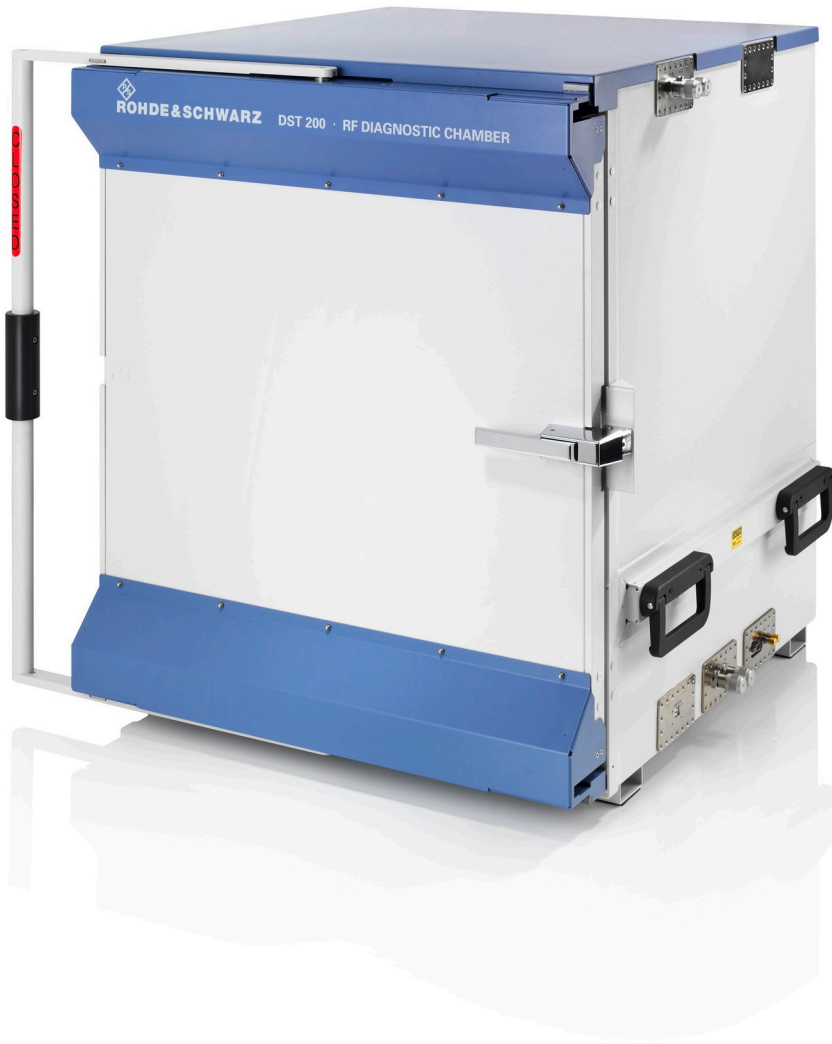


# R&S® DST200

## RF Diagnostic Chamber

### User Manual



1515.1421.02 – 04

This manual describes the RF Diagnostic Chamber R&S®DST200, order no. 1510.9047.02, including the following options and accessories:

- "DST200 Filter Panel, LP & FO", R&S DST-B101, stock number 1514.7778.02
- "DST200 Interface Panel, RF", R&S DST-B102, no. 1514.7784.02
- "DST200 Filter Panel, USB", R&S DST-B103, no. 1514.7990.02
- "DST200 Filter Panel, 100 V to 240 V, AC", R&S DST-B104, no. 1516.8407.02
- "Elevated EUT Table", R&S DST-B130, no. 1515.1467.02
- "Manual 3D Positioner", R&S DST-B150, no. 1515.1480.02
- "Automated 3D Positioner", R&S DST-B160, no. 1516.8007.02
- "Large Automated 3D Positioner", R&S DST-B165, no. 1519.3506.02
- "Cross-Polarized Test Antenna", R&S DST-B210, no. 1516.8207.02
- "Circular Polarized Test Antenna", R&S DST-B220, no. 1518.4509.02
- "Test Antenna Kit", R&S DST-B231, no. 1518.5328.02
- "Linear Polarized Test Antenna", R&S DST-B270, no. 1518.4515.02
- "2 pcs Communications Antenna, Power Splitter", R&S DST-B272, no. 1518.4609.02
- "Shipping Container", R&S DST-Z5, no. 1518.9530.02
- "RF Cable 18 GHz, 1.5 m", R&S DST-Z18, no. 1515.1473.02
- "EUT Holder for R&S DST-B160", R&S DST-Z160, no. 1518.5205.02
- "EUT Holder for R&S DST-B165", R&S DST-Z165, 1519.3941.02
- "Upgrade Kit U165 for R&S DST-B160", R&S DST-U165, no. 1519.3935.02
- "Over-the-Air (OTA) Performance Measurement Software", R&S AMS32, no. 1508.6650.02
- "EMC Measurement Software", R&S EMC32, no. 1300.7010.02

The front door of the RF Diagnostic Chamber is available with either left-hand mounting (selection R&S DST-S100A, order no. 1515.1396.02) or right-hand mounting (selection R&S DST-S100B, order no. 1515.1396.03).

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Mühlhofstr. 15, 81671 München, Germany

Phone: +49 89 41 29 - 0

Fax: +49 89 41 29 12 164

E-mail: [info@rohde-schwarz.com](mailto:info@rohde-schwarz.com)

Internet: [www.rohde-schwarz.com](http://www.rohde-schwarz.com)

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The following abbreviations are used throughout this guide: R&S®DST200 is abbreviated as R&S DST200, options R&S®DST-Bxxx as R&S DST-Bxxx and options R&S®DST-Zxxx as R&S DST-Zxxx. The instruments R&S®CMWxxx and R&S®CMU200 are abbreviated as R&S CMWxxx and R&S CMU200; R&S®TS8991, R&S®EMC32 and R&S®AMS32 as R&S TS8991, R&S EMC32 and R&S AMS32, respectively.

# 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.








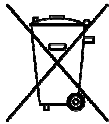

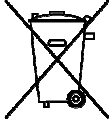

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety 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)

## Basic Safety Instructions

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 additional information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

### Signal words and their meaning

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



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



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



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



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

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

## Basic Safety Instructions

### Operating states and operating positions

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

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of  $\pm 10\%$  shall apply to the nominal voltage and  $\pm 5\%$  to the nominal frequency, overvoltage category 2, pollution 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.

## Basic Safety Instructions

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.

## Basic Safety Instructions

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.

## Basic Safety Instructions

- 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.*

- Cells must not be taken apart or crushed.
- 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.
- 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.
- Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
- 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.
- 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.
- 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

- 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.
- 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.
- 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.



## Instrucciones de seguridad elementales

### 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.















## Instrucciones de seguridad elementales

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.


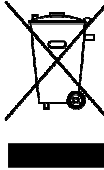

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto.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

## Instrucciones de seguridad elementales

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.



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



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



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



Indica información que se considera importante, pero no en relación con situaciones de peligro; p. ej., avisos sobre posibles daños materiales.

En la documentación del producto se emplea de forma sinónima el término CUIDADO.

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

### 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.*

## Instrucciones de seguridad elementales

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

### Seguridad eléctrica

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

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

## Instrucciones de seguridad elementales

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

## Instrucciones de seguridad elementales

### 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.

## Instrucciones de seguridad elementales

### 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.

## Instrucciones de seguridad elementales

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, dirijase 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 (povos 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 ISO9001 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 ISO9001 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 ISO9001 et ISO 14001.

## Engagement écologique

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





# ROHDE & SCHWARZ

CE Declaration of Conformity



Certificate No.: 2012-50

This is to certify that:

Equipment type	Stock No.	Designation
DST200 with Option	1510.9047.02	RF Diagnostic Chamber
DST-B104	1516.8407.02	AC Power Filter
DST-B160	1516.8007.02	Auto 3D Positioner
DST-B165	1519.3506.02	Large Auto 3D Positioner

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (2006/95/EC)
- relating to electromagnetic compatibility (2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61010-1: 2010  
EN 61326-1: 2006  
EN 61326-2-1: 2006  
EN 55011: 2007 + A2: 2007

For the assessment of electromagnetic compatibility, the limits of radio interference for Class B equipment as well as the immunity to interference for operation in industry have been used as a basis.

ROHDE & SCHWARZ GmbH & Co. KG  
Mühldorfstr. 15, D-81671 München

Munich, 2012-09-06



Central Quality Management GF-QP / Radde

CE

E-1

Vorlage: 2012\_50\_DST200+B160+B104.+B165.doc 3573.7044.05. / AI 01.00

# 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.

### Europe, Africa, Middle East

Phone +49 89 4129 12345  
[customersupport@rohde-schwarz.com](mailto:customersupport@rohde-schwarz.com)

### North America

Phone 1-888-TEST-RSA (1-888-837-8772)  
[customer.support@rsa.rohde-schwarz.com](mailto:customer.support@rsa.rohde-schwarz.com)

### Latin America

Phone +1-410-910-7988  
[customersupport.la@rohde-schwarz.com](mailto:customersupport.la@rohde-schwarz.com)

### Asia/Pacific

Phone +65 65 13 04 88  
[customersupport.asia@rohde-schwarz.com](mailto:customersupport.asia@rohde-schwarz.com)

### China

Phone +86-800-810-8228 /  
+86-400-650-5896  
[customersupport.china@rohde-schwarz.com](mailto:customersupport.china@rohde-schwarz.com)



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# 1 Documentation Overview

The documentation of the R&S DST200 RF Diagnostic Chamber consists of several documents that are available for download off the product homepage (<http://www2.rohde-schwarz.com/product/DST200.html>).

## **R&S DST200 User Manual**

The User Manual contains a comprehensive description of the functionality of the RF Diagnostic Chamber and all its hardware options.

It is delivered as a printed document with the R&S DST200 and also available on the internet as a pdf document. For the latest version of the User Manual, visit the product homepage.

## **R&S DST200 Application Sheets**

Application sheets contain a particular aspect of the R&S DST200 functionality and shows a typical application example.

Application sheets are available on the internet as pdf documents.

## **Additional documents**

The product homepage also provides additional documents that are referenced in this User Manual, for example the RF Parameter Tables required to perform the reference path loss measurement.

## 2 Safety Instructions

This R&S DST200 RF Diagnostic Chamber has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

---

### CAUTION

#### General safety instructions

To maintain this condition and to ensure safe operation, you must observe all instructions and warnings given in this manual. Please notice in particular the instructions below on this page.

---

1. In order to comply with local EMC regulations, it may be necessary in some places to have the front door closed when using the RF Diagnostic Chamber. It is the user's responsibility to ensure that the chamber is used in compliance with local regulations.
2. The RF Diagnostic Chamber must be stabilized, either by means of four screws through the feet or by the balancing weight in the slot at the back. Otherwise it may tilt forward when the front door is opened.
3. In view of its weight, at least two persons are required to carry the RF Diagnostic Chamber. The front door must be closed and the locking handle must be fastened in CLOSED position whenever the RF Diagnostic Chamber is carried or shipped. Use a cable tie or Velcro® strip to fix the locking handle to the carrying handle on the left side of the chamber.
4. The metallic EMI/EMC shielding gaskets around the joint of the front door are expendable parts that must be regularly cleaned and need to be exchanged if they are visibly corroded or damaged; see [chapter 4, "Maintenance"](#), on page 38.
5. When mounting a connector module (one of the feed throughs R&S DST-B101, DST-B102, R&S DST-B103), ensure that the contact surfaces are clean and the EMI/EMC shielding gaskets are in correct position.
6. When leaving the RF Diagnostic Chamber in a storage room that can be accessed by small children or when disposing of the chamber, always remove the locking handle to ensure that the chamber can be opened from inside.
7. Do not apply more than 50 W power to the diagnostic chamber over a period of more than 1 hour when it is closed.

Please also read [chapter 3, "RF Diagnostic Chamber Features"](#), on page 7 for more detailed information about safety-related issues.

## 3 RF Diagnostic Chamber Features

The RF Diagnostic Chamber R&S DST200 is a fully enclosed, RF-shielded anechoic chamber for interference-free and reflection-free tests of mobile phones (MS) and other devices with radio interfaces. R&S DST200 is particularly suited for over-the-air (OTA) performance tests and receiver sensitivity degradation (desense) tests in line with the CTIA, CWG and PTCRB standards. Automated measurements may be performed in combination with the R&S®TS8991 OTA Performance Test System and the R&S®AMS32 OTA software.

The chamber is also appropriate for general receiver and transmitter tests using a radio communication tester, e.g. a wideband radio communication tester of the R&S CMW family or a Universal Radio Communication Tester R&S CMU200.

You can equip the R&S DST200 with one or more antennas of various types. The antennas are available as hardware options.

- R&S DST-B210 (Cross-polarized Test Antenna)
- R&S DST-B220 (Circular-polarized Test Antenna)
- R&S DST-B231 (Test Antenna Kit)
- R&S DST-B270 and -B272 (Linear-polarized Communication Antenna)

Using an antenna is necessary for transmission of RF signals between the equipment under test (EUT) and the test instruments. For more information see [chapter 3.4, "Antennas for the R&S DST200"](#), on page 26.

The EUT is placed on a positioning device inside the chamber. Delivered with the base unit is an EUT table. In addition, various other positioning devices are available as hardware options.

- R&S DST-B130 (Elevated EUT Table)
- R&S DST-B150 (Manual 3D Positioner)
- R&S DST-B160 and -B165 (Automated 3D Positioner)

Due to the absorbing walls of the chamber and the distance between the test antenna and the positioning device, measurements can be performed under free-space conditions. On its right wall, below the top cover, the chamber provides one or more RF connectors for the RF connection of the antenna to the test instruments.

You can equip the R&S DST200 with several options and accessories to connect data, power and RF cables.

