R&S®FS-Z60/75/90/110
Harmonic Mixers
User Manual

1048.0242.02 – 01

Test and Measurement

User Manual

ROHDE&SCHWARZ

The User Manual describes the following R&S®FS-Z60/75/90/110 models:

- R&S®FS-Z60 (40 GHz to 60 GHz) 1089.0799.02
- R&S®FS-Z75 (50 GHz to 75 GHz) 1048.0271.02
- R&S®FS-Z90 (60 GHz to 90 GHz) 1048.0371.02
- R&S®FS-Z110 (75 GHz to 110 GHz) 1048.0471.02

The following abbreviations are used throughout this manual:
R&S®FS-Zxx is abbreviated as R&S FS-Zxx.

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.

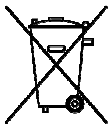
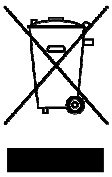
The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. 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 supply voltage
	Caution when handling heavy equipment		Standby indication
	Danger of electric shock		Direct current (DC)

Symbol	Meaning	Symbol	Meaning
	Warning! Hot surface		Alternating current (AC)
	Protective conductor terminal		Direct/alternating current (DC/AC)
	Ground		Device fully protected by double (reinforced) insulation
	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 additonal information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

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

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

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

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

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

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Operating states and operating positions

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

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of ±10 % shall apply to the nominal voltage and ±5 % to the nominal frequency, overvoltage category 2, pollution severity 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 AC 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 AC supply network, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the AC supply network. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

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

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

Repair and service

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

2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

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

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

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.
2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
   Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

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

Instrucciones de seguridad elementales

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

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

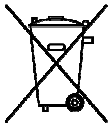
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa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

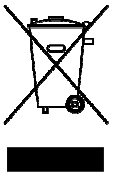
Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto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

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

Señalización de seguridad de los productos

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

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

Símbolo	Significado	Símbolo	Significado
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

Palabras de señal y su significado

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

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

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

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

AVISO — Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

Estados operativos y posiciones de funcionamiento

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

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

Seguridad eléctrica

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

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión.
   El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m).
   Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión U_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases de compatibilidad electromagnética (conforme a EN 55011 / CISPR 11; y en analogía con EN 55022 / CISPR 22, EN 55032 / CISPR 32)
   - Aparato de clase A:
     Aparato adecuado para su uso en todos los entornos excepto en los residenciales y en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.
     Nota: Los aparatos de clase A están destinados al uso en entornos industriales. Estos aparatos pueden causar perturbaciones radioeléctricas en entornos residenciales debido a posibles perturbaciones guiadas o radiadas. En este caso, se le podrá solicitar al operador que tome las medidas adecuadas para eliminar estas perturbaciones.
   - Aparato de clase B:
     Aparato adecuado para su uso en entornos residenciales, así como en aquellos conectados directamente a una red de distribución de baja tensión que suministra corriente a edificios residenciales.

Reparación y mantenimiento

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

Baterías y acumuladores o celdas

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

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

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.

Quality management and environmental management

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,
Sie haben sich für den Kauf eines Rohde&Schwarz Produktes entschieden. Sie erhalten damit ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unserer Qualitäts- und Umweltmanagementsysteme entwickelt, gefertigt und geprüft. Rohde&Schwarz ist unter anderem nach den Managementsystemen ISO 9001 und ISO 14001 zertifiziert.

Der Umwelt verpflichtet
- Energie-effiziente, RoHS-konforme Produkte
- Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ISO 14001-zertifiziertes Umweltmanagementsystem

Dear customer,
You have decided to buy a Rohde&Schwarz product. This product has been manufactured using the most advanced methods. It was developed, manufactured and tested in compliance with our quality management and environmental management systems. Rohde&Schwarz has been certified, for example, according to the ISO 9001 and ISO 14001 management systems.

Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Cher client,
Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests de ce produit ont été effectués selon nos systèmes de management de qualité et de management environnemental. La société Rohde&Schwarz a été homologuée, entre autres, conformément aux systèmes de management ISO 9001 et ISO 14001.

Engagement écologique
- Produits à efficience énergétique
- Amélioration continue de la durabilité environnementale
- Système de management environnemental certifié selon ISO 14001

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Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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Table of Contents

1 Introduction

1.1 General Remarks

The harmonic mixers of the R&S FS-Zxx series are highly sensitive measuring accessories. Therefore, the following points should be observed during operation although the equipment is of a sturdy design.

Improper handling can cause the mixer to become faulty or damaged.

- Heavy shocks can cause the diodes in the mixer to be destroyed.
  Shock-proof packaging should therefore be used for storing or dispatching the mixer.
- The maximum power at the RF input and the LO input (see data sheet) must not be exceeded.
- Avoid electrostatic discharges near the connectors.
- When the mixer is not used, the LO/IF connector (SMA) as well as the RF port (waveguide) should be covered with the cap supplied with the unit.
- The function of the diodes should not be checked by means of an ohmmeter. This would lead to their destruction.
- Do not loosen the screws of the mixer.
  Repair of the mixer can only be done at the manufacturer's servicing department.
- Avoid scratching the contact surface of the waveguide flange.

The following conditions are necessary to operate the mixers:

The mixers can be operated with the following instruments from Rohde& Schwarz:

Instrument model	Necessary firmware version
R&S FSP40 R&S FSU26/43/46/50/67 R&S FSQ26/40 R&S FSUP26/50 R&S FSV30/40 R&S FSVR30/40 R&S FSW26/43/50 with option B21	For R&S FSU: 2.10 or higher with Windows NT 3.10 or higher with Windows XP For R&S FSP: 2.11 or higher with Windows NT 3.11 or higher with Windows XP For R&S FSV 1.40 or higher For R&S FSVR any firmware version For R&S FSW 1.60 or higher

1.2 Typical Application

The harmonic mixers R&S FS-Z60, R&S FS-Z75, R&S FS-Z90 and R&S FS-Z110 are used for the frequency range extension of spectrum analyzers and signal analyzers (called "instrument" in this manual).

They allow measurements in the frequency ranges:

40 GHz to 60 GHz	R&S FS-Z60
50 GHz to 75 GHz	R&S FS-Z75
60 GHz to 90 GHz	R&S FS-Z90
75 GHz to 110 GHz	R&S FS-Z110

Due to the two-diode concept, these mixers do not require any biasing for operation so that measurements with higher level accuracy and reproducibility compared to single diode mixers can be performed.

The mixers of the R&S FS-Zxx series have been developed for use with R&S spectrum analyzers. Thus, the conversion loss data supplied, apply only when used in combination with R&S spectrum analyzers.

1.3 Description

The mixer R&S FS-Z60 is of two-port type, which means that only one coaxial cable is required for feeding the LO signal and tapping the IF signal. The two signals are separated by means of a diplexer in the instrument. The mixers R&S FS-Z75, R&S FS-Z90, and R&S FS-Z110 are of three port type which means that they have separate connectors for the LO input and the IF output signal. Biasing is not required.
The two design concepts are shown in Figure 1-1.

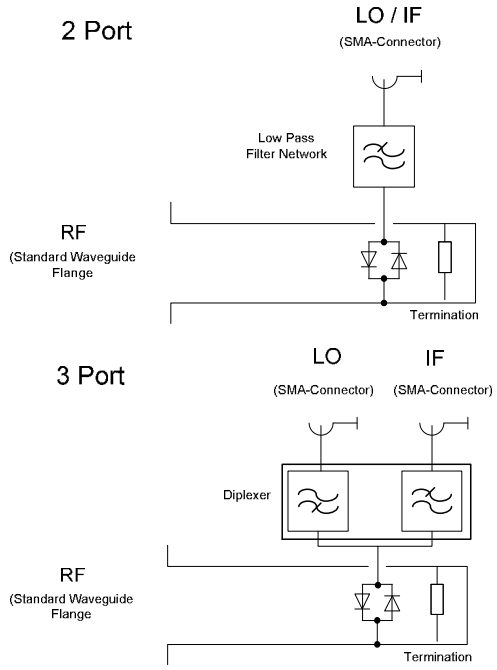

Figure 1-1: Design of R&S FS-Zxx harmonic mixers

The signal to be measured is fed into the input (RF) of the mixer (Standard waveguide flange).

The signal of the first local oscillator (LO) is applied to the mixer via the LO/IF SMA connector for the 2 port type, and via the LO SMA connector for the 3 port type, respectively.
Nonlinearities produce harmonics of the LO signal which are used to convert the input signal to a lower intermediate frequency (IF).
The signal converted to the intermediate frequency is tapped via the LO/IF connector on the 2 port mixer type, or the separate IF connector on the 3 port type, respectively, and fed into the corresponding connector of the analyzer. Since the LO signal and IF signal are fed and tapped via the same coaxial cable in case of a two port mixer, it is necessary to separate the two signals by means of a diplexer, which is integrated in the Rohde & Schwarz instruments listed above.

The mixer does not have any preselection. Image products and other unwanted mixer products are displayed on the instrument in addition to the wanted mixer products. Firmware functions (AUTO ID) are available to identify the input signals and separate them from image signals and other mixing products (see the operating manual of the used instrument for details).

