, 1 GHz, 2.5 GHz, 3.0 GHz, 4.0 GHz, 5.0 GHz, 6.0 GHz, 7.0 GHz.

1.7.5.3 Level

Level Accuracy

Requirement:	Perform relative and absolute level correction first.
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) • Signal analyzer (see Table 1-1, item 5) • 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 the RF power meter to the RF output of the DUT.
Measurement	1. Settings on DUT: • Level test levels • I/Q Mod. State Off 2. Measure the level P_{absolute} at the recommended test frequencies up to RF_{max} → the level error is the deviation of the measured level from the set value. 3. Repeat the measurement with IQ-Modulation switched on, starting at 100 kHz RF frequency.
Recommended test levels for frequency response measurement:	► Level -20 dBm and 20 dBm or maximum specified level, whichever is lower.
Recommended test frequ. for level frequency response measurement:	Around hardware switching points defined in Table 1-2 . Additionally at frequencies 8 kHz, 30 kHz, 200 kHz, 1 MHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz, 50 MHz, and in steps of 50 MHz up to maximum output frequency.

Test principle:	Test method for low levels 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.
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Maximum Level

- 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:
 - Signal analyzer (see [Table 1-1](#), item 5).
 - 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. 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 SMCV100B 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.

$$C = P_{\text{absolute}} - P_{\text{Marker}}$$
 with P_{absolute} from the measurements performed with the power meter.
 4. Now increase the DUT level to 30 dBm and calculate the output power P by adding the correction factor C to the marker readout.
 5. Apply the following maximum levels.

Frequency	P_{max} without options SMCVB-K31	P_{max} with option SMCVB-K31
0.004 MHz to 0.100 MHz	18 dBm	25 dBm
0.100 MHz to 20 MHz	18 dBm	25 dBm
20 MHz to 6000 MHz	18 dBm	25 dBm
6000 MHz to 7125 MHz	18 dBm	25 dBm

Interpolate linearly between the applied limits.

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

Recommended test frequencies: ▶ Recommended test frequencies according to [Table 1-2](#): Range limits, main test frequencies for CW mode, 0.1 MHz, 2 MHz, 3 MHz, 4 MHz and from RF_{min} to RF_{max} in steps of 100 MHz.

Factory Check: Level Linearity RF-Chain

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

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

- Measurement
1. Settings on DUT:
 - **Frequencies** 8.35 kHz, 70.0 kHz, 100.0 kHz, 200.0 kHz, 1.0 MHz, 20.1 MHz, 100.0 MHz, 380.0 MHz, 995.0 MHz, 2001.0 MHz, 4001.0 MHz, 5201.0 MHz, 5999.0 MHz, 7125.0 MHz.
 - **Level/EMF** menu
 - Generate **Full Scale DC-Signal** in baseband (i.e. MCCW-Signal with 1 Carrier)
 - **I/Q Source** internal baseband
 - Level P_{max} (= 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 increase the **Digital Attenuation** at the DUT in steps of 5 dB and measure the deviations from the nominal level difference.

Output Impedance

Test assembly: See [Chapter 1.2.1.2, "Test Assembly for Output Impedance \(VSWR\)"](#), on page 6.

Test method: A purely passive measurement using the VSWR bridge is possible at all levels.

Measurement Test assembly with second signal generator and VSWR bridge.

1. Settings on DUT:
 - **Frequency** Test frequencies
 - **Level** Test level
 - **Modulation** Off
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 $V_{\text{ref}} \pm 0.5 \%$.
 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 $\text{VSWR} = V_{\text{max}} / V_{\text{min}}$.

Recommended test frequencies and levels:

- For instruments equipped with R&S SMCVB-B103 or R&S SMCVB-KB106: Test frequencies: 200.001 kHz, 1.01 MHz, 7.9 MHz, from 10 MHz every 5 MHz up to 100 MHz from 100 MHz every 50 MHz up to RF_{max}

Recommended test level:

- 8 dBm, 5 dBm

1.7.6 Modulation

1.7.6.1 RF Level Accuracy with Modulation

Test equipment: Signal analyzer (see [Table 1-1](#), item 5).

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

Test method: An internal ARB is generating a signal with 21 carriers of equal amplitude and 1 MHz spacing.

Use channel power measurement of signal analyzer.

Measurement Settings on DUT:

- RF ON
- **Frequency** 1000 MHz
- **Level** 0 dBm
- **Modulation** On
- **Signal Source** MCCW
- **Number of Carriers:** 21
- **Carrier Spacing** 1 MHz

Measure the level with Mod Off as reference level.

- The level difference is the required measurement value.