- R&S DST-B101 (Filter Panel LP & FO)
- R&S DST-B102 (Interface Panel RF)
- R&S DST-B103 (Filter Panel USB 2.0)
- R&S DST-B104 (Filter Panel 100 V to 240 V AC)
- R&S DST-Z18 (RF Cable 18 GHz, 1.5 m)

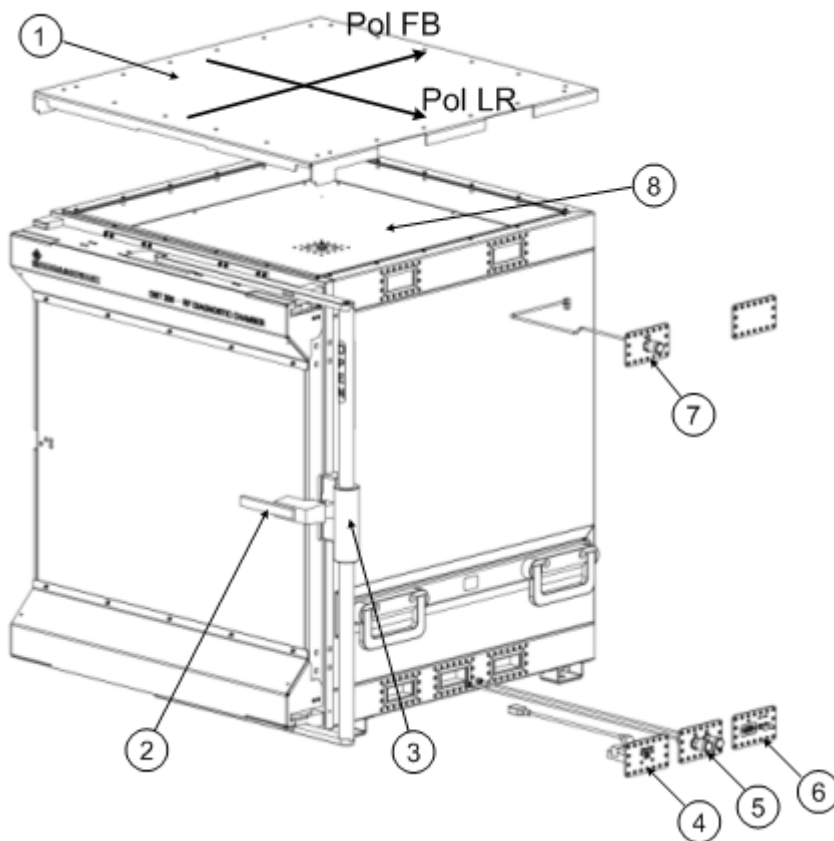
The panels are mounted at the positions shown in [figure 3-1](#). For more information see [chapter 3.2.5, "Mounting Filter and Interface Panels"](#), on page 18.



The present manual describes the positioning and use of the chamber, the installation of hardware options, and the functional check. The technical specifications of the RF Diagnostic Chamber are listed in the data sheet PD 5214.3600.22.

### 3.1 RF Diagnostic Chamber

The RF Diagnostic Chamber consists of several (re-)movable parts, including the options mentioned above.



**Fig. 3-1: RF Diagnostic Chamber with accessories**

- 1 = top cover
  - 2 = door latch
  - 3 = locking handle
  - 4 = filter panel, USB 2.0 (R&S DST-B103)
  - 5 = interface panel, 2xN / 2xRF (R&S DST-B102)
  - 6 = filter panel, D-Sub 9 / fibre optic (R&S DST-B101)
  - 7 = RF ANT connector (R&S DST-B220 and -B231)
  - 8 = upper compartment (mounting of test antenna)
- FB = Polarization Front-Back  
LR = Polarization Left-Right

### 3.1.1 Positioning the RF Diagnostic Chamber

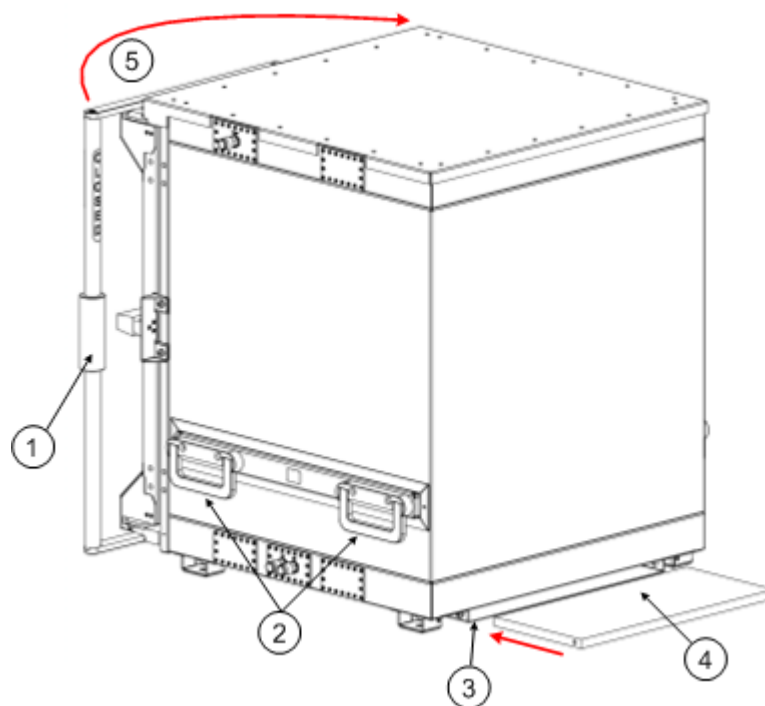
The RF Diagnostic Chamber is intended for operation on a flat, stable surface. Apply one of the following methods to ensure a stable position:

- Screw the four feet of the chamber to the surface.
- Ensure that the balancing weight is in the slot at the back of the chamber and affixed by the two screws on either side. For more information see [figure 3-2](#).

#### **CAUTION**

##### **Risk of injury**

If the RF Diagnostic Chamber is not properly stabilized as described above, it may tilt forward when the front door is opened.



**Fig. 3-2: Position of balancing weight**

- 1 = locking handle
- 2 = carrying handles
- 3 = balancing weight slot
- 4 = balancing weight
- 5 = turn handle to lock door

In view of its weight (see data sheet), at least two persons are required to carry the RF Diagnostic Chamber using the four handles on both side walls. If you wish to remove the balancing weight for easier transport, open the two screws on either side and remove it from the slot.

Never use the locking handle to carry the R&S DST200 RF Diagnostic Chamber.

**NOTICE****Protecting R&S DST200 during transportation**

For best protection against damage of R&S DST200 during transportation a shipping container (accessory R&S DST-Z5, stock number 1518.9530.02) can be ordered from Rohde & Schwarz. The multiple-use container provides a solid shell to encapsulate the whole R&S DST200.

### 3.1.2 Opening and Closing the Front Door

The RF Diagnostic Chamber is accessible by the front door. A U-shaped joint around the front side of the chamber accommodates metallic EMI/EMC shielding gaskets which ensure a good, continuous electrical contact. The 2-stage opening and closing mechanism of the door ensures a planar movement into the U-shaped joint. This protects the shielding gaskets from mechanical damage and increases their lifetime. It also provides a self-cleaning effect so that the shielding effectiveness is maintained even after a long time of use.

The RF Diagnostic Chamber is available with either left-hand front door mounting (selection R&S DST-S100A, order no. 1515.1396.02) or right-hand mounting (selection R&S DST-S100B, order no. 1515.1396.03). The two selections are symmetric to each other; [figure 3-2](#) shows a door with a left-hand mounting (hinges on the left side).

To open the front door,

1. Make sure that the RF Diagnostic Chamber is properly stabilized as described in [chapter 3.1.1, "Positioning the RF Diagnostic Chamber"](#), on page 9.
2. Turn the locking handle to the OPEN position as shown in [figure 3-1](#).
3. Pull the door latch in forward direction to release the closing mechanism.

To close the door,

1. Push the wing of the door against the front side of the chamber **until the latch is closed**.
2. Push the locking handle towards the CLOSED direction.

**CAUTION****Risk of damage or injury**

For safety reasons, the door also opens while the door latch is closed and the handle is in the OPEN position. It remains locked as long as the handle is CLOSED. Read the general [Safety Instructions](#) when shipping the chamber or when disposing of the chamber.

### 3.1.3 Replacing the Shielding Gaskets

The EMI/EMC shielding gaskets in the U-shaped joint around the front side of the chamber and the contact strips of the connector units and antenna are expendable parts which must be replaced if they are visibly corroded or damaged. It is recommended to use a plastic screwdriver for this purpose to avoid scratching the groove and the walls of the RF Diagnostic Chamber.

#### Replacing the gaskets at the front side

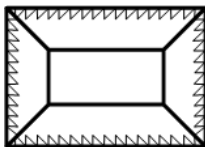
The U-shaped joint at the front side contains a band of clip-on gaskets. To replace the gaskets,

1. Carefully lift the clip-on gaskets from the groove starting at the corners.
2. Clean the empty groove using a soft cloth soaked in ethyl alcohol (see also [chapter 4, "Maintenance"](#), on page 38).
3. Cut the clip-on gaskets to cover the whole length of the groove.
4. Exercise care when placing the clip-on gaskets in position, as bent fingers will deteriorate the shielding effectiveness.

#### Replacing the contact strips

The connector units and the antenna are shielded by four self-adhesive metal contact strips. After removing the connector unit,

1. Remove the old gaskets using a plastic screwdriver.
2. Clean the contact surface below the gaskets using a soft cloth soaked in ethyl alcohol (see also [chapter 4, "Maintenance"](#), on page 38).
3. Place the new gaskets in position, with the teeth towards the rectangular opening as shown below.



New EMI/EMC gaskets are available as expendable parts. For more information see [chapter 3.6, "Expendable Parts"](#), on page 36 and [chapter 4, "Maintenance"](#), on page 38.

### 3.1.4 Accessing the Upper Compartment

The upper compartment accommodate the connecting RF cable between the antenna connector(s) at the top of the right-hand wall and the test antenna. An additional connector module can be mounted at the second upper connector port. Moreover, it is possible to place additional circuitry (e.g. an amplifier) into the upper compartment.

The antenna and the antenna cable(s) are available as expendable parts (see [chapter 3.6, "Expendable Parts"](#), on page 36), however, there is no need to access or remove the test antenna for normal use of the RF Diagnostic Chamber.

### NOTICE

#### Shielding effectiveness

Always use optimally shielded RF cables inside the upper compartment. Semi-rigid cables are recommended.

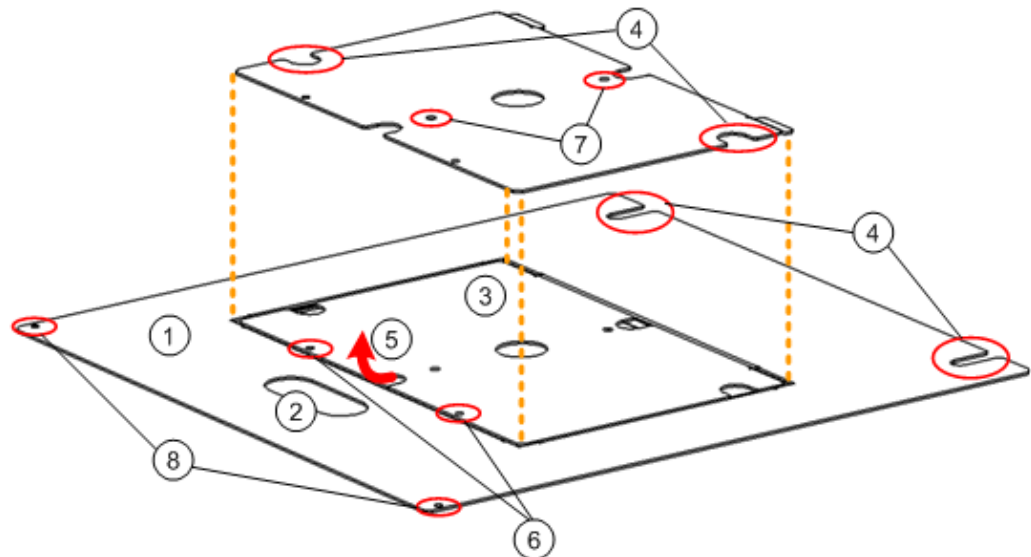
It is possible to use the RF Diagnostic Chamber with an open cover plate. The shielding effectiveness specified in the data sheet applies to a closed upper compartment.

To access the upper compartment, remove all screws at the top side and lift the cover.

### 3.1.5 Accessing the Lower Compartment

The lower compartment provides room for cables from the EUT to additional connector modules, including possible converters.

The lower compartment is covered by a metal plate that serves as the floor panel of the chamber. The panel consists of a frame and a removable centerpiece and is covered by three pieces of absorber material. The frame of the floor panel has two notches in the back to guide cables from the test space to the lower compartment. It also has a grip hole in the front for easy removal.



**Fig. 3-3: Floor panel of the R&S DST200**

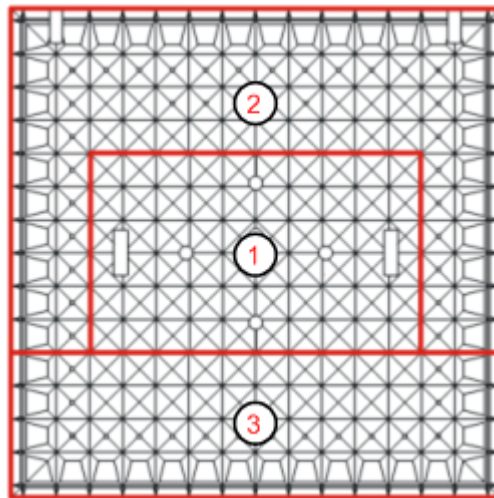
- 1 = Floor panel
- 2 = Grip hole
- 3 = Centerpiece
- 4 = Notches for guiding cables
- 5 = Lift the mounting plate and pull it out

- 6 = Screw to fixate the centerpiece
- 7 = Holes for mounting the positioning equipment
- 8 = Screw to fixate floor panel

Basically, it is sufficient to remove the centerpiece of the floor panel to access the lower compartment. However, it is also possible to remove the complete floor panel.

To remove the centerpiece and access the lower compartment,

1. Open the front door completely.  
For more information see [chapter 3.1.2, "Opening and Closing the Front Door"](#), on page 10.
2. Remove the absorbers bottom C and A.



**Fig. 3-4: Floor plan of the bottom absorbers**

- 1 = Absorber bottom A
- 2 = Absorber bottom B
- 3 = Absorber bottom C

3. Remove the positioning device if one is installed.
4. Unscrew the screws on either side of the centerpiece.
5. Lift the floor panel centerpiece until the hinges at the back become loose.
6. Pull out the centerpiece without damaging the EMI/EMC shielding gaskets around the joint of the door.

If necessary, you can also remove the extra absorber panel.

Proceed in reverse order to close the lower compartment and make the chamber ready for use.



### Removing the whole floor panel

Alternatively, you can also remove the whole floor panel. Instead of unscrewing and removing the centerpiece, remove the floor absorbers, unscrew the floor panel and pull it out with the grip located at the front of the floor panel.

If you do so, make sure not to damage any parts of the chamber door.