The conversion loss of the harmonic mixers must be taken into account in order to display the level of the measured signal correctly. The conversion loss is dependent on the frequency and the characteristics of the mixer in use. Therefore correction loss data is supplied for each mixer (see section "Conversion Loss Data").

1.4 Conversion Loss Data

The conversion loss of a harmonic mixer is measured in the factory. The resulting data is supplied in a document, which contains the list of frequencies and the conversion loss measured at each individual frequency. In addition, a table with correction data is affixed to the mixer, which contains a smaller number of frequency points.

Correction data is also supplied in form of a file on a USB stick (or 3.5" floppy disc with older models) to facilitate level correction. This file contains conversion loss data of 50 frequency points and all further parameters required for operating the mixer with R&S spectrum analyzers.

The prerequisites to read this file are explained in section "Prerequisites".

The conversion loss data only refers to the frequency-dependent conversion loss of the mixer. The attenuation of the cable used to tap the IF should be considered separately (see section "Parameters and Settings").

High-quality low-loss coaxial cables should be used to feed the LO signal or tap the IF signal to obtain a low conversion loss for the mixer. The spectrum analyzer’s option B21 comes with corresponding coaxial cables. It is highly recommended to always use these cables supplied with the B21.

2 Preparing for Use

To prepare a measurement with the external mixer, connect the mixer and the instrument in the specified order (also indicated in Figure 2-1).

1. First connect the waveguide flange of the harmonic mixer to the DUT.

   Note: Do not connect the coax cables to the mixer prior to this step to protect them against mechanical stress.

2. Connect the coaxial cable(s) supplied with the B21 to the LO OUT / IF IN port of the instrument.

   For 3 port mixers, connect another cable to the IF IN port of the instrument.

3. Connect the coaxial cable(s) from the LO OUT / IF IN port of the instrument to the LO/IF SMA connector (2 port type) or the LO SMA connector (3 port type) of the harmonic mixer.

   For 3 port mixers, additionally connect the cable from the IF IN port of the instrument to the IF port of the mixer.

   Note: Connect each cable to the analyzer first, before connecting it to the mixer. This makes sure that the coax cables are not electrostatically charged when connected to the mixer, which protects the mixer diodes against possible electrostatic discharge.

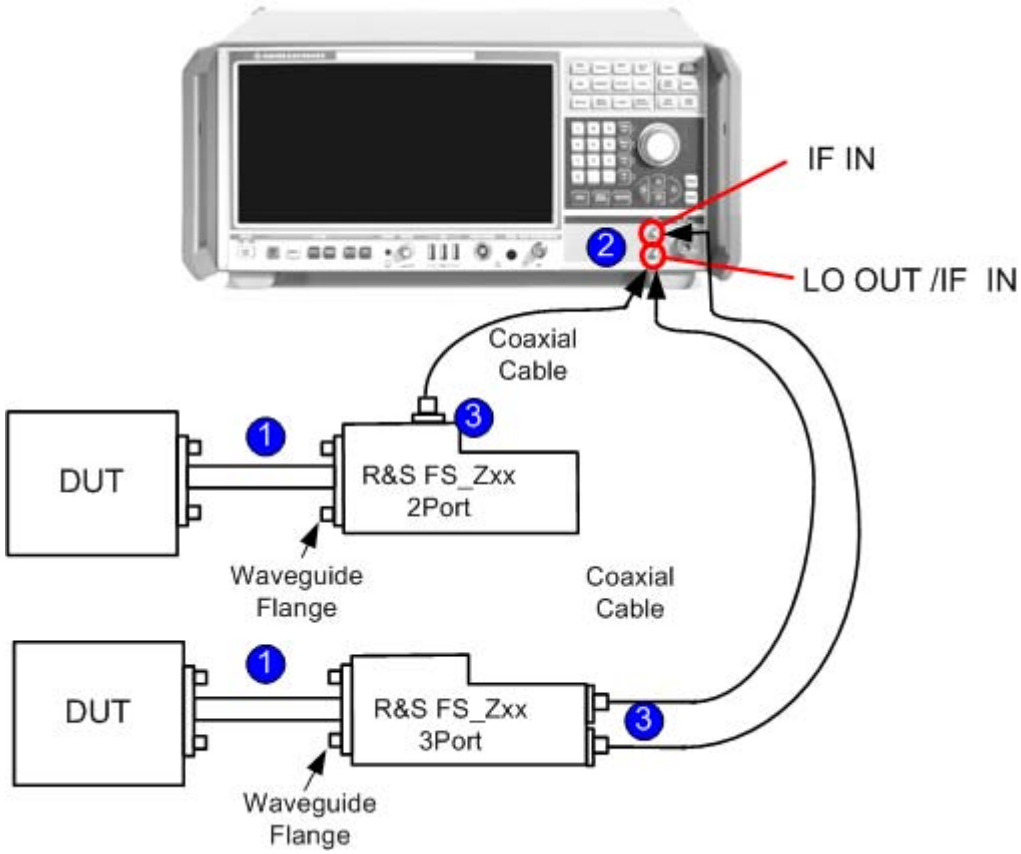

Figure 2-1: Measurement setup using a harmonic mixe

NOTICE

Risk of mixer damage

Before initial use of the external mixer, be sure to read all safety instructions provided on the Documentation CD carefully and make sure that the following conditions and precautions are met:

- Provide sufficient mechanical and electrostatic protection during storage or transportation of the mixer. Heavy shocks can cause damage to the diodes in the mixer.
- Avoid electrostatic discharges near the connectors to protect the mixer diodes.
- Do not apply a torque exceeding 100 Ncm when connecting the LO/IF and IF cables; this may damage the LO/IF and IF connectors (SMA).
- Do not check the function of the diodes by means of an ohmmeter. The diodes can be destroyed by the battery voltage.
- Signal levels at the mixer's RF port and the LO port must be within the ranges specified in the data sheet; otherwise the mixer may be damaged. If the signal level to be measured is not known, perform a test measurement of the DUT with a waveguide attenuator and a power meter first.
- If cables other than the ones supplied with the B21 are used for IF and LO signals, ensure that they have a low insertion loss and that the connection is as short as possible. If the insertion loss increases in the LO path, the LO level of the mixer decreases, resulting in a higher conversion loss and thus a reduced dynamic range.
- Do not stress the cables used to provide the LO signal and tap the IF to avoid cable damage.
- When the mixer is not in use, cover the LO/IF and IF connectors (SMA), as well as the RF port (waveguide) with the provided caps to prevent environmental impact which may cause damage to the mixer.

Failure to meet these conditions may cause damage to the mixer or other devices in the test setup.

3 Operating Instructions

The following chapter contains detailed operating instructions for the R&S FSP, FSU, FSQ and FSUP analyzer families. The corresponding operating instructions for R&S FSV, FSVR and FSW instruments can be found in their operating manuals under the keyword “B21”.

Conventions for settings to be made during the measurement:

[<KEY>]	Press a key on the front panel, e.g., [FREQ]
[<SOFTKEY>]	Press a softkey, e.g., [MARKER -> PEAK]
[<nn Dimension>]	Enter a value and terminate by entering the unit, e.g., [12 kHz]
{<nn>}	Enter values indicated in one of the following tables.

- Successive entries are separated by [:], e.g., [**FREQUENCY** : **15 kHz**]

3.1 Prerequisites

If a file with (old) calibration data stored on the hard drive should be replaced by a new file, proceed as described in section "Replacing Existing Data Files".

If not explicitly explained in the following, described operations are the same for R&S FSP and R&S FSU instruments.

Prior to the first use of the mixer, the conversion loss data file supplied on the memory stick must be imported to the hard drive of the used instrument.

Proceed as follows:

1. Connect the memory stick supplied with the harmonic mixer to a USB port of the instrument.
2. [**PRESET**]
   Reset the instrument.
3. [**FREQ** : EXTERNAL MIXER : EXT MIXER]
   Mixer option is enabled. Softkey EXT MIXER is switched to ON and all other softkeys (without ACCEPT BIAS) are activated
4. [**FREQ** : EXTERNAL MIXER : SELECT BAND : band]
   Select the desired band for which new conversion loss data is to be copied (with cursor keys or rollkey and ENTER). Start and Stop frequencies are changed in correspondence with the selected band.

Mixer	Waveguide band
R&S FS-Z60	U
R&S FS-Z75	V
R&S FS-Z90	E
R&S FS-Z110	W

5. [**FREQ** : EXTERNAL MIXER : CONV LOSS TABLE : LOAD TABLE]
   Use the Windows Explorer and the cursor keys/rollkey to browse for your desired conversion loss file. Select it with the cursor keys/rollkey and start copying with ENTER. The conversion loss file on USB stick is copied to the hard drive.