1.7.6.2 Modulation Frequency Response

Test equipment:	Signal analyzer (see Table 1-1 , item 5).
Test setup:	► Connect the spectrum analyzer to the RF output of the DUT with precision RF measurement cables.
Test method:	An internal ARB is generating a signal with 21 carriers of equal amplitude and 20 MHz spacing.
Measurement	Settings on DUT: • RF ON • Frequency 250 MHz to RF_{max}-250 MHz in 50 MHz steps. • Level 0 dBm • Modulation On • Optimization mode High Quality Table • Signal source MCCW • Number of carriers: 21 Vary the carrier frequency from 250 MHz to RF_{max}-250 MHz. Measure the level of the center carrier as reference level. ► The max. level difference of the other carriers is the required measurement value.

1.7.6.3 Modulation Error Ratio

Test equipment:	Signal analyzer (see Table 1-1 , item 5).
Test setup:	► Connect the spectrum analyzer to the RF output of the DUT with precision RF measurement cables.
Test method:	Instead of a static measurement, an equivalent dynamic measurement with a medium symbol rate is carried out.
Measurement	Settings on R&S SMCV100B: • RF On • Level 0.0 dBm • Modulation menu: • Modulation On • Optimization mode High Quality Table • Signal Source SERVICE • Service menu: • RF Output Signal: 5 (Test64QAM10MS022CR.wv) Signal parameters in "Test64QAM10MS022CR.wv":

- Modulation 64QAM
- Coding PRBS-21 data sequence
- SQR COS filter $\alpha = 0.20$
- Oversampling 8
- Length 128 symbols
- Symbol clock 8.000 MHz

Make the corresponding settings on the VSA. Result length 4000 symbols.

Vary the carrier frequency from 100 MHz to RF_{max} . For recommended setting values see

Note the "Modulation Error Ratio (MER)" indicated by the signal analyzer.

1.7.6.4 Additive White Gaussian Noise (R&S SMCVB-K62)

Test equipment:	Signal analyzer (see Table 1-1 , item 5).
Test setup:	Connect the spectrum analyzer to the RF output of the DUT with precision RF measurement cables.
Test method:	A digital modulated signal is generated and noise is added. Using the channel power measurement facility of the spectrum analyzer, the carrier power and the power of a section of the noise spectrum is determined. By expanding the result to the system bandwidth, the carrier to noise ratio can be reconstructed. The noise generator is a firmware option, realized in an FPGA. The functionality of this FPGA is tested with one measurement, data are guaranteed by design.
Measurement	- Settings on DUT: • Level 0 dBm • Frequency 1 GHz • RF State On • Optimization mode High Quality Table • Baseband Custom Digital Modulation • Set to default (GSM), Symbol Rate 500 Hz • State On • AWGN/IMP AWGN • Additive Noise, System Bandwidth 1 MHz • Carrier/Noise Ratio 20.00 dB - Settings on analyzer: • FREQ CENTER 1 GHz • MEAS CHAN PWR ACP • CP /ACP CONFIG CHANNEL BANDWIDTH 100 kHz • AMPT REF LEVEL 10 dBm • BW RES BW MANUAL 30 kHz • VIDEO BW MANUAL 300 kHz • TRACE DETECTOR RMS • SWEEP SWEEP TIME MANUAL 2 s

3. Measure carrier power and denote as a reference.
4. Settings on DUT if Unicod is not installed:
 - AWGN/IMP AWGN
 - Noise only, system bandwidth 1 MHz
 - Noise level -20.00 dB
 - State On
5. Now retune center frequency of the analyzer to 1.0003 GHz.
6. Measure the noise power.
 Since the measurement bandwidth is a tenth of the system bandwidth, the result is to be corrected by 10 dB.
 → The result is carrier power – noise power –10 dB.

1.7.6.5 Adjacent Channel Power for 3GPP FDD

Accredited calibration: No minimum requirement.

Test equipment: Signal analyzer (see [Table 1-1](#), item 5).

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

Test method: 1. Set standard 3GPP FDD Test Model 1 to 64 in the ARB baseband.
 2. Perform the measurements with the 3GPP ACLR measurement setting of the RF analyzer.

Measurement 1. Settings on DUT or signal generator:

- 3GPP FDD
 - Test Setups Test_Model_1_64channels
 - State On

 2. Settings on analyzer:

- FREQ CENTER 2160 MHz
- MEAS → CHAN PWR ACP
 - CP /ACP STANDARD WCDMA 3GPP FWD
 - SWEEP TIME 1 s
 - NOISE CORR ON
 - ADJUST REF LVL

 3. Measure ACLR:
 Read out Adjacent Channel and Alternate Channel (take the larger of the two measurement values UPPER or LOWER channel).