## NOTICE

### Position of the positioning device

The four feet of the positioning devices establish a firm connection to the base plate. To ensure that the table remains at a stable position relative to the chamber and the test antenna, always affix the base plate using the two screws.

The positioning devices and absorbers panels are available as expendable parts (see [chapter 3.6, "Expendable Parts"](#), on page 36).

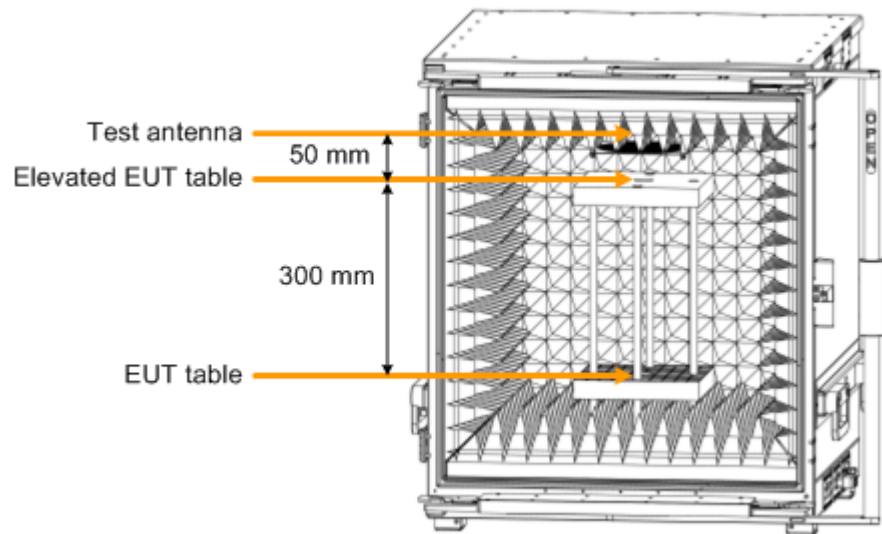
## 3.1.6 Installing the EUT and Connecting the Test Equipment

The purpose of the EUT table inside the RF Diagnostic Chamber is to hold EUTs in the zone far away from the antenna, where an EUT is placed outside the reactive near-field region of an antenna and the RF field is approximately homogeneous. Due to these field characteristics, EUT testing provides reproducible results. To perform measurements at a specific EUT orientation, use one of the 3D positioners described in [chapter 3.3, "3D Positioners for the R&S DST200"](#), on page 19.

### Elevated EUT table

The Elevated EUT Table (option R&S DST-B130) is used to place the EUT to a position close to the test antenna below the cover of the RF Diagnostic Chamber. This reduces the path loss between the test antenna and EUT, at the expense of field uniformity. In this case the test antenna is located in the reactive near-field region of the EUT enabling RF detection of its EMI sources. For examples of the electric field strength radiated by the test antenna within the chamber refer to the R&S DST200 product brochure, no. PD 5214.3600.12.

The Elevated EUT Table is mounted **on top** of the EUT table (supplied with every chamber) as shown below.



**Fig. 3-5: Mounting the elevated EUT table**

The center point of the elevated EUT table is 300 mm above the center of the EUT table. Its distance from the test antenna is approximately 50 mm.

#### **Radiated connection to the test equipment**

The outer antenna connectors on the right wall of the R&S DST200 RF Diagnostic Chamber can be connected to the RF connectors of the test equipment (e.g. R&S CMW500, RF1 COM connector). No additional cable is needed, since the antenna will ensure the internal RF connection to the EUT.

### **NOTICE**

#### **RF connection**

The RF transmissions and the path loss depend on the RF connection between the antenna connector and the RF input/output of the test instrument. To limit RF emissions, it is recommended to use the high-quality RF cable supplied with the RF Diagnostic Chamber.

For best results, especially at frequencies above 3 GHz, an optimized cable (accessory R&S DST-Z18, stock number 1515.1473.02) can be ordered from Rohde & Schwarz.

In addition, you can also use optional connections. For more information see [chapter 3.2, "Interfaces and Filter Panels for the R&S DST200"](#), on page 15.

## **3.2 Interfaces and Filter Panels for the R&S DST200**

You can equip the R&S DST200 with various interfaces and filter panels.

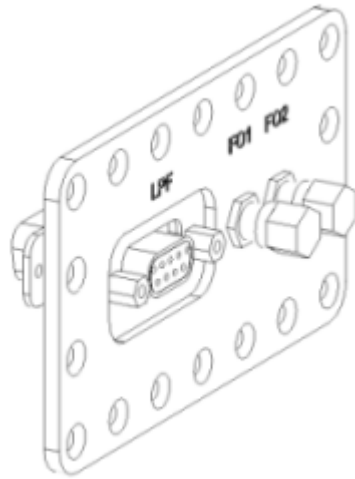
- [chapter 3.2.1, "LP&FO Filter Panel \(R&S DST-B101\)"](#), on page 16



- [chapter 3.2.2, "RF Interface Panel \(R&S DST-B102\)"](#), on page 16
- [chapter 3.2.3, "USB Filter Panel \(R&S DST-B103\)"](#), on page 17
- [chapter 3.2.4, "Power Interface Panel \(R&S DST-B104\)"](#), on page 18
- R&S DST200-Z18: The "RF Cable 18 GHz, 1.5 m" is an RF cable with a high shielding effectiveness.  
For more information see ["RF connection"](#) on page 15.

### 3.2.1 LP&FO Filter Panel (R&S DST-B101)

The LP & FO filter panel (R&S DST-B101) provides an additional 9-pin D-Sub connector with integrated low-pass filter and a 2x FSMA fibre optic interface for the DC supply and the AF or data signals of the EUT.

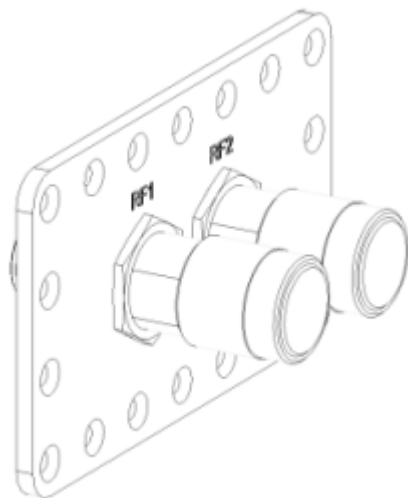


An integrated low-pass filter ensures high shielding effectiveness of the D-Sub connector. The FSMA connectors are particularly suited for connections with high data rates; a typical example is a LAN connection to the EUT. A LAN to fibre optic converter is placed outside the RF Diagnostic Chamber, a second converter for the connection of the EUT may be placed inside the lower compartment.

The filter panel is required to provide shielded interface for power supply and control cabling of the automated 3D positioners (R&S DST-B160 and -B165).

### 3.2.2 RF Interface Panel (R&S DST-B102)

The RF interface panel provides two additional RF connectors (type N) for tests with several RF signals.

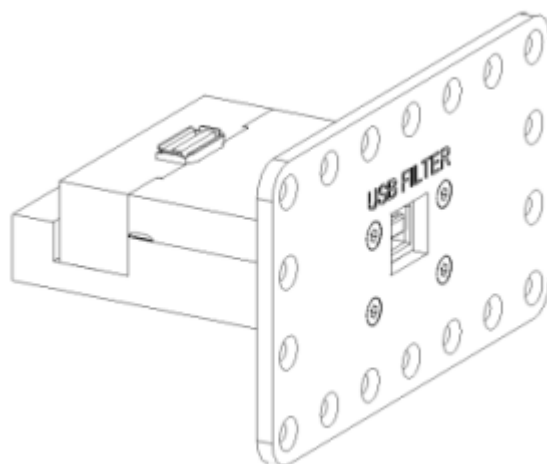


Together with antenna connectors, the RF interface panel allows you to supply the EUT with up to four independent RF signals. An additional RF feed through is also suited for connecting a reference antenna.

The filter panel is required to provide shielded RF connection of the R&S DST-B270 linear-polarized communication antenna to test equipment.

### 3.2.3 USB Filter Panel (R&S DST-B103)

The USB filter panel provides an additional USB 2.0 data connection. An integrated low-pass filter ensures high shielding effectiveness of the USB connector. Use shielded USB cables according to standard USB 2.0 to establish the connection to the EUT and an external controller

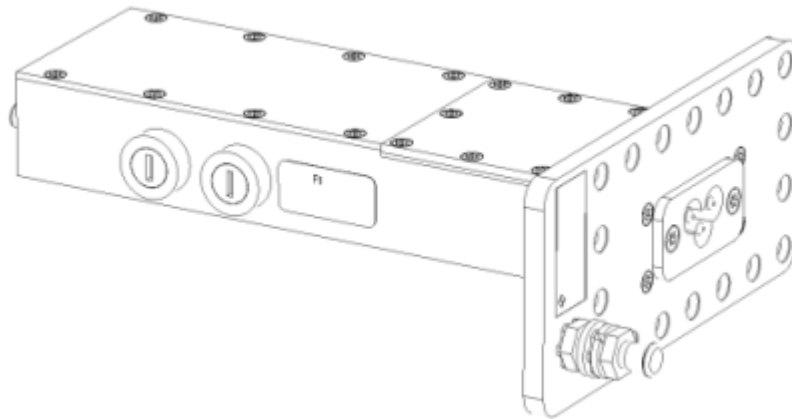


**NOTICE****Connecting USB cables and shielding requirements**

The "USB 2.0 Feed Through" is a passive module that causes no radiation. To avoid interference from the external connecting line, use a shielded USB cable that is equipped with EMI ferrite attenuators.

**3.2.4 Power Interface Panel (R&S DST-B104)**

The Power interface panel supplies the R&S DST200 with filtered AC power.



Make sure not to violate the current limitations. For more information refer to the data sheet.

**WARNING****Shock hazard**

To prevent electric shock, make sure to ground the R&S DST-B104 before connecting it to the AC power supply.

Grounding requires a grounding conductor of at least 4 mm<sup>2</sup> in size.

**3.2.5 Mounting Filter and Interface Panels**

The RF Diagnostic Chamber R&S DST200 is delivered with integrated test antenna. The N-connector unit labeled "RF ANT" (R&S DST-B220 and -B231) or "Pol. FB" and "Pol. LR" (R&S DST-B210) ensures the RF connection between the antenna and the external test equipment; it always occupies the connector port at the top of the right-hand wall, towards the front door of the chamber (see [figure 3-1](#)). Additional filter and interface panels can be mounted at any of the four remaining module ports at the top

and bottom of the right-hand wall. Select the position of the panels according to your needs.

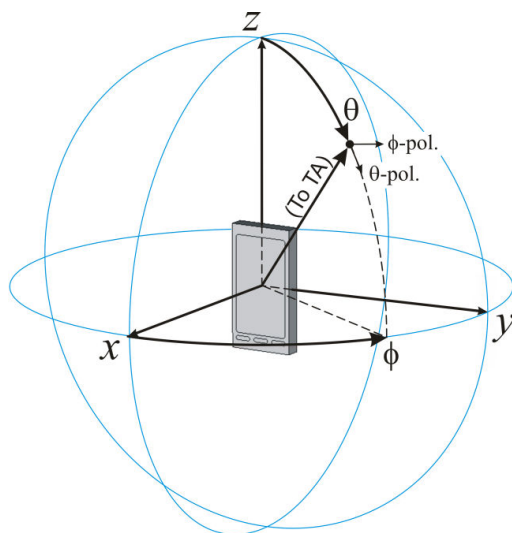
The connector units are delivered with spare EMI/EMC shielding gaskets. When mounting a unit, ensure that the contact surfaces at the unit and the RF Diagnostic Chamber are clean and the gaskets are in correct position, with the teeth to the outside of the chamber opening (see [chapter 3.1.3, "Replacing the Shielding Gaskets"](#), on page 11). Apply the connector module to the module port and affix it using the 18 screws delivered with the module. Fix the screws progressively in cycles in order to achieve uniform contact.

To remove a connector module, simply unscrew the 18 screws. Use a blank plate to cover every unused module port.

To connect the additional feed throughs to the antenna or to the EUT, you will usually have to access the upper and/or lower compartments of the RF Diagnostic Chamber. Proceed as described in [chapter 3.1.4, "Accessing the Upper Compartment"](#), on page 11 and [chapter 3.1.5, "Accessing the Lower Compartment"](#), on page 12.

### 3.3 3D Positioners for the R&S DST200

The 3D Positioners for the R&S DST200 holds the EUT at a specific angular orientation. Measurements at well-defined orientations are often required in the product design process. CTIA - The Wireless Association specifies appropriate spherical coordinates for the EUT orientation; refer to the "CTIA Certification, Test Plan for Mobile Station Over the Air Performance, Method of Measurement for Radiated RF Power and Receiver Performance, Rev. 3.1".



**Fig. 3-6: Spherical coordinate system of EUT**

The following 3D positioning devices are available.

- R&S DST-B150 (manual 3D positioner)
- R&S DST-B160 or -B165 (automated 3D positioners)

Basically, the manual and automated 3D positioners work the same in that they provide angular orientations of the EUT in close agreement with the spherical coordinate system defined in the CTIA Test Plan. The only difference is that the center of the coordinate system shall be located at the geometrical center of the EUT. The coordinate system is presented in [figure 3-6](#). The display and the keypad of the EUT points into the +x direction



Throughout the remainder of this manual and in the R&S AMS32 system software the following terms are synonymous to define angular positions of the EUT:

elevation = theta =  $\theta$

azimuth = phi =  $\phi$

The 3D positioning devices replace the EUT table delivered with the R&S DST200. In case of the manual 3D positioner, it is sufficient to just replace the table with the positioner. The automated 3D positioner is delivered with a customized base plate that you have to install instead of the one the R&S DST200 is delivered with. For more information on installing the automated 3D positioner see [chapter 3.3.2, "Automated 3D Positioners \(R&S DST-B160 / -B165\)"](#), on page 21.

The 3D positioners are designed to position the EUT below the test antennas installed at the top of the R&S DST200 RF diagnostic chamber. The EUT itself is held by a rubber band to the EUT holder that is delivered with the 3D positioners.

### Orientation of the EUT

The orientation of the EUT is variable. In case of the manual 3D positioner you have to align the orientation manually. When you use an automated 3D positioner, you can control the EUT orientation via PC with the R&S AMS32 system software. Aligning the EUT works as follows.