   For each mixer (R&S FS-Z75, R&S FS-Z90 and R&S FS-Z110), three directories are provided on the USB stick. Each of them contains a conversion loss file corresponding to a different intermediate frequency and is named after this frequency, i.e., 404.4 MHz, 729 MHz and 1330 MHz. The conversion loss file to be loaded depends on the type of spectrum analyzer the mixer is used with. The relations are as follows:

Spectrum Analyzer	Intermediate Frequency / Directory of conversion loss file
R&S FSP40	404.4 MHz
R&S FSU26/43/46/50/67	404.4 MHz
R&S FSQ26/40	404.4 MHz
R&S FSUP26/50	404.4 MHz
R&S FSV30/40	729 MHz
R&S FSVR30/40	729 MHz
R&S FSW26/43/50	1330 MHz

6. [**FREQ** : EXTERNAL MIXER : SELECT BAND : ports]
   Select PORTS table entry with cursor keys/rollkey in the row of the desired band and press ENTER. Use the cursor keys/rollkey to select “2” for a 2 port mixer or “3” for 3 port mixer in the subsequent popup table depending on the type of employed harmonic mixer. Then press ENTER.

   To activate the conversion loss data file copied on hard drive, select the file for the corresponding band in menu *SELECT BAND*.

7. [**FREQ** : EXTERNAL MIXER : SELECT BAND : file]
   To select the conversion loss file in the SELECT BAND table, go to the row of the desired band with up and down cursor keys. With right cursor key select the CONV LOSS TABLE column and press ENTER. The copied conversion loss file is listed in the subsequent popup table. Select it using the cursor up and down keys and press ENTER. The entry in column AVG CONV LOSS/dB for the selected band is now empty. In column CONV LOSS TABLE the conversion loss file name is listed instead (see Figure 3-1 below).

Figure 3-1: Activating the conversion loss file

8. To leave the SELECT BAND menu press [⇑] (MENU UP). The correction data of the selected file is now used for level correction.

Example:

The correction data file for mixer R&S FS-Z75 is to be copied to the hard drive, proceed as follows:

1. Connect the USB stick supplied with the harmonic mixer to the instrument
2. [PRESET]
3. If external mixer option is not activated (EXT MIXER softkey is switched to OFF) press [**FREQ** : EXTERNAL MIXER : EXT MIXER]
4. [**FREQ** : EXTERNAL MIXER : SELECT BAND : band]
   Select the V band in the BAND column with cursor keys/rollkey and ENTER.
5. [**FREQ** : EXTERNAL MIXER : SELECT BAND : CONV LOSS TABLE : LOAD TABLE]
   Use the Windows Explorer and the cursor keys/rollkey to browse for your desired conversion loss file. Select it with the cursor keys/rollkey and start copying with ENTER.
6. [**FREQ** : EXTERNAL MIXER : SELECT BAND : ports]
   Select PORTS table entry with cursor keys/rollkey in the V-band row and press ENTER. Select “3” in the subsequent popup table for the number of ports using the cursor keys/rollkey and ENTER.
7. [**FREQ** : EXTERNAL MIXER : SELECT BAND : file]
   Select CONV LOSS TABLE entry with cursor keys/rollkey in the V-band row and press ENTER. Select the R&S FS-Z75 file copied in step 5 with cursor keys/rollkey and ENTER.
8. Return to menu *EXTERNAL MIXER* by actuating key *MENU UP* [⇑].

3.2 Replacing Existing Data Files

To ensure that the new correction data of a re-calibrated mixer is used, the existing file with the same name must be deleted from the hard drive. Proceed as follows:

1. Connect the USB stick supplied with the harmonic mixer to the instrument
2. [PRESET]
3. If external mixer option is not activated (EXT MIXER softkey is switched to OFF) press [**FREQ** : EXTERNAL MIXER : EXT MIXER]
4. [**FREQ** : EXTERNAL MIXER : SELECT BAND : file]
   To deactivate the currently used conversion loss file in the SELECT BAND table, move the cursor to the row of the desired band using the up and down cursor keys. With the right cursor key select the CONV LOSS TABLE column and press ENTER. In the appearing popup table select the entry NONE using the up and down cursor keys and press ENTER. The AVG CONV LOSS/dB table entry is highlighted. The CONV LOSS TABLE column is empty.
5. [**FREQ** : EXTERNAL MIXER : CONV LOSS TABLE : file]
   Select the conversion loss file to be deleted with the up and down cursor keys in the TABLES table. Then press DELETE TABLE and reconfirm by selecting YES in the popup menu with the cursor keys and ENTER. The conversion loss file is now deleted from hard drive.
6. [**FREQ** : EXTERNAL MIXER : SELECT BAND : band]
   Select the desired band for which new correction data is to be copied (with cursor keys or rollkey and ENTER). Start and Stop frequencies are changed in correspondence with the selected band.

Mixer	Waveguide band
R&S FS-Z60	U
R&S FS-Z75	V
R&S FS-Z90	E
R&S FS-Z110	W

7. [**FREQ** : EXTERNAL MIXER : CONV LOSS TABLE : LOAD TABLE]
   Use the Windows Explorer and the cursor keys/rollkey to browse for your desired conversion loss file. Select it with the cursor keys/rollkey and start copying with ENTER. The conversion loss file on the USB stick is copied to the hard drive.

   To activate the conversion loss data file copied on the hard drive, select the file for the corresponding band in menu *SELECT BAND*.

8. [**FREQ** : EXTERNAL MIXER : SELECT BAND : file]
   To select the conversion loss file in the SELECT BAND table, move the cursor to the row of the desired band using the up and down cursor keys. With the right cursor key select the CONV LOSS TABLE column and press ENTER. In the appearing popup table the copied conversion loss file is listed. Select it using the up and down cursor keys and press ENTER. The entry in column AVG CONV LOSS/dB for the selected band is now empty. In column CONV LOSS TABLE the conversion loss file name is listed instead.
9. To leave the SELECT BAND menu press [⇑] (MENU UP). The new correction data of the selected file is now used for level correction.

Example:

New correction data is to be copied to the hard drive for mixer R&S FS-Z75. Proceed as follows:

1. Connect the USB stick supplied with the harmonic mixer to the instrument.
2. [PRESET]
3. If external mixer option is not activated (EXT MIXER softkey is switched to OFF) press [**FREQ** : EXTERNAL MIXER : EXT MIXER]
4. [**FREQ** : EXTERNAL MIXER : SELECT BAND : file]
   Select conversion loss table entry with cursor keys/rollkey in the V-band row and press ENTER. Select NONE entry with cursor keys and ENTER.
5. [**FREQ** : EXTERNAL MIXER : CONV LOSS TABLE]
   Select the conversion loss file to be deleted with the up and down cursor keys in the TABLES table. Then press DELETE TABLE and reconfirm by selecting YES in the popup menu with the cursor keys and ENTER.
6. [**FREQ** : EXTERNAL MIXER : SELECT BAND : band]
   Select the V band in the BAND column with cursor keys/rollkey and ENTER.
7. [**FREQ** : EXTERNAL MIXER : SELECT BAND : CONV LOSS TABLE : LOAD TABLE]
   Use the Windows Explorer and the cursor keys/rollkey to browse for the new conversion loss file to be loaded. Select it with the cursor keys/rollkey and start copying with ENTER.
8. [**FREQ** : EXTERNAL MIXER : SELECT BAND : file]
   Select CONV LOSS TABLE entry with cursor keys/rollkey in the V-band row and press ENTER. Select the R&S FS-Z75 file copied in step 7 with cursor keys and press ENTER.
9. Return to menu *EXTERNAL MIXER* by actuating key *MENU UP* [⇑].

3.3 Parameters and Settings

Once the conversion loss data file supplied with the mixer has been copied to the hard drive and activated for the corresponding band, the LO level must be set to its nominal value using the function [**FREQ** : EXTERNAL MIXER : LO LEVEL : value] (see also section 3.5 Nominal Local Oscillator Level on page 14). All additional parameters required are automatically set. The mixer is now ready for measurement.

Table 3-1: Parameters for operating R&S FS-Zxx waveguide mixers with R&S FSP

	R&S FS-Z60	**R&S FS-Z75**	**R&S FS-Z90**	**R&S FS-Z110**
Band	U	V	E	W
Frequency range / GHz	40 to 60	50 to 75	60 to 90	75 to 110
Order of harmonic	4^{th}: 40 to 52,3 GHz 6^{th}: 52,3 to 60 GHz	6^{th}	8^{th}	10^{th}
Harmonic even/odd	even	even	even	even
Ports	2	3	3	3
Bias / mA	0	0	0	0
IF / MHz	404.4	404.4	404.4	404.4
Nominal LO level / dBm	15.5	14.0	14.0	15.5

When using the FS-Z110 in combination with an R&S FSP instrument, the conversion loss table for the 10^{th} harmonic also supplied on the USB stick must be selected. The local oscillator range of an R&S FSP instrument only covers the entire RF frequency range from 75 GHz to 110 GHz when using the 10^{th} harmonic.

Table 3-2: Parameters for operating R&S FS-Zxx waveguide mixers with R&S FSU

	R&S FS-Z60	**R&S FS-Z75**	**R&S FS-Z90**	**R&S FS-Z110**
Band	U	V	E	W
Frequency range / GHz	40 to 60	50 to 75	60 to 90	75 to 110
Order of harmonic	4	6	6	8
Harmonic even/odd	even	even	even	even
Ports	2	3	3	3
Bias / mA	0	0	0	0
IF / MHz	404.4	404.4	404.4	404.4
Nominal LO level / dBm	15.5	14.0	14.0	15.5

The allocation of the conversion loss data file to a defined band is maintained when you switch off the instrument or reset it using the "Preset" key. After preset, simply select the corresponding band.