Recommended test frequencies and levels: 1. Test frequencies:
 1800 MHz, 2000 MHz and 2200 MHz and 5 GHz
 Test level: 13 dBm (PEP)

Show these measurements in test report, too.

2. Test frequency: 2160 MHz
Test levels: -2 dBm to 20 dBm (PEP) in steps of 2 dB

1.8 Measurement and Storage of FPGA Reference Temperature

Test assembly:	None
Preparation of measurement:	Use preset settings of SMCV, SMCV power up time > 10 minutes.
Measurement	Read diagnostic value of "Test Point" → "BBCV - FPGA_TEMP_CORE". Read also diagnostic value of "Test Point" → "BBCV - TEMP_BOARD".
Action:	Calculate difference of temperature values → delta value (delta value = temperature FPGA - temperature BOARD). Convert this value in a 32-bit integer value and store in the BBCV EEPROM block ID "20547" with blockstring "BBCV_CLEAN_COOLING_REF_DELTA_TEMP".
Additional information:	BBCV EEPROM-Block-ID: <code>datablock blockid="20547"</code> <code>blockstring="BBCV_CLEAN_COOLING_REF_DELTA_TEMP"</code>

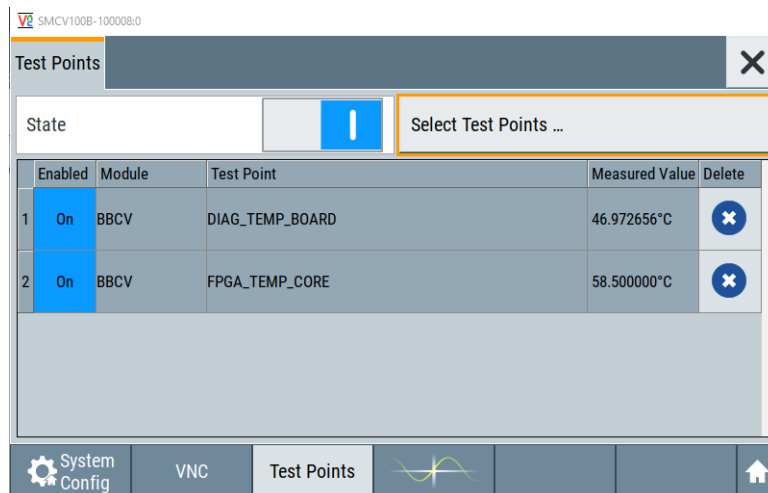


Figure 1-2: Test Points

1.9 Statistical Evaluation (SE)

1.9.1 Information on Parameters to Be Evaluated Statistically

Define here if for example typical data sheet values have to verified statistically.

1.10 Performance Test Report

A performance test report according to PAD-M Ergebnisberichte has to be issued.

2 Adjustment

This chapter describes all necessary measures to restore the performance of the R&S SMCV100B after module replacement.

There are no manual adjustments to be performed. External adjustment routines are implemented for this purpose.

Spare part RF boards are tested at Rohde & Schwarz with calibrated working standards according to the performance test. All measurement values are within the specified values including the measurement uncertainty as a minimum guard band.

If a calibration of the instrument is strictly necessary, the performance test should be performed completely.

After replacing modules, always run the internal selftest, which has to be completed successfully, also check the following [Table 2-1](#) to see which service procedure you perform.

Table 2-1: Selftest

Changed module	Required adjustments	Internal selftest	Recommended test procedure (refer to Chapter 1 , "Performance Test", on page 5)
MBCV	None	Perform selftest	None
RFCV	External adjustments: all	Perform selftest	Complete test procedure
BBCV	None	Perform selftest	None
FRONTCV	None	Perform selftest	None
LPS363-M (power supply unit)	None	Perform selftest	None
IPS3 (processor unit board)	None	Perform selftest	None

2.1 Selftest

The internal selftest of the R&S SMCV100B provides various tests of voltages, temperatures and other functional tests. It includes tests for all relevant modules within the device.

Access:

1. Select in the setup menu "Maintenance" > "Selftest".

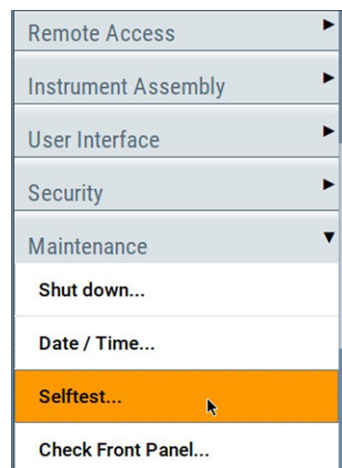


Figure 2-1: Select selftest

2. Click "Run Module Test".

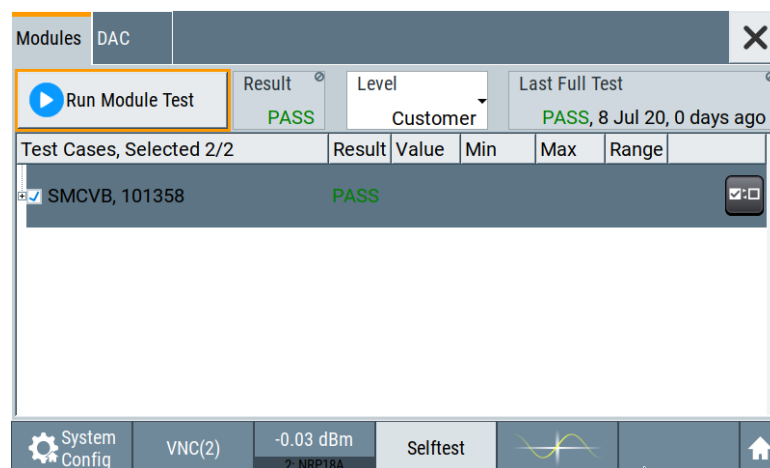


Figure 2-2: Start Run Module Test

After a few seconds, the R&S SMCV100B displays the results. If the selftest is successful, all results are indicated by the status "PASS".

When one or more test routines failed, the instrument displays "FAIL".

2.2 Internal Adjustments

There are no internal adjustments to perform.

3 Installing Options

This section contains information on installing options on the R&S SMCV100B. A list of all available hardware and software options is provided in the data sheet and on the Internet www.rohde-schwarz.com.

For retrofitting, note the mounting instructions enclosed with the options.

WARNING

Shock hazard

Before opening the housing, ensure that the instrument is switched off and disconnected from the power supply by removing the plug from the AC and DC power connector. Read all safety instructions at the beginning of this manual carefully!



Risk of electrostatic discharge

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

3.1 Installing Software Options

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

Only if the R&S SMCV100B is equipped with an older firmware version, a firmware update prior to enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option.

3.2 Options Overview

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

4 Firmware Update

This chapter contains information on installing/updating the firmware and restoring the operating-system on the R&S SMCV100B.

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 SMCV100B Firmware

Your R&S SMCV100B is delivered with the latest firmware version available. Firmware updates and the release notes that describing the improvements and modifications are provided on the Internet at the download site of the R&S SMCV100B homepage www.rohde-schwarz.com. This homepage always offers the latest information on your signal generator, e.g. also on changes of the firmware update procedure.

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

Firmware update: SMCVB_x.xx.xxx.xx.rsu

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

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

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

4.1.1 Downgrade

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

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

Downgrade Info:	
Package	Version
Factory Version	3.18.246
Min. Version	03.01.009.16

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

4.1.2 Update Information

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

NOTICE

USB storage must be enabled in security settings

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

4.1.3 Updating the Firmware

Required equipment

- **Software:** Firmware update file `SMCVB_x.xx.xxx.xx.rsu`
- **Hardware:** USB memory stick with enough free space to save the update file (up to 800 MB).

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

Prepare memory stick

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

Install new firmware on R&S SMCV100B.

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

4.1.4 Alternative Update Procedures

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

4.1.4.1 Firmware Update over LAN

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

1. Get access to the file system of the instrument using ftp (other methods like samba share is also supported, see application note 1GP72 for details).
Enter `ftp://<ip address or host name>` in the file manager.
2. Copy `SMCVB_x.xx.xxx.xx.rsu` to directory `/update/` (example file manager: `ftp://smcv100b-100008/update/`).
3. The update procedure starts immediately.
4. Execute internal adjustments, if indicated.

4.1.4.2 Firmware Update using ISO Image

NOTICE

Potential loss of data!

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

Required equipment

Software:

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

Hardware:

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

About ISO image

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

Update procedure

Burn ISO image onto CD

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

1. Connect the external USB CD/DVD drive to the PC.
2. Insert CD recordable.
3. Start Nero StartSmart.
4. Select medium "CD".
5. Select "Create Data CD".
6. From the **Files menu**, open file **SMCVB_x.xx.xxx.xx.iso** (e.g.SMCVB_4.70.176.12.beta.x86-64.iso).
7. Click "Burn".
8. When finished, close Nero and disconnect external USB CD/DVD drive.

Install new firmware on R&S SMCV100B.

1. Instrument must be switched off.
2. Connect the external USB CD/DVD drive to the R&S SMCV100B.
3. Switch on instrument.
4. The instrument boots from external drive.
5. Follow the instructions on screen.
6. Disconnect the external USB device.
7. Reboot instrument.
8. Execute internal adjustments, if indicated.

NOTICE**Burn the ISO-image as an "image"**

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

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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