- If you turn the elevation rotator of the positioning device, you align the EUT position on the  $\theta$ -axis.  
The position on the  $\theta$ -axis is indicated on a label on the elevation rotator.
- If you turn the azimuth rotator of the positioning device, you align the EUT position on the  $\phi$ -axis.  
The position on the  $\phi$ -axis is indicated on a label on the azimuth rotator.

## 3.3.1 Manual 3D Positioner (R&S DST-B150)

### 3.3.1.1 Overview

If you turn the manual 3D positioner to a position where both angles are at 0° (home position),

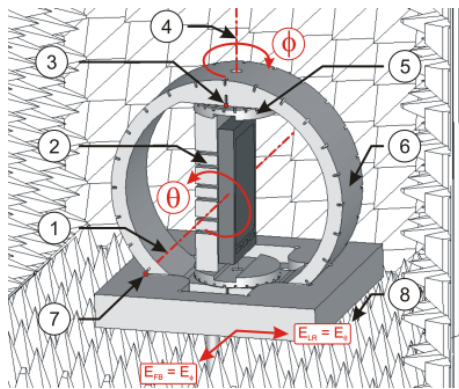
- the EUT is in a vertical position
- the face of the EUT points to the right side of the R&S DST200 RF Diagnostic Chamber in case of the manual 3D positioner in 'X' orientation

- the face of the EUT points to the rear side of the R&S DST200 RF Diagnostic Chamber in case of the manual 3D positioner in 'Y' orientation

In case of the manual 3D positioner the elevation rotator can be placed either in 'X' or 'Y' orientation. The orientation can be changed by turning the elevation rotator around the vertical axis by 90°. At the same time  $\theta$  and  $\phi$  polarizations of the test antenna are exchanged. For 'Y' orientation the EUT position on the  $\theta$ -axis is shown at the ' $\theta$ -REF Y' label. For 'X' orientation the EUT position on the  $\theta$ -axis is shown at the ' $\theta$ -REF X' label.

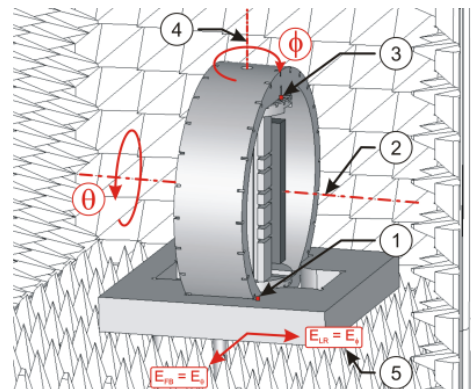
**Table 3-1: Manual 3D positioner in 'X' and 'Y' orientation with EUT at the home position ( $\theta = \phi = 0$ )**

#### 'X' orientation



- 1 = Elevation axis
- 2 = EUT holder
- 3 = Read  $\phi$  value
- 4 = Azimuth axis
- 5 = Azimuth rotator
- 6 = Elevation rotator
- 7 = Read  $\theta$  value
- 8 = Field polarization

#### 'Y' orientation



- 1 = Read  $\theta$  value
- 2 = Elevation axis
- 3 = Read  $\phi$  value
- 4 = Azimuth axis
- 5 = Field polarization

### 3.3.2 Automated 3D Positioners (R&S DST-B160 / -B165)

Instead of the EUT tables or the manual 3D positioner, you can use an automated 3D positioner (R&S DST-B160 or -B165) to test an EUT at various orientations in relation to an antenna. The automated 3D positioner has the advantage that you do not have to open the chamber every time you need to change the position of the EUT. Instead you control the positioner remotely with the R&S AMS32 or R&S EMC32 system software.

The automated 3D positioners are available in a standard and a large version.

- The R&S DST-B160 has a round EUT mobile unit suited for measurements on smaller devices like cell phones or smartphones.
- The R&S DST-B165 has a bigger square mobile unit also suited for measurements on big devices like tablet computers or netbooks.

Except for the size of the mobile unit, the functionality and handling of the positioners are the same.

### 3.3.2.1 Overview

If you turn the automated 3D positioner to a position where both angles are at 0° (home position),

- the EUT is in a vertical position
- the face of the EUT points to the front side of the R&S DST200 RF Diagnostic Chamber in case of the automated 3D positioner

## NOTICE

### Risk of damaging the automated 3D positioner

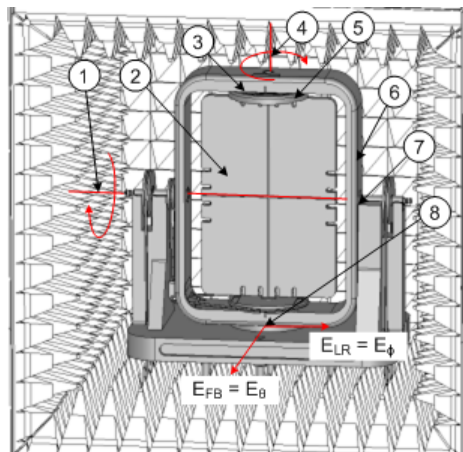
Do not turn the elevation and azimuth rotators of the automated 3D positioner manually. Manual turning may cause damage of the positioner. To work with the positioner use R&S AMS32 system software.

**Table 3-2: EUT holder on an automated 3D positioner**

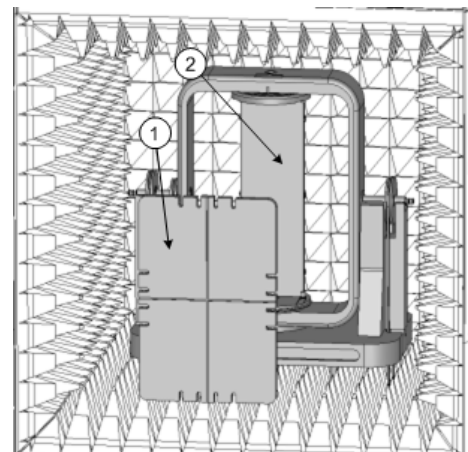
**Automated 3D positioner with EUT at the home position (theta = phi = 0)**

**Mounting of EUT holder on automated 3D positioner**

Note that the pictures show the R&S DST-B165 as an example. The principles are the same for the R&S DST-B160.



- 1 = Elevation axis
- 2 = EUT holder
- 3 = Read  $\phi$  value
- 4 = Azimuth axis
- 5 = Azimuth rotator
- 6 = Elevation rotator
- 7 = Read  $\theta$  value
- 8 = Field polarization



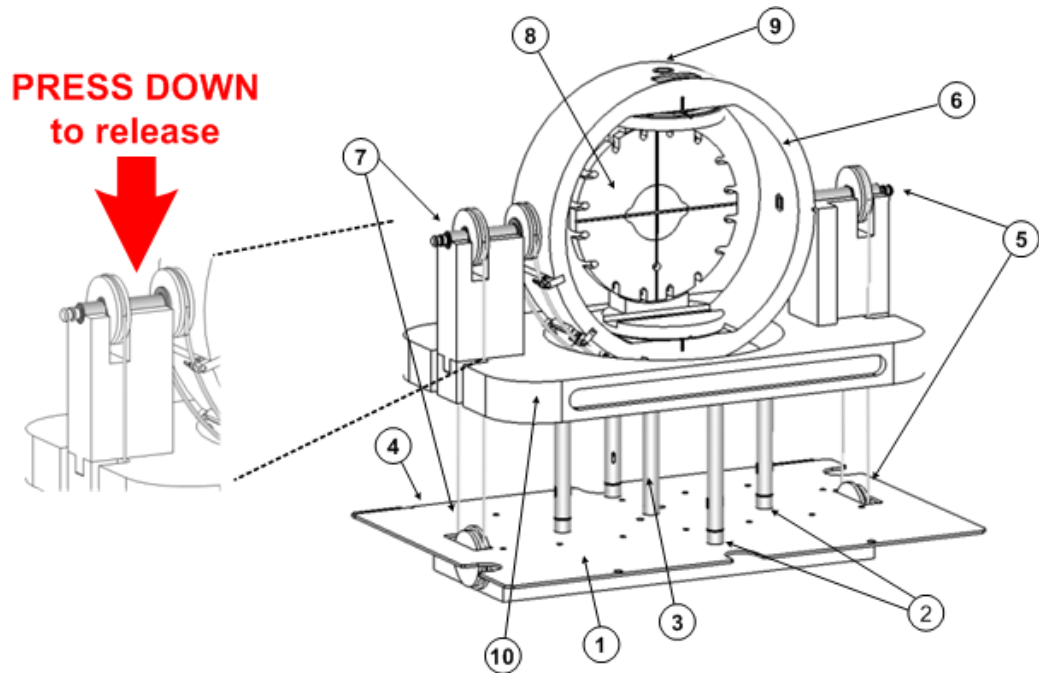
- 1 = EUT holder
- 2 = R&S DST-B160 is mounted with a positioning pin
- 2 = R&S DST-B165 is mounted with a guide rail

Two EUT holders are delivered with R&S DST-B160. For quick and more reproducible tests of several EUTs more EUT holders can be advantageous. Then each EUT can be mounted on a separate EUT holder which in turn can be quickly snapped into the

azimuth rotator of R&S DST-B160 / -B165. An additional EUT holder is available as accessory R&S DST-Z160 / -Z165.

### 3.3.2.2 Installation

The automated 3D positioner uses a modular concept that allows to configure it according to your needs



**Fig. 3-7: Overview of the automated 3D positioner**

= Note that the figure shows an R&S DST-B160. The configuration of the R&S DST-B165 is basically the same.

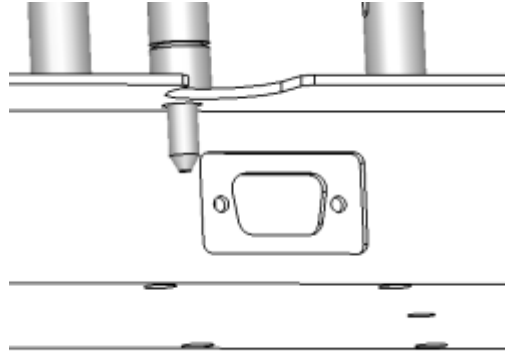
- 1 = Motor unit
- 2 = Feet of the positioner
- 3 = Waveguide for optical sensor signals
- 4 = Hinges to attach the foundation to the R&S DST200 floor panel
- 5 = Belt drive for elevation axis adjustment
- 6 = Elevation rotator (mobile unit)
- 7 = Long belt drive for azimuth axis adjustment
- 8 = Azimuth rotator with EUT holder that you can snap on
- 9 = Elevation optical reflector
- 10 = Mobile unit support
- n/a = Azimuth optical reflector on the bottom side of the azimuth rotator (not visible)

- The whole system rests on feet that are stuck into the cover of the motor unit. The cover is compatible to the other positioning devices. Thus, if you remove the automated 3D positioner from the motor unit, you can use it for the other devices as well.  
For instructions on how to install the centerpiece of the R&S DST200 floor panel see [chapter 3.1.5, "Accessing the Lower Compartment"](#), on page 12.
- The rotators (one for the azimuth position on the  $\phi$ -axis, one for the elevation position on the  $\theta$ -axis) rest on a table attached to the system feet.



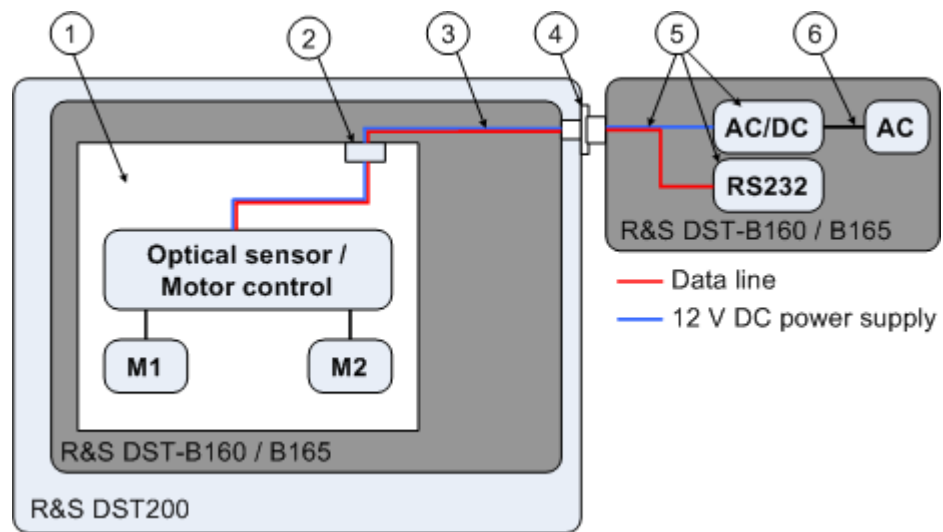
The azimuth rotator also serves as a mount for the EUT holder

- The EUT holder is a snap-in system. If you attach the EUT with a rubber band or a similar fastener device to its mount, you can easily snap it to the azimuth rotator. The EUT holder is delivered with low permittivity distance plates. The plates can be used to align the geometrical center of the EUT with the origin of the coordinate system for the EUT.
- The rotators are controlled by belt drives. One belt drive controls the position of the EUT on the azimuth axis. The other belt drive control the position on the elevation axis.  
You can remove the belts by pushing down the mounts the belt wheels rest on. Remove the belts only if you want to remove the positioning system from the cover of the motor unit, e.g. if you want to use another positioning device like the EUT table.
- The belts are powered by two motors that are built into the motor unit.  
To supply the motors with power you have to connect it to an AC outlet via the D-Sub port on the back of the motor unit. The port is in a location that the cabling has to be guided through the lower compartment of the R&S DST200.



*Fig. 3-8: D-Sub port on the back of the motor unit*

For more information on how access the lower compartment of the R&S DST200 see [chapter 3.1.5, "Accessing the Lower Compartment"](#), on page 12.



**Fig. 3-9: Electrical block diagram of R&S DST-B160 and -B165 automated 3D positioner**

- 1 = Motor unit
- 2 = 9-pin D-Sub filter
- 3 = Data and +12 VDC power supply cable (cable motor box)
- 4 = R&S DST-B101 filter panel, 9-pin D-Sub, fiber-optic
- 5 = AC/DC power converter, RS232 data interface, data and DC power supply cables (cable RS232)
- 6 = AC power cable
- M(x) = Motor, one for each belt drive

- A motor unit with an integrated D-Sub filter provides shielded environment for both motors supply and control signals. Accordingly radiated and conducted EMI emission of the automated 3D positioner is minimized.
- An optical sensor in the center of the centerpiece.
- Two optical reflectors on the top and bottom of the positioner to determine the exact position of the EUT on the  $\phi$ - and  $\theta$ -axis.
- The cable that supplies the motor with power also contains cabling to connect the positioning system to the computer that controls the position of the EUT. For details on the cabling within the automated 3D positioner see [figure 3-9](#).