3.4 Notes on Level Correction

The correction data only takes into account the conversion loss of the mixer. The insertion loss of the cable used for tapping the IF signal must be taken into account separately in the correction of the level.

In contrast to the conversion loss of the mixer, the cable loss in the IF path is independent of the frequency. Depending on the spectrum analyzer the mixer is used with, the IF cable loss must be determined at the following frequencies:

Spectrum Analyzer	Intermediate Frequency
R&S FSP40	404.4 MHz
R&S FSU26/43/46/50/67	404.4 MHz
R&S FSQ26/40	404.4 MHz
R&S FSUP26/50	404.4 MHz
R&S FSV30/40	729 MHz
R&S FSVR30/40	729 MHz
R&S FSW26/43/50	1330 MHz

The cable loss is then simply taken into account with a level offset (function [**AMPT** : REF LEVEL OFFSET : value]).

3.5 Nominal Local Oscillator Level

The nominal local oscillator (LO) level is the power at the mixer's LO input port, for which the supplied conversion loss tables are derived. The LO level must be set to this value. However, to compensate for losses of the LO cable, the LO level can be set into the power range as specified in the mixer's datasheet. For the specified level uncertainty the conversion loss tables are valid within this power range. Independent of the used spectrum analyzer, the nominal LO levels of the mixers are:

Mixer	Nominal LO level [dBm]
R&S FS-Z60	15.5
R&S FS-Z75	14.0
R&S FS-Z90	14.0
R&S FS-Z110	15.5

The LO level is set by the function [**FREQ** : EXTERNAL MIXER : LO LEVEL : value]. You can also check the value of the nominal LO level in the calibration protocol delivered with the mixer.

4 Measurement Accuracy

The measurement of signal levels always involves some uncertainty. Depending on the type of measurement, this uncertainty is due to various sources of errors (see section "Errors from Mismatch"). Basically, these sources of errors originate from the used instrument and the harmonic mixer.
Measurement errors due to a too low signal/noise ratio are not taken into account in the following.

Ensuring measurement accuracy

In order to ensure correct measurement and avoid signal distortion, consider the following:

- Ensure the ambient temperature does not exceed the range specified in the data sheet.
- Do not loosen the screws of the mixer or the screws at the SMA connector. Otherwise the calibration data becomes invalid and measurements may provide inaccurate results. The mixer can only be repaired by the manufacturer's servicing department.
- The flanges of the waveguides between the mixer and the DUT should be connected without offsets or air gaps (e.g. due to canting). The contact surface of the waveguide flange should not be soiled or scratched. Only proper connections ensure accurate results.

4.1 Errors from the Used Instrument

When using the harmonic mixers, the measurement accuracy can be influenced by the following sources of errors due to the instrument:

- **Absolute error**: the absolute error made when a signal is directly fed into the LO/IF port or IF input of the spectrum analyzer (see B21 IF input level uncertainty specification).
- **IF amplifier error**: the error due to switching the IF gain. It typically amounts to 0.2 dB.
- **Log linearity error**: the error made during AD conversion (see nonlinearity of displayed level specification).
- **Error on switching the bandwidth:** see bandwidth switching uncertainty/error specification
- **Bandwidth error**: see resolution bandwidth uncertainty

The error specifications are given in the instrument’s data sheet.

4.2 Errors from the Harmonic Mixer

The following sources of errors from the harmonic mixer can contribute to the overall measurement error:

- Uncertainty
- Deviation of the LO level from the ideal value

As for any measurement, measuring conversion loss of mixers involves some errors which have different causes. These errors are included in the specified uncertainty.

Despite the two-diode concept, there is some dependency between the mixer conversion loss and the LO level. If during measurement another LO level is applied to the mixer than the level for measurement of conversion loss in the factory, the actual conversion loss can deviate from that taken into account by the conversion loss data. The resulting measurement uncertainty, however, is already taken into account in the uncertainty given in the specifications. The values only apply if the LO level is set to its nominal value taking into account possible LO cable losses or into its level range as specified in the mixer's data sheet.

4.2.1 Errors from Mismatch

An ideal mixer with an input reflection coefficient of 0 would absorb the total input power offered to it irrespective of the output impedance of the signal source. Mismatch results from the fact that the reflection coefficient of a real mixer is however > 0. The measurement result thus also depends on the output reflection coefficient of the source which is generally > 0. The following equation applies to the measurement uncertainty M_U due to mismatch:

$$M_U = 100 \cdot [(1 \pm r_g \cdot r_l)^2 - 1] \qquad \text{(Equation 1)}$$

with M_U measurement uncertainty in %
r_g magnitude of the source reflection coefficient
r_l magnitude of the mixer reflection coefficient.

The following approximation applies:

$$M_U \approx \pm 200 \cdot r_g \cdot r_l \ . \qquad \text{(Equation 2)}$$

Taking the values of the input or output VSWR of the mixer or DUT, the corresponding reflection coefficients can be calculated as follows:

$$r = \frac{s-1}{s+1} \qquad \text{(Equation 3)}$$

with r reflection coefficient
s VSWR

The mismatch of the mixer IF output and the instruments IF input is also a possible source of error. However, the resulting error can be calculated using the above equations. Due to low VSWR at the IF inputs the resulting error can be neglected.

4.2.2 Total Measurement Error

The sources of errors contributing to the total measurement error depend on the type of measurement. The sources of errors are listed below for the most important cases:

Measurement of the absolute level:

Sources of errors of the instrument:	● Absolute error ● IF amplifier error ● Linearity error ● Error on switching the bandwidth ● Bandwidth error (only with channel power and noise measurement)
Sources of errors of the harmonic mixer:	● Uncertainty
Error from mismatch:	● Mismatch between DUT output and mixer RF input

Relative level measurement:

Sources of errors of the instrument:	● Linearity error
Conditions:	● Constant bandwidths and reference level setting ● Measurements at a signal frequency[1] ● Constant source output impedance

A maximum error (worst case) can be calculated from these contributions by simply adding them up. The maximum error calculated in this way has confidence level of 100 %, i.e., the actual error from a measurement never exceeds the calculated values.

In practice, however, the maximum error seldom occurs. If the total error is the sum of individual errors the causes of which are independent of another, this is statistically a very rare event that all individual errors occur at the same time with their maximum value and same sign during a measurement.

What is more suitable for the practice is to calculate the total error with a certain confidence level, usually 95 % (see Application Note 1EF36 'Level Error Calculation for Spectrum Analyzers').

For systematic errors, i.e., for sources of errors of the instrument, a rectangular distribution is assumed, whereas the level uncertainty of the harmonic mixer is assumed to be normally distributed.

The following equation applies to the variance σ^2 of the individual errors of the instrument:

[1] If the signal frequency varies just a little between two signals to be measured (up to some MHz), the frequency response can be neglected. What appears is just the linearity error of the spectrum analyzer.

$$\sigma^2 = \frac{a^2}{3}$$ (Equation 4)

with σ^2 the variance
a the max. systematic error, in dB

Bandwidth errors are usually specified in %. Thus, the following applies:

$$\sigma^2 = \frac{\left(10 \cdot \lg\left(1 + \frac{RBW_{err}}{100}\right)\right)^2}{3}$$ (Equation 5)

with σ^2 the variance
RBW_{err} the bandwidth error, in %

If an error (e.g. uncertainty of conversion loss data of the mixer) is already given with a defined confidence level, i.e., the indication does not reflect the maximum value, the variance should be first calculated from the specified value.

The following equation applies to indications with a confidence level of 95 % and normal distribution

$$\sigma^2 = \left(\frac{a_{RSS}}{1{,}96}\right)^2$$ (Equation 6)

with σ^2 the variance
a_{RSS} the systematic error with a confidence level of 95 % in dB

Errors from mismatch have a U distribution. Thus, the following equation applies to variance σ^2

$$\sigma^2 = \frac{\left(20 \cdot \lg\left(1 - r_g \cdot r_l\right)\right)^2}{2}$$ (Equation 7)

with σ^2 the variance
r_g the magnitude of the source reflection coefficient, i.e., the DUT
r_l the magnitude of the load reflection coefficient, i.e., the mixer

The magnitude of the reflection coefficient can be calculated with the equation

$$r = \frac{s-1}{s+1}$$ (Equation 8)

with r the reflection coefficient
s the VSWR

Taking the variances σ_i of the different contributions, the combined standard deviation σ_{tot} is calculated using the equation

$$\sigma_{tot} = \sqrt{\sigma_1^2 + \sigma_2^2 + ... + \sigma_n^2}\ .$$ (Equation 9)

The resulting standard deviation has a confidence level of 68 %. This value should be multiplied by 1.96 to obtain a confidence level of 95 %.

Example:

For the absolute level measurement of an input signal (output VSWR of signal source 1.2:1), the total error is to be determined with a confidence level of 95 %. The resolution bandwidth set is 100 kHz, the signal level is approx. 20 dB below the reference level. The bandwidth error should be assumed to be 10 %.

The data sheets for the mixer and the instrument contain the relevant specifications.