### 3.3.2.3 Functional Check

1. Start the R&S AMS32 software.
2. Configure the test PC.
  - a) Open the "Device List" in the "Extras" menu.
  - b) Open the dialog box to define the characteristics for the "DST200 Elevation Positioner" device by double-clicking on it.
  - c) In the "Homing" tab, press the "Auto Calibration" button to determine correction factors automatically.

Read elevation ( $\theta$ ) and azimuth ( $\phi$ ) angles on the scales glued to both rotators of the positioner. The automated 3D positioner should be at the angle  $\phi = \theta = 0$  deg with the accuracy defined in the data sheet.

In case of errors at homing or calibration of the positioner the optical sensor tube and the reflectors should be checked for dirt or dust.

## 3.4 Antennas for the R&S DST200

### 3.4.1 Test Antennas

You can equip the R&S DST200 with various test antennas that are available as hardware options.

- Cross-polarized test antenna (R&S DST-B210)
- Circular-polarized test antenna (R&S DST-B220)
- Test antenna kit (R&S DST-B231)

#### 3.4.1.1 Cross-Polarized Test Antenna (R&S DST-B210)

The R&S DST-B210 cross-polarized test antenna radiates dual linear-polarized fields. The polarization directions are associated with the RF ports of the antenna polarization Front → Back (FB) and polarization Left → Right (LR). The directions of the electric fields for each polarization are shown in [figure 3-1](#) and also labeled on the antenna PCB.

The antenna phase center is located in the center of the antenna PCB. The location of the phase center does not change over the frequency range of operation. The main radiation direction is perpendicular to the antenna PCB and it points to the quiet zone center of all positioning devices.

A quiet zone is the space inside a 3D positioner where EUT can be held. The center of the quiet zone is at the cross-section of the elevation and azimuth axes.

The antenna is designed to enable testing of vector radiation characteristics of an EUT. In addition, its polarization diversity can be used to provide two orthogonal data streams necessary for MIMO OTA testing such as noise-limited OTA performance in transmit diversity mode. For more information on that topic see the R&S Application Brochure "OTA performance measurements of MIMO-enabled devices" available for download on the Internet ([http://www2.rohde-schwarz.com/file\\_17212/TS8991\\_app-bro\\_en.pdf](http://www2.rohde-schwarz.com/file_17212/TS8991_app-bro_en.pdf))

For more information on antenna installation see [chapter 3.4.1.4, "Installing Test Antennas"](#), on page 28.

**Table 3-3: Antenna polarization in the EUT coordinate system**

3D Positioner	R&S DST-B150		R&S DST-B160 /-B165
	x orientation	y orientation	
Pol. FB	$\phi$ (phi)	$\theta$ (theta)	$\theta$
Pol. LR	$\theta$ (theta)	$\phi$ (phi)	$\phi$

The antenna connectors for both polarizations are available at the interface panel mounted at the right side of the R&S DST200 RF Diagnostic Chamber. The N female connectors are labeled "Pol. FB" and "Pol. LR".



#### Antenna polarization in the R&S AMS32 software "Hardware Configuration"

If "Great Circle Cut (two-axis MAPS)" is used as the "Hardware System Type", the H port of the antenna indicates theta polarization and the V port of the antenna indicates phi polarization.



You can find the "Hardware System Type" in the "System" tab of the "Extras" → "Options" → "OTA Options" menu.

#### 3.4.1.2 Circular-Polarized Test Antenna (R&S DST-B220)

The R&S DST-B220 test antenna radiates a circular-polarized field.

The antenna phase center is located in the center of the antenna PCB. The location of the phase center does not change over the frequency range of operation. The main radiation direction is normal to the antenna PCB and it points to the quiet zone center of all positioning devices. In this way the variation of the EUT coupling to the test antenna is minimized as a function of the location and orientation of the EUT.

The antenna connector is available at the interface panel mounted at the right side of R&S DST200 RF Diagnostic Chamber. The N female connector is labeled "RF ANT".



#### Circular polarization of the test antenna

Since the test antenna has nominally a circular polarization, it verifies two linear polarization characteristics of the EUT simultaneously. In an EUT radiation measurement, the output power  $P_{TA}$  at the RF ANT connector depends on both orthogonal components in the horizontal plane of the EUT's radiated field ( $E_{FB}$  and  $E_{LR}$ ) incident on the test antenna. In the case where the EUT is illuminated by the test antenna, the input power  $P_{TA}$  at the RF ANT connector creates two orthogonal field components in the horizontal plane incident on the EUT.

#### 3.4.1.3 Test Antenna Kit (R&S DST-B231)

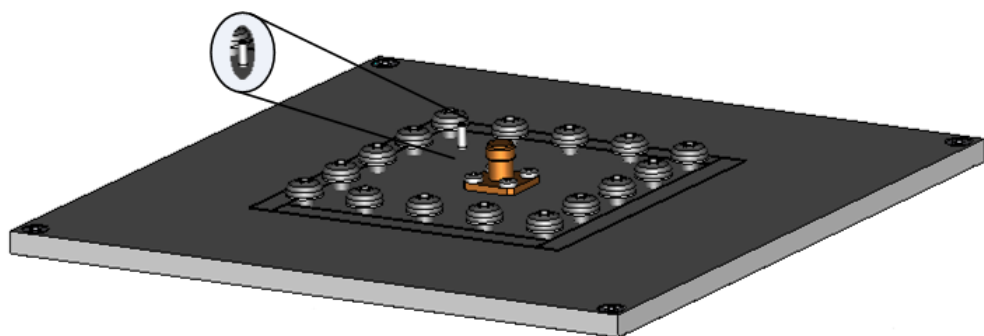
The R&S DST-B231 test antenna kit allows the installation of application-specific test antennas inside the R&S DST200 at the same location as for R&S DST-B210 and R&S DST-B220. The antenna element is designed to be fixed by screws, using the four mounting holes in the metal antenna base plate. The two RF absorber parts included in the test antenna kit must be installed to avoid reflections from the antenna base plate.

The antenna connector is available externally at the interface panel mounted at the right side of the R&S DST200 RF diagnostic chamber. The N connector (female) is labeled "RF ANT".

#### 3.4.1.4 Installing Test Antennas

Test antennas are screwed to the ceiling of the diagnostic chamber.

1. Remove the top cover as described in [chapter 3.1.4, "Accessing the Upper Compartment"](#), on page 11.
2. Position the antenna in the right direction.  
Test antennas have a small metal pin on the top that determine the way you have to align the antenna. Position the antenna in a way that the positioning pin fits into the corresponding hole in the ceiling of the R&S DST200.
3. Screw the antenna to the ceiling of the chamber.  
Note that you have to open the upper compartment of the R&S DST200 to be able to screw the antenna on from outside the chamber.
4. Position the interface panel with one (circular-polarized antenna ) or two (cross-polarized antenna) N female feedthroughs at the upper part of the right side wall of the chamber.
5. Screw the interface panel to the right wall of the chamber.
6. Connect the antenna output to the RF output of the R&S DST200 with one (circular-polarized) or two (cross-polarized) cables.  
Circular-polarized antennas have one output.  
Cross polarized-antennas have two outputs.
7. Close the upper compartment by reattaching the top cover of the R&S DST200.



*Fig. 3-10: Positioning pin of the antenna casing*



### Removing the antenna

When removing the antenna,

- hold onto the antenna to prevent it from falling down
- make sure not to damage the connectors or the positioning pin.

## 3.4.2 Communication Antennas

You can equip the R&S DST200 with linear-polarized communication antennas that are available as hardware options.

- Linear Polarized Test Antenna (R&S DST-B270)
- 2 pcs Communications Antenna (R&S DST-B272)  
The 2 part communication antenna also requires a power splitter that is part of the delivery.

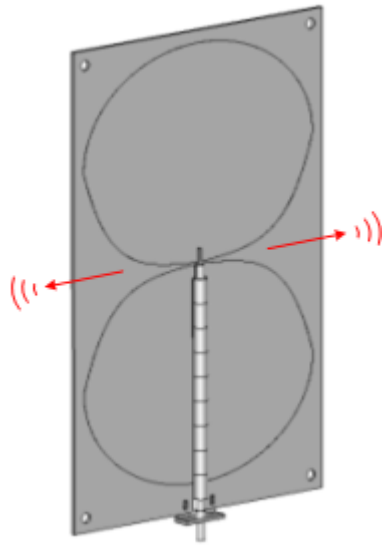
The 2 piece communication antenna is made up out of 2 single linear-polarized communication antennas connected with a power splitter for more stable measurements in case of non-isotropic radio patterns. Otherwise, the characteristics are the same as that of the single piece linear-polarized communication antenna.

### 3.4.2.1 Overview

The communication antenna radiates a linear-polarized electric field along the longer edge of the antenna PCB. The main radiation direction is along an exponential taper of the antenna. It was designed to provide an auxiliary radiation element to support a wide variety of applications, such as:

- Carrying UL or DL signal during radiated power or sensitivity tests.
- Radiating source of additional communication technologies during co-existence tests.
- Radiating source of interference signals.
- Antenna to provide additional radiation directions for MIMO measurements.

Very low thickness of the antenna allows easy installation at the edge of the cubical test space inside the R&S DST200. A traveling wave structure of the antenna provides ultra wideband frequency operation.



*Fig. 3-11: Main radiation directions of communication antenna (R&S DST-B270)*

To connect communication antenna to the external RF instrument the interface panel R&S DST-102 is required. Then the antenna connector is available at the interface panel mounted at the right side of R&S DST200 RF Diagnostic Chamber. The N female connectors are labeled "RF1" or "RF2". Single interface panel R&S DST-102 allows connection up to two communication antennas.

#### 3.4.2.2 Installing Communication Antennas

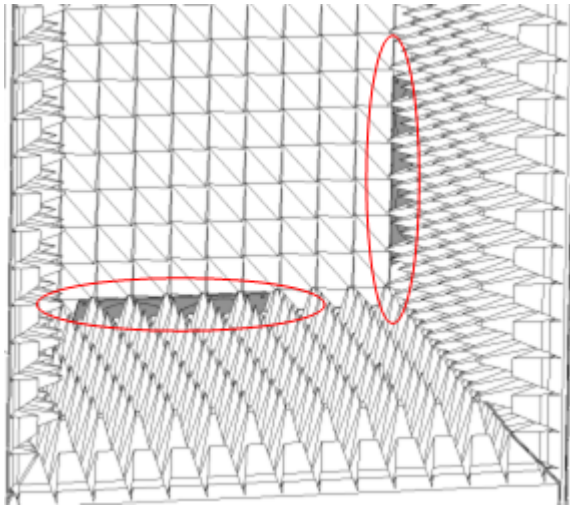
Communication antennas are simply stuck into the corners or edges of the chamber.

The R&S DST-B270 should be stuck to the rear right edge and the R&S DST-B272 to rear right and bottom edge. The antennas of the R&S DST-B272 should be connected to port 1 and 2 of the power splitter. The splitter can be placed into the bottom compartment.

The common port of the power splitter is connected to port RF1 of the interface panel R&S DST-B102.

The absorber panels inside the chamber provide enough foothold for the antenna to hold on its own. Thus, it is sufficient to just stick it in between the panels as shown in [figure 3-12](#).

To achieve maximum radiated coupling the EUT and the center of the communication antenna should be at the same height.



*Fig. 3-12: Installation of communication antenna into the chamber (RF cable is not shown)*

### 3.4.3 Functional Check

These instructions apply to the R&S DST200 antennas R&S DST-B210, -B220, -B231, -B270 and -B272.

The technical data of the RF Diagnostic Chamber and the antennas are listed in the R&S DST200 data sheet, see PD 5214.3600.22. To check compliance with the rated VSWR specifications of the antenna, you can use one of the following measurement devices:

- Network analyzer with the necessary frequency range **or**
- Spectrum analyzer with the necessary frequency range and a tracking generator and reflection measurement bridge

The frequency range depends on the frequency range of the antenna and is specified in the datasheet.

1. For network analyzers: Connect the RF cable to the network analyzer and calibrate the analyzer for a reflection measurement.
2. Connect the analyzer (or the bridge) to the **closed** chamber using the antenna connector and the RF cable.
3. Measure the VSWR at different frequencies.

The VSWR must be below the value specified in the data sheet across the entire frequency range of the antenna.

The RF shielding complies with the rated specifications provided that the cover plate is mounted, the front door is completely closed, and the EMI/EMC shielding gaskets are in place and not corroded or damaged. For more information see [chapter 3.1.3, "Replacing the Shielding Gaskets"](#), on page 11.

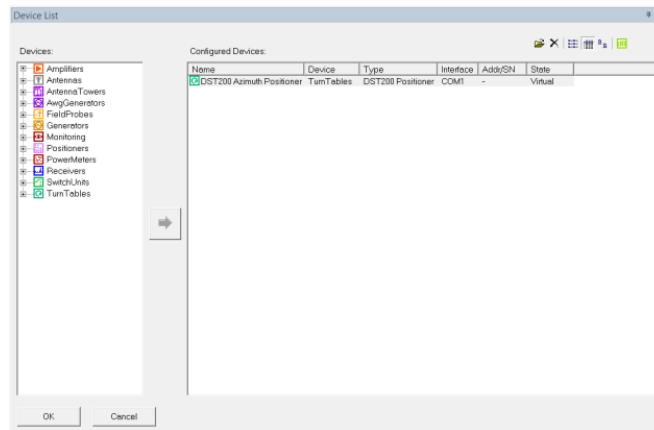


## 3.5 Configuring a Test PC

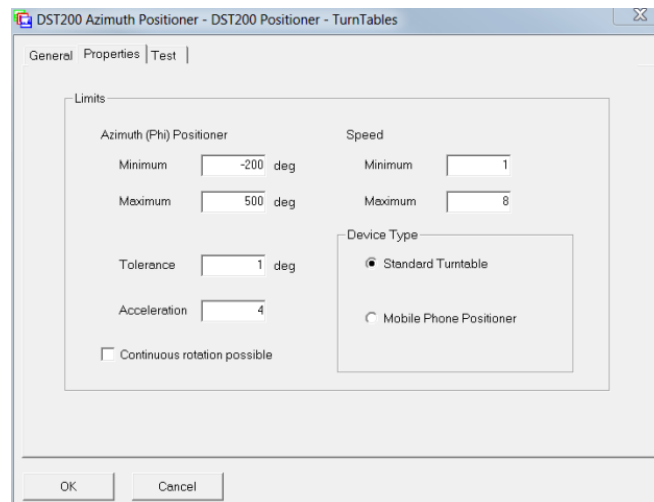
You can control the automated 3D positioner available for the R&S DST200 RF Diagnostic Chamber (R&S DST-B16x) with an external control computer that is equipped with the R&S AMS32 or R&S EMC32 system software. Both system software should be in version 9.00 or higher. In the following the presented procedure is valid for both system software. R&S EMC32 system software does not require step "3. Configuration of OTA options".