	Specified error	**Variance σ_i^2**	**Remarks**
Spectrum analyzer			
Absolute error (with external mixing)	1.0 dB	0.33	comp. equation 4
IF amplifier error	0.2 dB	0.01	comp. equation 4
Linearity error	0.3 dB	0.03	comp. equation 4
Error on switching the bandwidth	0.2 dB	0.01	comp. equation 4
Bandwidth error	10 %	0.07	comp. equation 5
Harmonic mixer			
Uncertainty	3,0 dB	2,34	comp. equation 6
Mismatch			
VSWR RF input of mixer	3,5		
VSWR signal source output	1,2	0,10	comp. equation 7

The combined standard deviation for σ_{tot} = 1.70 can be calculated from variances σ_i^2 using equation 9. The total measurement error of 3.34 dB is obtained with a confidence level of 95 % by multiplying the standard deviation by a factor of 1.96.

An MS Excel® 5.0 spreadsheet (EXTERR0R.XLS file) is supplied on the USB stick with the mixer to simplify such error calculations.

Table 4-1: MS Excel® 5.0 spreadsheet for error calculation

Error Calculation for FSP/FSU/FSUP/FSQ/FSV/FSVR/FSW + External Mixer			
Inherent errors		**specified error**	**variance**
Spectrum analyzer			
absolute error (IF input for external mixing)	[dB]	1.00	0.33
IF amplifier error	[dB]	0.20	0.01
log linearity error	[dB]	0.30	0.03
bandwidth switching error	[dB]	0.20	0.01
bandwidth error	[%]	10.00	0.07
External mixer			
uncertainty of conversion loss data (95% confidence level)	[dB]	3.00	2.34
combined variance			2.80
combined standard uncertainty			1.67
rss error (95% confidence level)	[dB]		**3.28**
Error due to source mismatch			
VSWR of external mixer (RF port)		3.50	
VSWR of DUT		1.20	0.10
combined variance			2.90
combined standard uncertainty			1.70
error including source mismatch (95%)	[dB]		**3.34**

The different errors are to be entered in the yellow fields in the specified unit. The calculated error with a confidence level of 95 % is output in the dark blue fields.

The error output under "rss error (95 % confidence level)" takes into account all individual errors due to the instrument and mixer.
Errors due to mismatch between DUT and mixer input are taken into account in the value for ‘error including source mismatch (95 %)’.

5 Maintenance and Troubleshooting

5.1 Maintenance

The harmonic mixers FS-Z60/75/90/110 are maintenance-free. Clean the contact surface of the waveguide flange with alcohol and a soft cloth at regular intervals.

NOTICE

Do not scratch the contact surface.

To keep measurement errors at a minimum level the mixer should be returned to the manufacturer for recalibration at regular intervals (see specifications for calibration intervals in the data sheet).

5.2 Troubleshooting

Troubleshooting as such is not possible in the harmonic mixers of the R&S FS-Zxx series. Defective mixers require repair and new measurement of conversion loss by the manufacturer.
Damages are generally recognizable by increased conversion loss up to complete dropout.

NOTICE

Risk of blowing the diodes

Do not check the function of the diodes by means of an ohmmeter. The diodes can be destroyed by the battery voltage.

Risk of measurement errors

Do not loosen the screws of the mixer and the screws for fastening the SMA connector. Otherwise the calibration data becomes invalid and measurements may provide inaccurate results.

Risk of invalid data

The label with conversion loss data also serves as a seal. Conversion loss data becomes invalid if this seal is broken.

6 Checking Rated Specifications

6.1 Measurement Equipment and Accessories

Table 6-1: Measurement Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Page
1	Spectrum analyzer		R&S FSP40 + B21[1)] or R&S FSU26 + B21 or R&S FSU43 + B21 or R&S FSU46 + B21 or R&S FSU50 + B21 or R&S FSQ26 + B21 or R&S FSQ40 + B21 or R&S FSUP26 + B21 or R&S FSUP50 + B21 or R&S FSV30 + B21 or R&S FSV40 + B21 or R&S FSVR30 + B21 or R&S FSVR40 + B21 or R&S FSW26 + B21 or R&S FSW43 + B21 or R&S FSW50 + B21 1) Option B21 R&S Order No. 1155.1758.01 for R&S FSP, 1157.1090.03 for R&S FSU, 1157.1090.04 for R&S FSUP 1310.9597.02 for R&S FSV 1310.9597.02 for R&S FSVR 1313.1100.26 for R&S FSW26 1313.1100.43 for R&S FSW43 1313.1100.43 for R&S FSW50	1164.4391.40 1166.1660.26 1166.1660.43 1166.1660.46 1166.1660.50 1155.5001.26 1155.5001.40 1166.3505.26 1166.3505.50 1307.9002K30 1307.9002K40 1311.0006.30 1311.0006.40 1312.8000K26 1312.8000K43 1312.8000K50	24
2	Signal generator	Frequency range up to 2 GHz	SMBV100A with SMBV-B103	1407.6004.02 1407.9603.02	24
3	Signal source	-15 dBm < Output level < -5 dBm Output VSWR < 2.0 : 1 Frequency range: R&S FS-Z60: 40 GHz to 60 GHz R&S FS-Z75: 50 GHz to 75 GHz R&S FS-Z90: 60 GHz to 90 GHz R&S FS-Z110: 75 GHz to 110 GHz Waveguide flange R&S FS-Z60: UG-383/U-M R&S FS-Z75: UG-385/U R&S FS-Z90: UG-387/U R&S FS-Z110: UG-387/U-M	R&S FS-Z60: R&S SMR60 R&S FS-Z75: R&S SMF 100A + R&S SMF-B144 + R&S SMZ75 + R&S SMZ-B75E R&S FS-Z90: R&S SMF 100A + R&S SMF-B144 + R&S SMZ90 + R&S SMZ-B90E R&S FS-Z110: R&S SMF 100A + R&S SMF-B144 + R&S SMZ110 + R&S SMZ-B110E	 1134.9008.60 1167.0000.02 1167.7204.03 1417.4004.02 1417.6107.02 1167.0000.02 1167.7204.03 1417.4504.02 1417.6607.02 1167.0000.02 1167.7204.03 1417.5000.02 1417.7103.02	24
4	Power meter		R&S NRVD	0857.8008.02	24
5	Power sensor	Frequency range up to 2 GHz RSS error referred to indicated power ≤ 0,8% Meter noise ≤ 20 pW	R&S NRV-Z4	0828.3618.02	24

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Page
6	Power meter	Capability for waveguide sensors R&S FS-Z60: 40 GHz to 60 GHz R&S FS-Z75: 50 GHz to 75 GHz R&S FS-Z90: 60 GHz to 90 GHz R&S FS-Z110: 75 GHz to 110 GHz	R&S FS-Z60: Anritsu ML4803A + Anritsu MP715A4		24
7	Power sensor	Frequency range R&S FS-Z60: 40 GHz to 60 GHz R&S FS-Z75: 50 GHz to 75 GHz R&S FS-Z90: 60 GHz to 90 GHz R&S FS-Z110: 75 GHz 110 GHz Waveguide flange R&S FS-Z60: UG-383/U-M R&S FS-Z75: UG-385/U R&S FS-Z90: UG-387/U R&S FS-Z110: UG-387/U-M Input VSWR < 1.5 : 1 Meter noise ≤ -30 dBm Error (RSS) ≤ 4 %	R&S FS-Z75: Agilent E4419A V8486A R&S FS-Z90: Anritsu ML4803A + Anritsu MP717A4 R&S FS-Z110: Agilent E4419A W8486A		24
8	Attenuator	Attenuation 10 dB VSWR ≤ 1.15 : 1 Waveguide flange R&S FS-Z60: UG-383/U-M R&S FS-Z75: UG-385/U R&S FS-Z90: UG-387/U R&S FS-Z110: UG-387/U-M	R&S FS-Z60: Millitech FXA-19-R10G0 R&S FS-Z75: Millitech FXA-15-R10G0 R&S FS-Z90: Millitech FXA-12-R10G0 R&S FS-Z110: Millitech FXA-10-R10G0		24
9	Waveguide transitions	required only for R&S FS-Z60: V-coaxial male to WR-19 transition	Anritsu 35WR19V		24

6.2 Test Instructions

Consider the following when executing performance checks:

- Prior to the performance check of the harmonic mixer, and after a warm-up time of at least 30 minutes, a total calibration of the R&S FSP/FSU/FSQ/FSUP/FSV/FSVR/FSW has to be carried out. Only in this case the compliance with the guaranteed data can be ensured.
- The settings are defined from the Preset state.
- Values provided in the following sections are not guaranteed. Only the technical specifications of the harmonic mixer data sheet are binding.