### Configuring the control computer

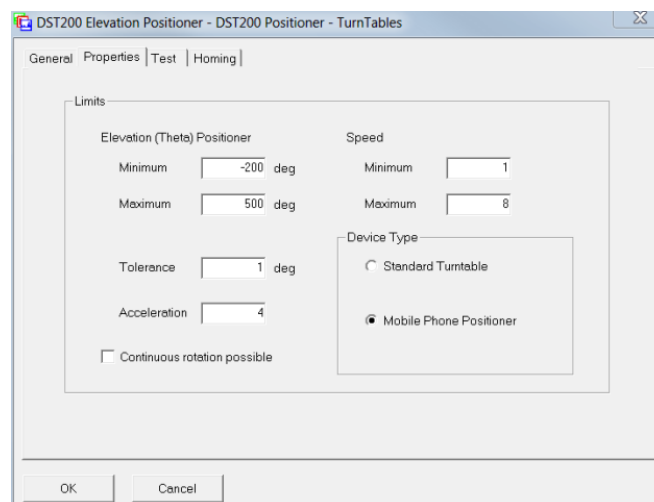
1. Start the R&S AMS32 software.
2. Configure positioner drivers.
  - a) Open the "Device List" in the "Extras" menu.
  - b) In the "Device List", register a first "DST200 Positioner" device from the device class "TurnTables" and rename it to "DST200 Azimuth Positioner".



- c) Open the dialog box to define the characteristics of the device by double-clicking on it.  
In the "Properties" tab, select "Standard Turntable" as the device type. Set the "Tolerance" to 1 and "Acceleration" to 4.

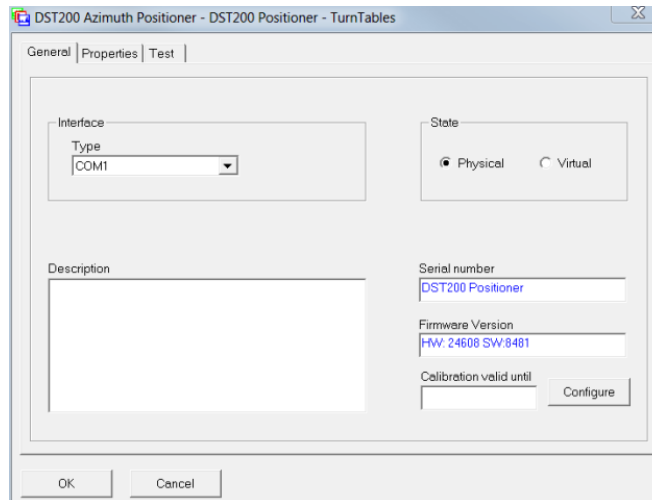


- d) In the "Device List", register a second "DST200 Positioner" device from the device class "TurnTables" and rename it to "DST200 Elevation Positioner". In the "Properties" tab, select "Mobile Phone Positioner" as the device type. Set the "Tolerance" to 1 and "Acceleration" to 4.

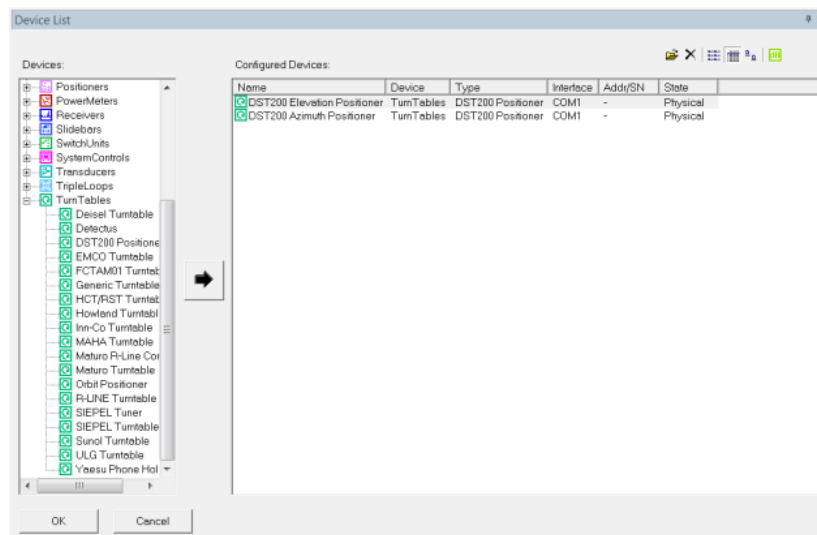


- e) In the "General" tab, select "COM1" as the "Interface Type" for both positioners ("DST200 Azimuth Positioner" and "DST200 Elevation Positioner").  
The RS232 cable of R&S DST-B16x shall be connected to the COM interface of the Test PC. Change the number of the COM interface if necessary.
- f) Connect the RS232 cable.

- g) In the "General" tab, set the "State" for both positioners to "Physical".



- h) Finally registration and configuration of both positioners is completed.

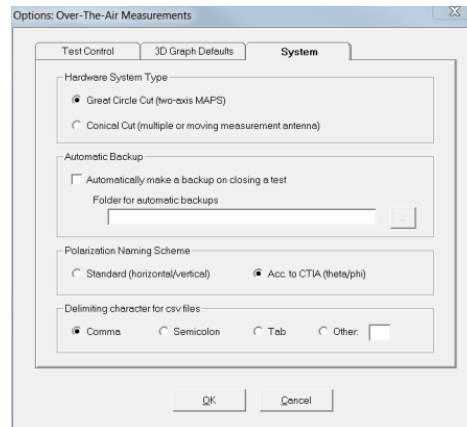


**Fig. 3-13: Registered drivers for R&S DST200 elevation and azimuth positioners in R&S AMS32**

### 3. Configure OTA options

- Open the "OTA Options" in the "Extras"→"Options..." menu.
- In the "System" tab, select "Great Circle Cut (two-axis MAPS)" as the "Hardware System Type".

- c) Select "Acc. To CTIA (theta/phi)" as "Polarization Naming Scheme".



### Performing automatic calibration

Azimuth and elevation correction values are found automatically by performing Auto Calibration. They are unique for a given sample of the automated 3D positioner. The correction values assure proper gear ratio between motor drives and actual orientation of the EUT holder. To perform auto calibration:

1. Open the "Device List" in the "Extras" menu.
2. Open the dialog box to define the characteristics for the "DST200 Elevation Positioner" device by double-clicking on it.
3. In the "Homing" tab, press the "Auto Calibration" button to determine correction factors automatically.

The software saves the results to a file. It is stored under `\EMC32\Logs\DSTposCommands.log`. The file contains two sections, one for the results of the azimuth rotator and one for the results of the elevation rotator.

Normally auto calibration shall be performed only once at the first configuration of the R&S DST200 positioner drivers in R&S AMS32 software. It needs to be repeated when the test PC is changed or the positioner is maintained.

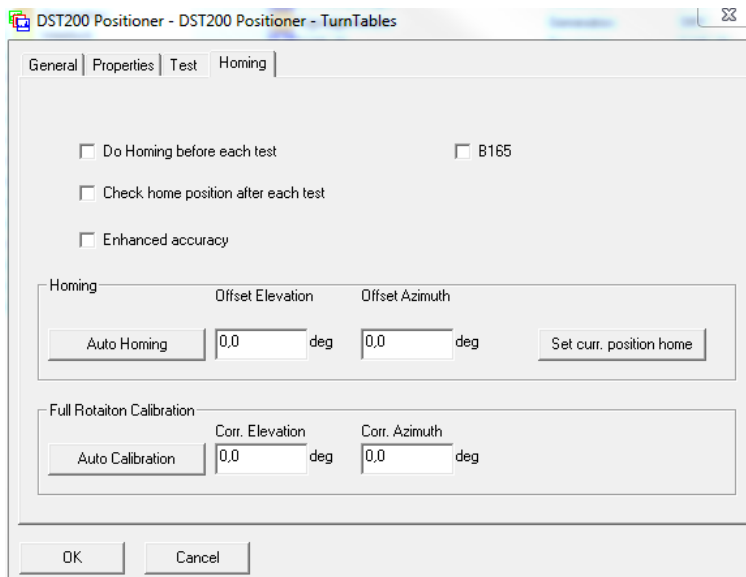
### Defining offset angles for the azimuth and elevation rotators

The actual home position of the EUT should correspond to the one that has been specified (azimuth = elevation = 0). If the actual home position deviates from the specified one, you can define an offset angle to move the EUT to the right position.

1. Open the "Device List" in the "Extras" menu.
2. Open the dialog box to define the characteristics for the "DST200 Elevation Positioner" device by double-clicking on it.
3. In the "Homing" tab, set the "Offset Elevation" and the "Offset Azimuth" to 0°.
4. Press the "Auto Homing" button.

After the homing procedure is done, check the offset of both rotators (read the angle labels on the positioner).

5. If there is an offset, proceed as follows.
  - a) In the "Test" tab, set appropriate values for the "New Position" for both rotators to achieve azimuth = elevation = 0° on the angle lables.
  - b) In the "Homing" tab of the "DST200 Elevation Positioner" device, enter the offset values you have found in the "Offset Elevation" and "Offset Azimuth" fields.
  - c) Press the "Set Curr. Position" button to correct the home position.



The R&S DST-B160 automated positioner is ready for operation with R&S AMS32 after performing auto calibration and defining offset angles for azimuth and elevation rotators.

### 3.6 Expendable Parts

The mechanical expendable parts for the RF Diagnostic Chamber are listed below. Please contact your local Rohde & Schwarz service center if you need to order spare parts:

[http://www2.rohde-schwarz.com/en/service\\_and\\_support/service\\_locations/](http://www2.rohde-schwarz.com/en/service_and_support/service_locations/)

Table 3-4: List of expendable parts

Part designation	Stock no.	Remarks
<b>R&amp;S DST200 RF Diagnostic Chamber</b>		
FEEDTHROUGH PANEL BLIND	1514.2101.00	See <a href="#">chapter 3.2.5, "Mounting Filter and Interface Panels"</a> , on page 18
EUT TABLE	1514.7655.00	See <a href="#">figure 3-5</a>

Part designation	Stock no.	Remarks
VELCRO FASTENER SET	1514.5823.00 <sup>1)</sup>	To mount ABSORBER WALL at the door and ABSORBER TOP at the top panel of the R&S DST200
ABSORBER TOP	1519.0059.00	
ABSORBER WALL	1519.0071.00 <sup>2)</sup>	
ABSORBER BOTTOM A	1519.0088.00	See <a href="#">figure 3-4</a>
ABSORBER BOTTOM B	1519.0036.00	
ABSORBER BOTTOM C	1519.0042.00	
EMV GASKET SET	1518.5092.00 <sup>1)</sup>	See <a href="#">chapter 3.1.3, "Replacing the Shielding Gaskets"</a> , on page 11
<b>R&amp;S DST-B16x Automated 3D Positioners</b>		
EUT HOLDER (DST-B160)	1518.5086.00	See <a href="#">table 3-2</a>
EUT HOLDER (DST-B165)	1519.3906.00	
MOBILE UNIT SUPPORT (DST-B160)	1518.5163.00	See <a href="#">figure 3-7</a>
MOBILE UNIT SUPPORT (DST-B165)	1519.3887.00	
MOBILE UNIT (DST-B160)	1518.5170.00	
MOBILE UNIT (DST-B165)	1519.3893.00	
MOTOR UNIT (DST-B160/-B165)	1518.5186.00	
CABLE RS232	1518.4744.00	See <a href="#">figure 3-9</a>
CABLE MOTOR BOX	1518.4738.00	
<b>Other</b>		
R&S DST-B210 CROSS-POLARIZED TEST ANTENNA	1516.8207.02	Includes the whole option
R&S DST-B220 CIRCULAR-POLARIZED TEST ANTENNA	1518.4509.02	
R&S DST-B231 TEST ANTENNA KIT	1518.5328.02	
R&S DST-B270 LINEAR-POLARIZED COMMUNICATION ANTENNA	1518.4515.02	

1) Contains required quantity for the whole unit.

2) Four pieces required for the whole unit.

## 4 Maintenance

The outside of the RF Diagnostic Chamber can be cleaned sufficiently using a soft, lint-free dust cloth.

### Shielding gaskets at the front door

The front door and the EMI/EMC shielding gaskets around the door joint must be inspected at regular intervals. The purpose of the gaskets is to ensure a good, continuous electrical contact between the closed door and the front side of the chamber. To maintain the shielding effectiveness of the chamber, the gaskets must be regularly cleaned.

To clean the gaskets, gently wipe the contact surfaces with a clean cloth soaked in ethyl alcohol. If corrosion or discoloration persists, you can clean the surfaces using a non-scratch scrub sponge such as Scotch-Brite™. There is no need to coat the cleaned gaskets with lubricant or oil.

If corrosion still persists, replace the gaskets as described in [chapter 3.1.3, "Replacing the Shielding Gaskets"](#), on page 11. Replace all gaskets with broken, bent, or missing fingers.

### Inspection intervals

The door and the shielding gaskets should be inspected every six months. Shorter inspection and cleaning intervals are recommended if the RF Diagnostic Chamber is used very frequently or if it is exposed to temperature change, humidity, or corrosive environments.

Positioning accuracy of R&S DST-B160 automated 3D positioner should be verified before each test session. The user shall perform Auto Homing operation using R&S AMS32 software package. The user should verify if azimuth and elevation rotator stay at the position 0 deg within the specification limits defined by the data sheet of the R&S DST200, see PD 5214.3600.22. If the position values exceed the limits the user shall contact the local R&S service engineer."

## 5 Reference Path Loss Measurement

Over-the-air (OTA) measurements attempt to determine the performance of radio transmitters and receivers in a test environment which closely simulates the conditions in which the devices will be used. OTA tests for mobile phones have been promoted and specified by CTIA - The Wireless Association®; refer to the "CTIA Certification, Test Plan for Mobile Station Over the Air Performance, Method of Measurement for Radiated RF Power and Receiver Performance, Rev. 3.1".