Conventions used to describe the measurement settings and procedures:

[<*KEY*>] Press a key on the front panel, e.g., [SPAN]
[<*SOFTKEY*>] Press a softkey, e.g., [MARKER -> PEAK]
[<nn unit>] Enter a value and terminate by entering the unit, e.g., [12 kHz]
Successive entries are separated by [:], e.g., [SPAN: 15 kHz]

6.2.1 Checking the Conversion Loss

Test equipment:

- spectrum analyzer (Table 6-1, Item 1)
- signal generator (Table 6-1, Item 2)
  frequency range up to 2 GHz
- power meter (Table 6-1, Item 4)
- power sensor (Table 6-1, Item 5)
  frequency range up to 2 GHz
  RSS error referred to indicated power ≤ 0.8 %
  meter noise ≤ 20 pW
- signal source (Table 6-1, Item 3)
  -20 dBm < output level < -5 dBm
  output VSWR < 2.0 : 1
  frequency range
  R&S FS-Z60: 40 GHz to 60 GHz
  R&S FS-Z75: 50 GHz to 75 GHz
  R&S FS-Z90: 60 GHz to 90 GHz
  R&S FS-Z110: 75 GHz to 110 GHz
  waveguide flange
  R&S FS-Z60: UG-383/U-M
  R&S FS-Z75: UG-385/U
  R&S FS-Z90: UG-387/U
  R&S FS-Z110: UG-387/U-M
- attenuator (Table 6-1, Item 8)
  attenuator 10 dB
  VSWR ≤ 1,15 : 1
  frequency range
  R&S FS-Z60: 40 GHz to 60 GHz
  R&S FS-Z75: 50 GHz to 75 GHz
  R&S FS-Z90: 60 GHz to 90 GHz
  R&S FS-Z110: 75 GHz to 110 GHz
  waveguide flange
  R&S FS-Z60: UG-383/U-M
  R&S FS-Z75: UG-385/U
  R&S FS-Z90: UG-387/U
  R&S FS-Z110: UG-387/U-M

- power meter (Table 6-1, Item 6)

  capability for waveguide power sensors

- power sensor (Table 6-1, Item 7)

  meter noise ≤ -30 dBm

  RSS error ≤ 4 %

  input VSWR < 1.5 : 1

  frequency range
  - R&S FS-Z60: 40 GHz to 60 GHz
  - R&S FS-Z75: 50 GHz to 75 GHz
  - R&S FS-Z90: 60 GHz to 90 GHz
  - R&S FS-Z110: 75 GHz to 110 GHz

  waveguide flange
  - R&S FS-Z60: UG-383/U-M
  - R&S FS-Z75: UG-385/U
  - R&S FS-Z90: UG-387/U
  - R&S FS-Z110: UG-387/U-M

- waveguide transition (Table 6-1, Item 9)
  required only for R&S FS-Z60

  V-coaxial male to WR19

6.2.1.1 Determining the Absolute Level Error

This measurement determines the overall level error $L_{err\ abs}$, which consists of the level error of the used analyzer $L_{err\ analyzer}$ plus the level error of the used IF cable $L_{err\ cable}$.

To measure the level error $L_{err\ analyzer}$ of the used spectrum analyzer, execute the B21 IF performance test described in the corresponding instrument manual.

The following instructions determine the level error $L_{err\ cable}$ of the used IF cable

Test setup:
- ➢ connect power sensor (Table 6-1, Item 5) to the power meter (Table 6-1, Item 4) and execute function ´ZERO´ when there is no signal applied to the power sensor.
- ➢ connect power sensor directly to RF output of signal generator (Table 6-1, Item 2).

Signal generator settings:
- frequency: 404.4 MHz for FSP/FSQ/FSU/FSUP instruments
  729.9 MHz for FSV/FSVR instruments
  1330 MHz for FSW instruments
- level: -10 dBm

Measurement:
- ➢ determine output power of the signal generator with the power meter. To achieve higher accuracy it is recommended to compensate the frequency response of the power sensor.
- ➢ connect the IF cable delivered with the B21 to RF output of the signal generator and RF input of the power sensor.

Evaluation: The signal level measured directly at the RF output of the signal generator minus the power measured with the IF cable between generator and power sensor is the level error $L_{err\ cable}$. The level error $L_{err\ abs}$ is sum of $L_{err\ analyzer}$ and $L_{err\ cable}$

$$L_{err\ abs} = L_{err\ analyzer} + L_{err\ cable}$$

The determined absolute error $L_{err\ abs}$ should be noted in Table 6-2 (Item 1) of the performance test report.

6.2.1.2 Determining the Output Level of the Signal Source

Test setup:

- connect power sensor (Table 6-1, Item 7) to the power meter (Table 6-1, Item 6) and execute function ´ZERO´ when there is no signal applied to the power sensor.
- connect power sensor via attenuator (Table 6-1, Item 8) to RF output of signal source (Table 6-1, Item 3).

For R&S FS-Z60*: Use waveguide transition V to WR19* (Table 6-1, Item 9) *at the output of the signal source to adapt it to the waveguide flange of the attenuator.*

Signal source settings:

- level -8 dBm
- frequency f_{fresp}

See Table 6-2 (Item 2) of performance test report for values of f_{fresp}.

Power meter settings: Determine signal level L_{gen} and note it in Table 6-2 (Item 2). To achieve higher accuracy it is recommended to compensate the frequency response of the power sensor.

6.2.1.3 Determining the Conversion Loss of the Mixer

Test setup:

- connect harmonic mixer via attenuator (Table 6-1, Item 8) to signal source Table 6-1, Item 3).

For R&S FS-Z60*: Use waveguide transition V to WR19* Table 6-1, Item 9) *at the output of the signal source to adapt it to the waveguide flange of the attenuator.*

- Connect front panel connector ‘LO OUT / IF IN’ of the used analyzer instrument with connector ‘LO / IF’ of the harmonic mixer in case of a 2 port mixer.
  In case of a 3 port mixer connect instrument front panel connector ‘LO OUT / IF IN’ with connector ‘LO’ of the harmonic mixer and ‘IF IN’ front panel connector with connector ‘IF’ of the mixer. Use the coaxial cables delivered with the B21.

Signal generator settings:

- frequency f_{fresp}

See Table 6-2 (Item 3) of performance test report for values of f_{fresp}.

Analyzer settings:

- [**PRESET**]
- enable external mixer support [2]
- [**FREQ** CENTER : {f_{fresp}}]
  See Table 6-2 (Item 3) of performance test report for values of f_{fresp}.
- select desired band of the measured mixer
  - Select desired band (R&S FS-Z60 band U, R&S FS-Z75 band V, R&S FS-Z90 band E, R&S FS-Z110 band W)
  - Select AVG CONV LOSS/dB table entry and set the conversion loss to 0 dB.
  - Select PORTS "2" for 2 port mixers and "3" for 3 port mixers in the mixer port entry, respectively
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- Set marker to peak [**MKR->** : PEAK]

The signal level $L_{analyzer}$ is displayed by level reading of marker 1.

Evaluation: The conversion loss can be calculated as follows:

$$a_{conv} = L_{gen} - (L_{analyzer} - L_{err\ abs})$$

Compare the measured values with the limits given in Table 6-2 (Item 3) of performance test report.

6.2.2 Checking the Noise Display

Test setup:

➢ Connect front panel connector ‘LO OUT / IF IN’ of the used analyzer instrument with connector ‘LO / IF’ of the harmonic mixer in case of a 2 port mixer.
In case of a 3 port mixer connect instrument front panel connector ‘LO OUT / IF IN’ with connector ‘LO’ of the harmonic mixer and ‘IF IN’ front panel connector with connector ‘IF’ of the mixer. Use the coaxial cables delivered with the B21.

[2] For detailed information how to operate the external mixer settings please refer to the operating manual of the used instrument.

Analyzer settings:

- [**PRESET**]
- enable external mixer support
- [**FREQ** CENTER : {f_{fresp}}]

See Table 6-2 (Item 3) of performance test report for values of f_{fresp}.

select desired band of the measured mixer

- Select desired band (R&S FS-Z60 band U, R&S FS-Z75 band V, R&S FS-Z90 band E, R&S FS-Z110 band W)
- Select AVG CONV LOSS/dB table entry and set the conversion loss to {a_{conv}}. See Table 6-2 (Item 3) of performance test report for value of a_{conv} at {f_{fresp}}
- Select PORTS "2" for 2 port mixers and "3" for 3 port mixers in the mixer port entry, respectively

- [**SPAN** : **10 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**BW** : VIDEO BW MANUAL : **10 Hz**]
- [**TRACE** : AVERAGE]
- [**TRACE** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : **-35 dBm**]
- [**SWEEP** : SINGLE SWEEP]

- set marker to peak

[**MKR->** : PEAK]

Evaluation: The noise level is displayed by the level reading of marker 1. Compare the measured values with the limits given in Table 6-2 (Item 4) of performance test report

6.3 Performance Test Report

The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.

Table 6-2: Performance test report

ROHDE & SCHWARZ	Performance Test Report	Harmonic Mixer	Version 07-Mar-2013
Model (R&S FS-Z60 / 75 / 90 / 110):			
Order number:			
Serial number:			
Test person:			
Date:			
Signature:			

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
1	Checking the conversion loss absolute error	24	 -	 _____	 -	 dB
2	Checking the conversion loss **output level L_{gen} of signal source** f_{fresp} **R&S FS-Z60:**	24				
	40 GHz		-	_____	-	dBm
	41 GHz		-	_____	-	dBm
	42 GHz		-	_____	-	dBm
	43 GHz		-	_____	-	dBm
	44 GHz		-	_____	-	dBm
	45 GHz		-	_____	-	dBm
	46 GHz		-	_____	-	dBm
	47 GHz		-	_____	-	dBm
	48 GHz		-	_____	-	dBm
	49 GHz		-	_____	-	dBm
	50 GHz		-	_____	-	dBm
	51 GHz		-	_____	-	dBm
	52 GHz		-	_____	-	dBm
	53 GHz		-	_____	-	dBm
	54 GHz		-	_____	-	dBm
	55 GHz		-	_____	-	dBm
	56 GHz		-	_____	-	dBm
	57 GHz		-	_____	-	dBm
	58 GHz		-	_____	-	dBm
	59 GHz		-	_____	-	dBm
	60 GHz		-	_____	-	dBm

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
2	Checking the conversion loss **output level L_{gen} of signal source** f_{fresp} **R&S FS-Z75:**	24				
	50 GHz		-	_____	-	dBm
	51 GHz		-	_____	-	dBm
	52 GHz		-	_____	-	dBm
	53 GHz		-	_____	-	dBm
	54 GHz		-	_____	-	dBm
	55 GHz		-	_____	-	dBm
	56 GHz		-	_____	-	dBm
	57 GHz		-	_____	-	dBm
	58 GHz		-	_____	-	dBm
	59 GHz		-	_____	-	dBm
	60 GHz		-	_____	-	dBm
	61 GHz		-	_____	-	dBm
	62 GHz		-	_____	-	dBm
	63 GHz		-	_____	-	dBm
	64 GHz		-	_____	-	dBm
	65 GHz		-	_____	-	dBm
	66 GHz		-	_____	-	dBm
	67 GHz		-	_____	-	dBm
	68 GHz		-	_____	-	dBm
	69 GHz		-	_____	-	dBm
	70 GHz		-	_____	-	dBm
	71 GHz		-	_____	-	dBm
	72 GHz		-	_____	-	dBm
	73 GHz		-	_____	-	dBm
	74 GHz		-	_____	-	dBm
	75 GHz		-	_____	-	dBm

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
2	Checking the conversion loss **output level L_{gen} of signal source** f_{fresp} **R&S FS-Z90:**	24				
	60 GHz		-	_____	-	dBm
	61 GHz		-	_____	-	dBm
	62 GHz		-	_____	-	dBm
	63 GHz		-	_____	-	dBm
	64 GHz		-	_____	-	dBm
	65 GHz		-	_____	-	dBm
	66 GHz		-	_____	-	dBm
	67 GHz		-	_____	-	dBm
	68 GHz		-	_____	-	dBm
	69 GHz		-	_____	-	dBm
	70 GHz		-	_____	-	dBm
	71 GHz		-	_____	-	dBm
	72 GHz		-	_____	-	dBm
	73 GHz		-	_____	-	dBm
	74 GHz		-	_____	-	dBm
	75 GHz		-	_____	-	dBm
	76 GHz		-	_____	-	dBm
	77 GHz		-	_____	-	dBm
	78 GHz		-	_____	-	dBm
	79 GHz		-	_____	-	dBm
	80 GHz		-	_____	-	dBm
	81 GHz		-	_____	-	dBm
	82 GHz		-	_____	-	dBm
	83 GHz		-	_____	-	dBm
	84 GHz		-	_____	-	dBm
	85 GHz		-	_____	-	dBm
	86 GHz		-	_____	-	dBm
	87 GHz		-	_____	-	dBm
	88 GHz		-	_____	-	dBm
	89 GHz		-	_____	-	dBm
	90 GHz		-	_____	-	dBm

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
2	Checking the conversion loss **output level L_{gen} of signal source** f_{fresp} **R&S FS-Z110:**	24				
	75 GHz		-	_____	-	dBm
	76 GHz		-	_____	-	dBm
	77 GHz		-	_____	-	dBm
	78 GHz		-	_____	-	dBm
	79 GHz		-	_____	-	dBm
	80 GHz		-	_____	-	dBm
	81 GHz		-	_____	-	dBm
	82 GHz		-	_____	-	dBm
	83 GHz		-	_____	-	dBm
	84 GHz		-	_____	-	dBm
	85 GHz		-	_____	-	dBm
	86 GHz		-	_____	-	dBm
	87 GHz		-	_____	-	dBm
	88 GHz		-	_____	-	dBm
	89 GHz		-	_____	-	dBm
	90 GHz		-	_____	-	dBm
	91 GHz		-	_____	-	dBm
	92 GHz		-	_____	-	dBm
	93 GHz		-	_____	-	dBm
	94 GHz		-	_____	-	dBm
	95 GHz		-	_____	-	dBm
	96 GHz		-	_____	-	dBm
	97 GHz		-	_____	-	dBm
	98 GHz		-	_____	-	dBm
	99 GHz		-	_____	-	dBm
	100 GHz		-	_____	-	dBm
	101 GHz		-	_____	-	dBm
	102 GHz		-	_____	-	dBm
	103 GHz		-	_____	-	dBm
	104 GHz		-	_____	-	dBm
	105 GHz		-	_____	-	dBm
	106 GHz		-	_____	-	dBm
	107 GHz		-	_____	-	dBm
	108 GHz		-	_____	-	dBm
	109 GHz		-	_____	-	dBm
	110 GHz		-	_____	-	dBm

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
3	Checking the conversion loss **Conversion a_{conv} of harmonic mixer** f_{fresp}	24				
	R&S FS-Z60, 4th harmonic:		-			
	40 GHz		-	_____	25	dB
	41 GHz		-	_____	25	dB
	42 GHz		-	_____	25	dB
	43 GHz		-	_____	25	dB
	44 GHz		-	_____	25	dB
	45 GHz		-	_____	25	dB
	46 GHz		-	_____	25	dB
	47 GHz		-	_____	25	dB
	48 GHz		-	_____	25	dB
	49 GHz		-	_____	25	dB
	50 GHz		-	_____	25	dB
	51 GHz		-	_____	25	dB
	52 GHz		-	_____	25	dB
	53 GHz		-	_____	25	dB
	54 GHz		-	_____	25	dB
	55 GHz		-	_____	25	dB
	56 GHz		-	_____	25	dB
	57 GHz		-	_____	25	dB
	58 GHz		-	_____	25	dB
	59 GHz		-	_____	25	dB
	60 GHz					
	R&S FS-Z60, 6th harmonic:				30	
	40 GHz		-	_____	30	dB
	41 GHz		-	_____	30	dB
	42 GHz		-	_____	30	dB
	43 GHz		-	_____	30	dB
	44 GHz		-	_____	30	dB
	45 GHz		-	_____	30	dB
	46 GHz		-	_____	30	dB
	47 GHz		-	_____	30	dB
	48 GHz		-	_____	30	dB
	49 GHz		-	_____	30	dB
	50 GHz		-	_____	30	dB
	51 GHz		-	_____	30	dB
	52 GHz		-	_____	30	dB
	53 GHz		-	_____	30	dB
	54 GHz		-	_____	30	dB
	55 GHz		-	_____	30	dB
	56 GHz		-	_____	30	dB
	57 GHz		-	_____	30	dB
	58 GHz		-	_____	30	dB
	59 GHz		-	_____	30	dB
	60 GHz		-	_____	30	dB

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
3	Checking the conversion loss **Conversion a_{conv} of harmonic mixer** f_{fresp} **R&S FS-Z75:**	24				
	50 GHz		-	_____	34	dB
	51 GHz		-	_____	34	dB
	52 GHz		-	_____	34	dB
	53 GHz		-	_____	34	dB
	54 GHz		-	_____	34	dB
	55 GHz		-	_____	34	dB
	56 GHz		-	_____	34	dB
	57 GHz		-	_____	34	dB
	58 GHz		-	_____	34	dB
	59 GHz		-	_____	34	dB
	60 GHz		-	_____	34	dB
	61 GHz		-	_____	34	dB
	62 GHz		-	_____	34	dB
	63 GHz		-	_____	34	dB
	64 GHz		-	_____	34	dB
	65 GHz		-	_____	34	dB
	66 GHz		-	_____	34	dB
	67 GHz		-	_____	34	dB
	68 GHz		-	_____	34	dB
	69 GHz		-	_____	34	dB
	70 GHz		-	_____	34	dB
	71 GHz		-	_____	34	dB
	72 GHz		-	_____	34	dB
	73 GHz		-	_____	34	dB
	74 GHz		-	_____	34	dB
	75 GHz		-	_____	34	dB

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
3	Checking the conversion loss **Conversion a_{conv} of harmonic mixer** f_{fresp} **R&S FS-Z90:**	24				
	60 GHz		-	_____	30	dB
	61 GHz		-	_____	30	dB
	62 GHz		-	_____	30	dB
	63 GHz		-	_____	30	dB
	64 GHz		-	_____	30	dB
	65 GHz		-	_____	30	dB
	66 GHz		-	_____	30	dB
	67 GHz		-	_____	30	dB
	68 GHz		-	_____	30	dB
	69 GHz		-	_____	30	dB
	70 GHz		-	_____	30	dB
	71 GHz		-	_____	30	dB
	72 GHz		-	_____	30	dB
	73 GHz		-	_____	30	dB
	74 GHz		-	_____	30	dB
	75 GHz		-	_____	30	dB
	76 GHz		-	_____	30	dB
	77 GHz		-	_____	30	dB
	78 GHz		-	_____	30	dB
	79 GHz		-	_____	30	dB
	80 GHz		-	_____	30	dB
	81 GHz		-	_____	30	dB
	82 GHz		-	_____	30	dB
	83 GHz		-	_____	30	dB
	84 GHz		-	_____	30	dB
	85 GHz		-	_____	30	dB
	86 GHz		-	_____	30	dB
	87 GHz		-	_____	30	dB
	88 GHz		-	_____	30	dB
	89 GHz		-	_____	30	dB
	90 GHz		-	_____	30	dB