An important preparatory stage of any OTA measurement consists of removing the test system's influence from the radiated power and sensitivity results. To this end the equipment under test (EUT) is replaced by a reference antenna with known gain characteristics, and a reference path loss measurement is performed. The reference measurement is combined with the known gain of the reference antenna to determine an **isotropic** reference correction for the power and sensitivity results. The remainder of this section outlines how to perform the reference path loss measurement using the RF Diagnostic Chamber in combination with a vector network analyzer. For a detailed description of the measurement method refer to section "Range Reference Requirements" in the CTIA certification document.

The reference path loss measurement is different from the path loss measurement described in [chapter 6.2, "Path Loss Measurement"](#), on page 45 where the EUT (typically, a mobile phone) provides the information about the path loss values.

### 5.1 Background

The purpose of the reference path loss measurement is to relate the measured radiated power or sensitivity of the EUT to the same quantities from an ideal isotropic radiator. We define the total reference path loss PL of the RF Diagnostic Chamber as the difference:

$$PL = P_{RA} - P_{TA, ISO}$$

where  $P_{RA}$  is the input power and  $P_{TA, ISO}$  is the output power, assuming that the chamber is equipped with an isotropic radiator. As shown in [figure 6-4](#) and in [figure 5-1](#),  $P_{TA, ISO}$  depends on the propagation loss along the cable, the test antenna, and in free space.

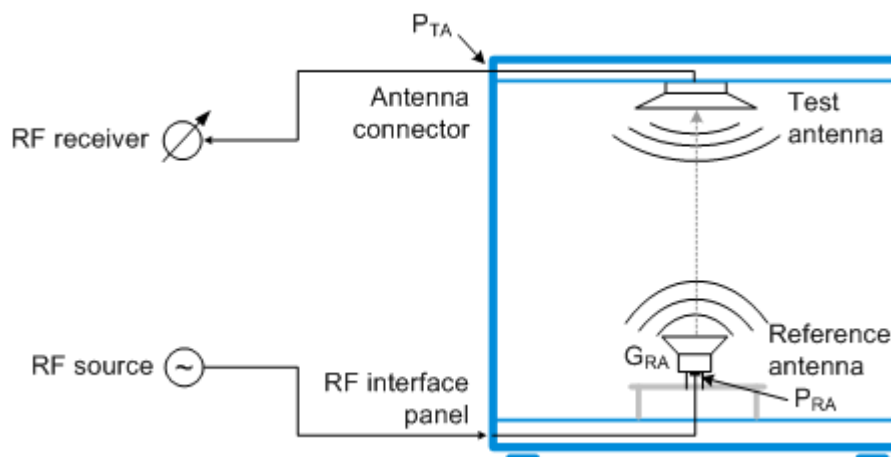
Most conveniently, the RF input signal for the reference path loss measurement is fed to an additional RF feed through (the "Double N Connector" R&S DST-B102 mounted at one of the lower connector ports); the RF output signal is tapped at the antenna connector of the respective antenna being measured.



#### Disturbance due to cabling

Watch that the connecting cable does not disturb the radiation pattern of the isotropic radiator (or reference antenna, see below). The cable must be either outside the radiated field or perpendicular to the electric field **E**.





**Fig. 5-1: Schematic test setup for reference path loss measurement**

In practice, the ideal isotropic radiator is replaced by a calibrated reference antenna. The (known) gain of the reference antenna  $G_{RA}$  is defined as the difference between the antenna's actual radiated power and the ideal isotropic power, hence:

$$PL = G_{RA} + P_{RA} - P_{TA}$$

In the equation above,  $P_{TA}$  denotes the output power of the RF Diagnostic Chamber in the presence of the reference antenna, including the effect of the antenna's radiation characteristics. The power difference  $P_{RA} - P_{TA}$  can be measured as described below. Together with the known value of  $G_{RA}$  this determines the total reference path loss PL.



#### **Polarization of the reference antenna**

Make sure to align the polarization of the reference antenna to that of the test or communication antenna before beginning with the calibration procedure.

In addition, do not move the antenna to another position after you have calibrated the test setup or else calibration becomes invalid.

## **5.2 Measurement**

The principle of the following measurement procedure is valid for all R&S DST200 antennas when a calibration plane is selected at the appropriate antenna connector. For more information see [chapter 3.4, "Antennas for the R&S DST200"](#), on page 26.

A vector network analyzer (VNA) is ideally suited for the reference path loss measurement because the necessary steps are all part of its basic functionality. The VNA will perform most of the necessary calculations by itself. To measure the power difference  $P_{RA} - P_{TA}$ ,

1. Calibrate the connecting cables between the VNA source port and the input connector of the reference antenna and between the antenna connector of the chamber and the VNA receiver port.

2. Measure the connected RF Diagnostic Chamber in transmission.

### Cable calibration

The suggested test setup uses port 1 of the VNA as a source port, port 2 as a receive port. Calibration is performed with all cables connected to both analyzer ports. For best accuracy, use high-quality RF cables and perform a full two-port calibration. Connect the required calibration standards successively to the cable ends as required by the selected calibration type.

The calibrated VNA results will relate to the cable ends. Calibration moves the "reference plane" from the VNA ports towards the input and output connectors of the chamber.

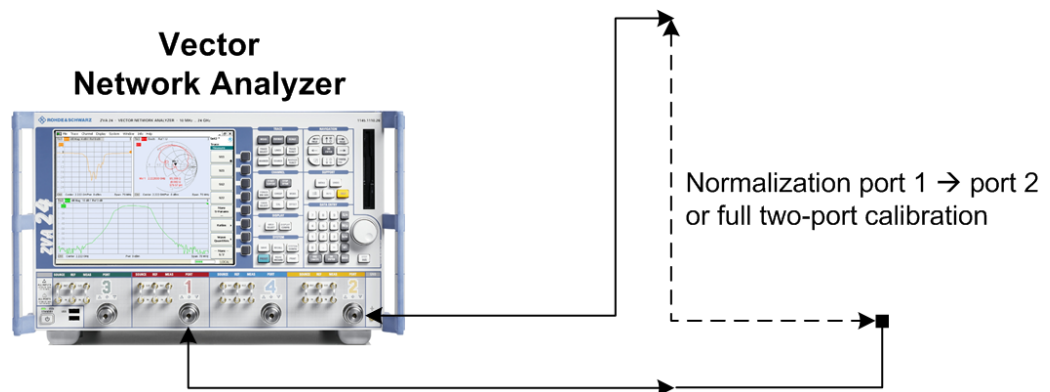


Fig. 5-2: VNA test setup for cable calibration

### Transmission measurement

Apply the calibration and connect the cable ends to the input connector of the reference antenna and the antenna connector of the RF Diagnostic Chamber. Measure the forward transmission coefficient  $S_{21}$ , converted to a dB-magnitude value (this is the preset measurement mode of many VNAs). The power difference  $P_{RA} - P_{TA}$  is equal to the negative of the transmission coefficient:

$$P_{RA} - P_{TA} = -|S_{21}|$$

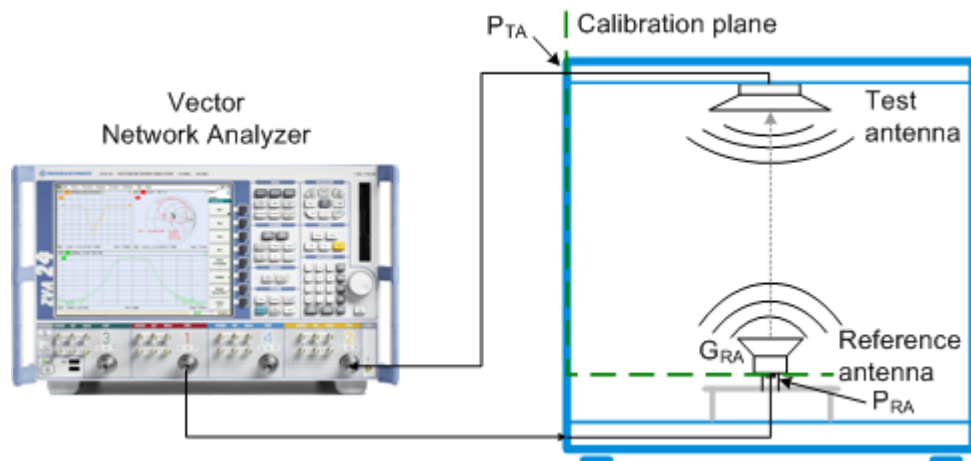


Fig. 5-3: VNA test setup for transmission measurement

### Reference path loss calculation

To determine the reference path loss, add the antenna gain to the VNA results:

$$PL = G_{RA} - |S_{21}|$$

Reference path loss values must be acquired for all test frequencies, most easily by configuring an appropriate frequency sweep at the VNA. The path loss values must be stored and used to correct the OTA performance test results.

## 5.3 Generic RF Parameters: R&S DST-B220

You can download a set of measured antenna factors (AF), reference path loss values (PL) and transducer factors (TRD) off the R&S DST200 homepage (<http://www2.rohde-schwarz.com/product/DST200.html>).

The measured values are valid for any linear-polarized electrical field in the horizontal plane ( $E_z = 0$ ) incident on the test antenna (AF, PL) or the EUT (TRD, PL). The EUT is positioned at the origin of the rectangular coordinate system of the chamber, once on the top surface of the standard EUT table, once in the center of the manual or automated 3D positioner. For more information see [chapter 3.3, "3D Positioners for the R&S DST200"](#), on page 19.

The two distances  $D_1 = 350$  mm and  $D_2 = 280$  mm are the distances between the reference antenna / receiver and the test antenna.

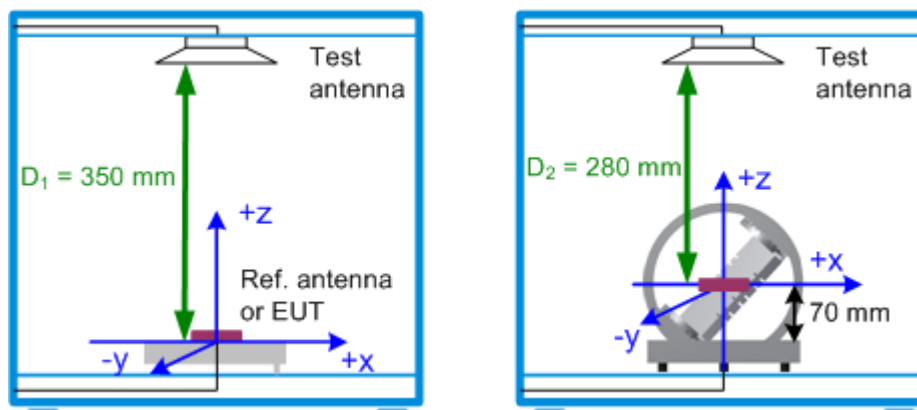


Fig. 5-4: Definition of distances between test antenna and reference antenna

The uncertainty  $U$  is the sum of the expanded uncertainty of the gain of the reference antenna utilized for determining the RF parameters, and the maximum uncertainty due to an imperfect axial ratio of the test antenna.

The test antenna factor  $AF$  ([dB/m], for EMI applications) is obtained as:

$$AF = E_{TA} - V_{TA}$$

where  $E_{TA}$  [dB $\mu$ V/m] is the electric field strength with horizontal polarization incident on the test antenna, and  $V_{TA}$  [dB $\mu$ V] is the output voltage at RF ANT.  $AF$  was determined using the standard EUT table (distance  $D_1$ ).

The reference path loss  $PL$  ([dB], for OTA applications) is measured as described in chapter 5.1, "Background", on page 39:

$$PL = G_{RA} + P_{RA} - P_{TA}$$

The antenna transducer factor  $TRD$  ([dBV/m/sqrt(W)], for EMS applications) is given by:

$$TRD = E_{EUT} - 0.5 * P_{TA}$$

where  $E_{EUT}$  [dBV/m] is the electric field strength with horizontal polarization at the EUT location ( $D_1$  or  $D_2$ ) when the test antenna is fed with  $P_{TA}$  [dBW] into the RF ANT connector.



### RF parameters

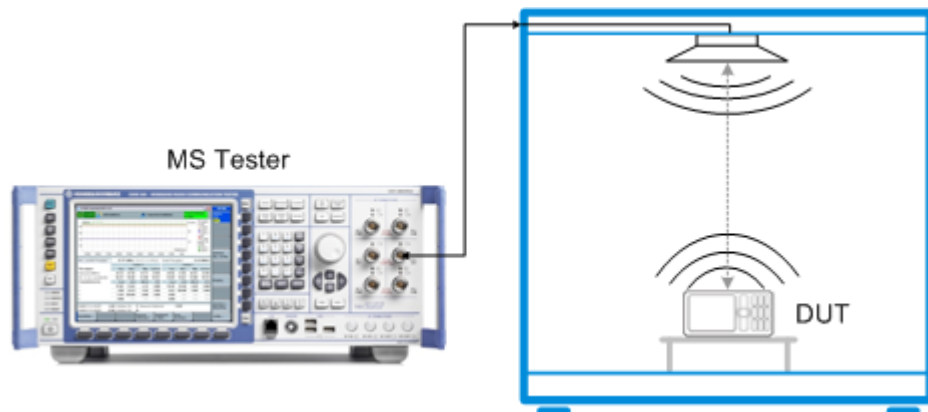
A comprehensive set of RF parameters is available for download on the product homepage (<http://www2.rohde-schwarz.com/product/DST200.html>) of the R&S DST200.

These values are generic values collected in a specific R&S DST200 sample measurement. To obtain the values specific for your RF Diagnostic Chamber, use a calibrated reference antenna and perform the reference path loss measurement as described in chapter 5.2, "Measurement", on page 40.

## 6 Test Scenarios

### 6.1 Desense and Self-Interference Tests

The basic test setup for receiver and transmitter tests in an interference-free and reflection-free environment is shown below. The equipment under test (typically, a mobile station, but also any other device with a radio interface) is placed on the EUT table inside the RF Diagnostic Chamber. The bidirectional RF connector RF ANT is connected to a radio communication tester. The tester serves as a base station simulator (BSS) providing a downlink/forward link signal for receiver tests and measuring the uplink signal from the EUT.



*Fig. 6-1: Basic test setup for receiver and transmitter tests*

Knowledge of the RF path loss in downlink and uplink direction is essential for this type of measurement; see [chapter 6.2, "Path Loss Measurement"](#), on page 45.