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
3	Checking the conversion loss **Conversion a_{conv} of harmonic mixer** f_{fresp} **R&S FS-Z110, 8th harmonic:**	24				
	75 GHz		-	_____	25	dB
	76 GHz		-	_____	25	dB
	77 GHz		-	_____	25	dB
	78 GHz		-	_____	25	dB
	79 GHz		-	_____	25	dB
	80 GHz		-	_____	25	dB
	81 GHz		-	_____	25	dB
	82 GHz		-	_____	25	dB
	83 GHz		-	_____	25	dB
	84 GHz		-	_____	25	dB
	85 GHz		-	_____	25	dB
	86 GHz		-	_____	25	dB
	87 GHz		-	_____	25	dB
	88 GHz		-	_____	25	dB
	89 GHz		-	_____	25	dB
	90 GHz		-	_____	25	dB
	91 GHz		-	_____	25	dB
	92 GHz		-	_____	25	dB
	93 GHz		-	_____	25	dB
	94 GHz		-	_____	25	dB
	95 GHz		-	_____	30	dB
	96 GHz		-	_____	30	dB
	97 GHz		-	_____	30	dB
	98 GHz		-	_____	30	dB
	99 GHz		-	_____	30	dB
	100 GHz		-	_____	30	dB
	101 GHz		-	_____	30	dB
	102 GHz		-	_____	30	dB
	103 GHz		-	_____	30	dB
	104 GHz		-	_____	30	dB
	105 GHz		-	_____	30	dB
	106 GHz		-	_____	30	dB
	107 GHz		-	_____	30	dB
	108 GHz		-	_____	30	dB
	109 GHz		-	_____	30	dB
	110 GHz		-	_____	30	dB

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
3	Checking the conversion loss **Conversion a_{conv} of harmonic mixer** f_{fresp} **R&S FS-Z110, 10th harmonic:**	24				
	85 GHz		-	_____	34	dB
	86 GHz		-	_____	34	dB
	87 GHz		-	_____	34	dB
	88 GHz		-	_____	34	dB
	89 GHz		-	_____	34	dB
	90 GHz		-	_____	34	dB
	91 GHz		-	_____	34	dB
	92 GHz		-	_____	34	dB
	93 GHz		-	_____	34	dB
	94 GHz		-	_____	34	dB
	95 GHz		-	_____	34	dB
	96 GHz		-	_____	34	dB
	97 GHz		-	_____	34	dB
	98 GHz		-	_____	34	dB
	99 GHz		-	_____	34	dB
	100 GHz		-	_____	34	dB
	101 GHz		-	_____	34	dB
	102 GHz		-	_____	34	dB
	103 GHz		-	_____	34	dB
	104 GHz		-	_____	34	dB
	105 GHz		-	_____	34	dB
	106 GHz		-	_____	34	dB
	107 GHz		-	_____	34	dB
	108 GHz		-	_____	34	dB
	109 GHz		-	_____	34	dB
	110 GHz		-	_____	34	dB

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
4	Checking the noise display f_{fresp} **R&S FS-Z60:**	27				
	40 GHz		-	_____	-110	dBm
	41 GHz		-	_____	-110	dBm
	42 GHz		-	_____	-110	dBm
	43 GHz		-	_____	-110	dBm
	44 GHz		-	_____	-110	dBm
	45 GHz		-	_____	-110	dBm
	46 GHz		-	_____	-110	dBm
	47 GHz		-	_____	-110	dBm
	48 GHz		-	_____	-110	dBm
	49 GHz		-	_____	-110	dBm
	50 GHz		-	_____	-110	dBm
	51 GHz		-	_____	-110	dBm
	52 GHz		-	_____	-110	dBm
	53 GHz		-	_____	-110	dBm
	54 GHz		-	_____	-110	dBm
	55 GHz		-	_____	-110	dBm
	56 GHz		-	_____	-110	dBm
	57 GHz		-	_____	-110	dBm
	58 GHz		-	_____	-110	dBm
	59 GHz		-	_____	-110	dBm
	60 GHz		-	_____	-110	dBm
	R&S FS-Z75:					
	50 GHz		-	_____	-98	dBm
	51 GHz		-	_____	-98	dBm
	52 GHz		-	_____	-98	dBm
	53 GHz		-	_____	-98	dBm
	54 GHz		-	_____	-98	dBm
	55 GHz		-	_____	-98	dBm
	56 GHz		-	_____	-98	dBm
	57 GHz		-	_____	-98	dBm
	58 GHz		-	_____	-98	dBm
	59 GHz		-	_____	-98	dBm
	60 GHz		-	_____	-98	dBm
	61 GHz		-	_____	-98	dBm
	62 GHz		-	_____	-98	dBm
	63 GHz		-	_____	-98	dBm
	64 GHz		-	_____	-98	dBm
	65 GHz		-	_____	-98	dBm
	66 GHz		-	_____	-98	dBm
	67 GHz		-	_____	-98	dBm
	68 GHz		-	_____	-98	dBm
	69 GHz		-	_____	-98	dBm
	70 GHz		-	_____	-98	dBm
	71 GHz		-	_____	-98	dBm
	72 GHz		-	_____	-98	dBm
	73 GHz		-	_____	-98	dBm
	74 GHz		-	_____	-98	dBm
	75 GHz		-	_____	-98	dBm

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
4	Checking the noise display f_{fresp} **R&S FS-Z90:**	27				
	60 GHz		-	_____	-101	dBm
	61 GHz		-	_____	-101	dBm
	62 GHz		-	_____	-101	dBm
	63 GHz		-	_____	-101	dBm
	64 GHz		-	_____	-101	dBm
	65 GHz		-	_____	-101	dBm
	66 GHz		-	_____	-101	dBm
	67 GHz		-	_____	-101	dBm
	68 GHz		-	_____	-101	dBm
	69 GHz		-	_____	-101	dBm
	70 GHz		-	_____	-101	dBm
	71 GHz		-	_____	-101	dBm
	72 GHz		-	_____	-101	dBm
	73 GHz		-	_____	-101	dBm
	74 GHz		-	_____	-101	dBm
	75 GHz		-	_____	-101	dBm
	76 GHz		-	_____	-101	dBm
	77 GHz		-	_____	-101	dBm
	78 GHz		-	_____	-101	dBm
	79 GHz		-	_____	-101	dBm
	80 GHz		-	_____	-101	dBm
	81 GHz		-	_____	-101	dBm
	82 GHz		-	_____	-101	dBm
	83 GHz		-	_____	-101	dBm
	84 GHz		-	_____	-101	dBm
	85 GHz		-	_____	-101	dBm
	86 GHz		-	_____	-101	dBm
	87 GHz		-	_____	-101	dBm
	88 GHz		-	_____	-101	dBm
	89 GHz		-	_____	-101	dBm
	90 GHz		-	_____	-101	dBm

Item No.	Characteristic	Test described on page	Min. value	Actual value	Max. value	Unit
4	Checking the noise display f_{fresp} **R&S FS-Z110:**	27				
	75 GHz		-	_____	-105	dBm
	76 GHz		-	_____	-105	dBm
	77 GHz		-	_____	-105	dBm
	78 GHz		-	_____	-105	dBm
	79 GHz		-	_____	-105	dBm
	80 GHz		-	_____	-105	dBm
	81 GHz		-	_____	-105	dBm
	82 GHz		-	_____	-105	dBm
	83 GHz		-	_____	-105	dBm
	84 GHz		-	_____	-105	dBm
	85 GHz		-	_____	-105	dBm
	86 GHz		-	_____	-105	dBm
	87 GHz		-	_____	-105	dBm
	88 GHz		-	_____	-105	dBm
	89 GHz		-	_____	-105	dBm
	90 GHz		-	_____	-105	dBm
	91 GHz		-	_____	-105	dBm
	92 GHz		-	_____	-105	dBm
	93 GHz		-	_____	-105	dBm
	94 GHz		-	_____	-105	dBm
	95 GHz		-	_____	-105	dBm
	96 GHz		-	_____	-105	dBm
	97 GHz		-	_____	-105	dBm
	98 GHz		-	_____	-105	dBm
	99 GHz		-	_____	-105	dBm
	100 GHz		-	_____	-105	dBm
	101 GHz		-	_____	-105	dBm
	102 GHz		-	_____	-105	dBm
	103 GHz		-	_____	-105	dBm
	104 GHz		-	_____	-105	dBm
	105 GHz		-	_____	-105	dBm
	106 GHz		-	_____	-105	dBm
	107 GHz		-	_____	-105	dBm
	108 GHz		-	_____	-105	dBm
	109 GHz		-	_____	-105	dBm
	110 GHz		-	_____	-105	dBm

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