Desense is the degradation of receiver performance, which is typically caused by in-band or out-of-band signals or broadband noise. The receiver performance is characterized by the sensitivity level, i.e. the minimum RF input signal level where the Bit Error Rate is below a given threshold value. Receiver desense results in an increased sensitivity level. The following figure shows a desense test in the GSM900 band. The two sharp peaks are caused by self-interference on two particular channels.

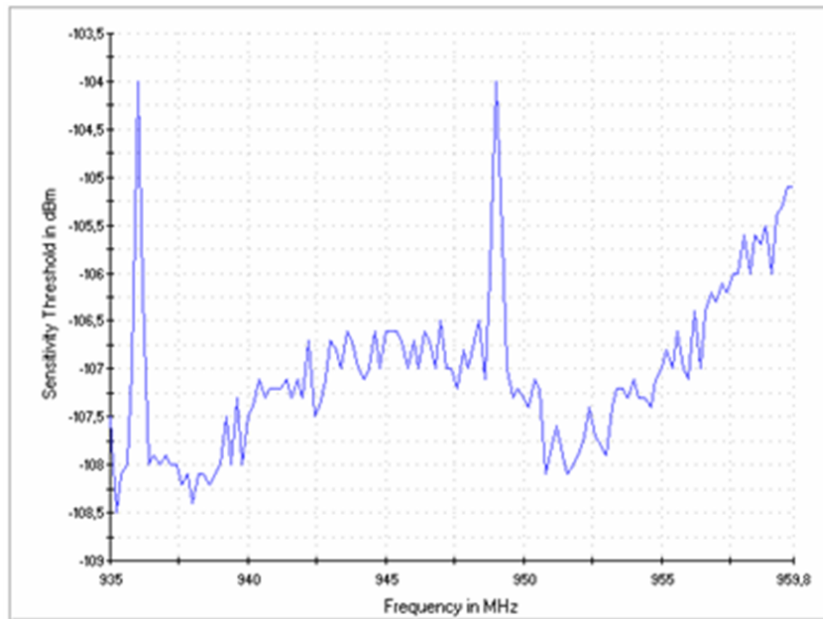


Fig. 6-2: GSM desense test

### Coexistence tests

The following figure shows a test setup for a Bluetooth® / GSM coexistence test with the RF Diagnostic Chamber and two radio communication testers. The R&S CBT Bluetooth® tester maintains a connection to the EUT and measures the sensitivity level. An R&S CMW500 is used to set up a parallel GSM connection which may (or may not) adversely affect the Bluetooth® sensitivity level.

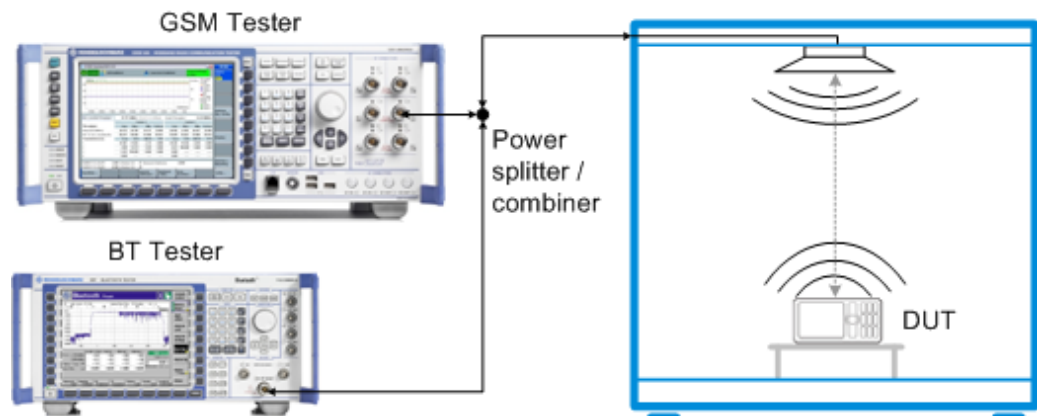


Fig. 6-3: Test setup for Bluetooth / GSM coexistence tests

## 6.2 Path Loss Measurement

RF signals are attenuated on their way from the equipment under test (EUT) to the test instrument and back. The total path loss in either direction includes the contribution of

the range path loss  $PL_r$  due to the distance  $r$  between the EUT and the test antenna of the RF Diagnostic Chamber (including its connection to the RF ANT connector), the loss  $PL_A$  introduced by the antenna, and any loss  $PL_{ext}$  in the signal path between RF ANT and the input/output connector of the test instrument. All these contributions may depend on the signal direction.

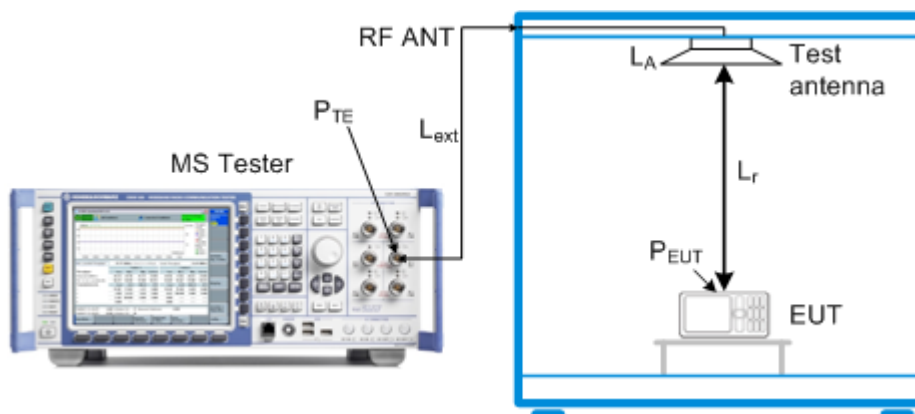


Fig. 6-4: Path loss

We define the total path loss for the two signal directions as the difference between transmitted and received powers:

- $Input\ path\ loss/dB = P_{EUT, out} - P_{TE, in}$   
 $= \langle EUT\ output\ power \rangle / dBm - \langle RF\ input\ power\ at\ tester \rangle / dBm$
- $Output\ path\ loss/dB = P_{TE, out} - P_{EUT, in}$   
 $= \langle Generator\ level\ of\ tester \rangle / dBm - \langle Received\ signal\ level\ at\ the\ EUT \rangle / dBm$

Each R&S DST200 antenna model (R&S DST-B210, R&S DST-B220, R&S DST-B231 and R&S DST-B270) provides different path loss. If you use a cross-polarized antenna (R&S DST-B210), you should measure the path loss for each electric field polarization separately

Once the path loss values are known for a given EUT type, position, and RF connection they can be reported to the test instrument as external attenuation factors ("External Attenuation (Input)", "External Attenuation (Output)"). The tester will then correct all power measurements by the reported input path loss and increase its RF generator level to compensate for the output path loss.

In the definitions above the sign of the input and output path loss is in accordance with the definition of external input and output attenuation factors ("Ext. Att. Input", "Ext. Att. Output") in the R&S CMW and R&S CMU200.



### Path loss, R&S DST200 antenna model and EUT type

The path loss values depend on the R&S DST200 antenna model (R&S DST-B210, R&S DST-B220, R&S DST-B231 and R&S DST-B270) and the EUT type. If a cross-polarized antenna (R&S DST-B210) is used then the path loss for each field polarization should be measured separately. Results for a particular EUT (e.g. a mobile phone) type should be determined using a fully functional and proven device ("golden" device); they may then be applied to all EUTs of the same type. The path loss value changes as a function of EUT orientation for the EUT with non-isotropic radiation pattern. Consequently, the path loss measurement procedure described in this chapter is sufficient for basic receiver and transmitter tests."

For over-the-air (OTA) performance tests, a more elaborate "reference path loss" measurement is required to remove the test system's influence from radiated power and sensitivity results; see [chapter 5, "Reference Path Loss Measurement"](#), on page 39.

## 6.2.1 Input Path Loss

If an external input attenuation is reported to the test instrument, all EUT power readings are increased. The tester shows the actual EUT transmitter output power which is higher than the level at its input connectors.

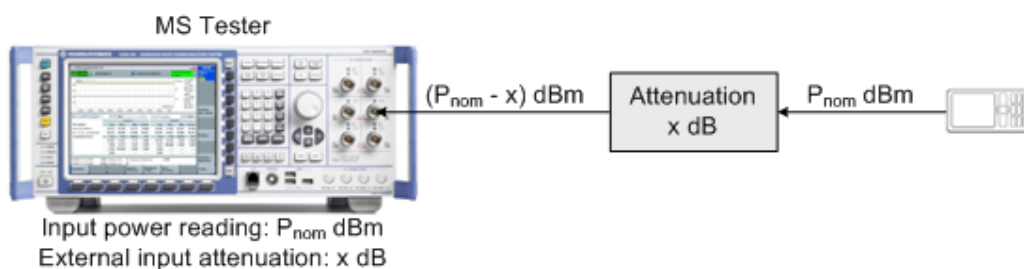


Fig. 6-5: Definition of input path loss

## 6.2.2 Output Path Loss

If an external output attenuation is reported to the test instrument, the generator power is increased relative to the nominal generator power setting. The actual signal power at the input of the EUT, after attenuation by the test setup, is equal to the nominal generator power.



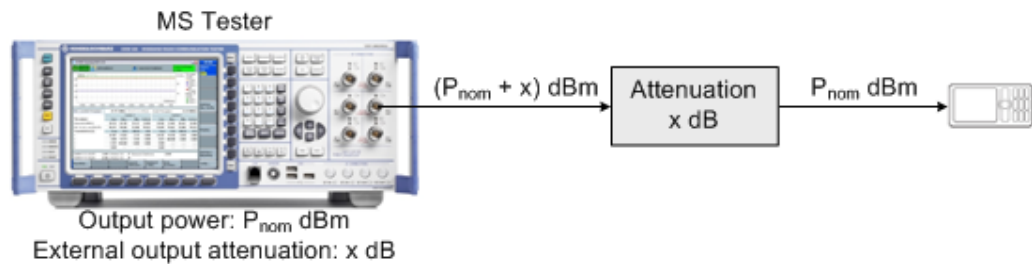


Fig. 6-6: Definition of output path loss

### 6.2.3 Determining Path Loss Values: R&S CMW

External input and output attenuation factors are reported in the configuration dialogs of the different measurement and generator/signaling firmware applications of the R&S CMW. The procedure for determining the path loss values is analogous for all networks; for an overview refer to [chapter 6.2.3.4, "Other Network Standards"](#), on page 50. The following example shows the necessary steps for a WiMAX mobile phone.



The following example requires an R&S CMW tester (model R&S CMW500 or R&S CMW270) equipped with the "WiMAX Measurements" and the "WiMAX Signaling" firmware applications. If no signaling application is available for a given network standard, you have to determine the received signal power and the transmitter output power of your EUT by external means.

#### 6.2.3.1 Preparatives

In the following example, the EUT is a WiMAX MS supporting a 10 MHz bandwidth. The procedure for other bandwidths is similar, however, some more R&S CMW settings may have to be adjusted.

1. Connect the N connector of your RF Diagnostic Chamber R&S DST200 to the bidirectional RF connector RF 1 COM of the R&S CMW, preferably using the high-quality RF cable supplied with the RF Diagnostic Chamber.
2. Place a fully functional and proven MS on the EUT table.
3. Switch on the R&S CMW and the MS.

#### 6.2.3.2 Input Path Loss

Determining the input path loss requires the "WiMAX Measurements" and the "WiMAX Signaling" firmware applications.

1. Access the "WiMAX Signaling" firmware application and establish a connection between the R&S CMW and the MS, using default settings.

When the R&S CMW shows the connection status "Network Entry Completed", press the "MS Channel Report" softkey.

- Open the "Results > MS Channel Report" section in the measurement dialog and read the "UL TX Power (Data Carrier Power)" result.

MS Channel Report	
CINR Mean	28.000 dB
CINR Deviation	12.000 dB
UL TX Power (Data Carrier Power)	-37.000 dBm
RSSI Mean	-50.00 dBm
RSSI Deviation	-3.50 dB

Fig. 6-7: WiMAX Signaling: UL TX Power

- Open the "WiMAX Measurements" application and press ON | OFF to start the measurement.
- Open the "Multi Evaluation Configuration" dialog and enable an "Combined Signal Path" measurement scenario.

Scenario	Combined Signal Path
RF Routing	RF-Rx 1 Connector: RF1 COM
External Attenuation (Input)	0.00 dB
Frequency	3500.000000 MHz
Expected Nominal Power	0.00 dBm Ref.Level: 0.00 dBm
User Margin	0.00 dB

Fig. 6-8: WiMAX Measurement: RF Settings

- Close the configuration dialog and read the average "Subcarrier Power > Data" result from the "Measurement Overview" tables.

Subcarrier Power				
Data [dBm]	-69.65	-69.55	-69.76	-69.43
Pilots [dBm]	-69.55	-69.46	-69.56	-69.37

Fig. 6-9: WiMAX Measurements: Subcarrier Power

- To determine the input path loss of your mobile phone, subtract the measured "Subcarrier Power > Data" from the reported "UL TX Power (Data Carrier Power)" of the MS. In the example above, the input path loss equals to approx.  $(-37.00 - (-69.65)) \text{ dB} = 32.65 \text{ dB}$ .
- Re-open the "Multi Evaluation Configuration" dialog and enter the input path loss as an "External Attenuation (Input)"; see figure 6-8.



For the example above we assume that the "UL TX Power" reported by the MS corresponds to the power of one subcarrier. Adjust the calculation if your MS uses a different definition of the "UL TX Power".

### 6.2.3.3 Output Path Loss

Determining the output path loss requires the "WiMAX Signaling" firmware application only.

1. Access the "WiMAX Signaling" firmware application and establish a connection between the R&S CMW and the MS, using default settings.  
When the R&S CMW shows the connection status "Network Entry Completed", press the "MS Channel Report" softkey.
2. Open the "Results > MS Channel Report" section in the measurement dialog and read the "RSSI Mean" result.

MS Channel Report	
CINR Mean	20.000 dB
CINR Deviation	40.000 dB
UL TX Power (Data Carrier Pow...	-19.500 dBm
RSSI Mean	-80.000 dBm
RSSI Deviation	-101.000 dB

Fig. 6-10: WiMAX Signaling: RSSI Mean

3. Expand the "General Settings > RF Output (Tx)" section and read the "Preamble Power".

RF Output (Tx)		FrontEnd 1
RF Routing		RF1 COM
External Attenuation		0.00 dB
Tx Power Data Carrier		-80.00 dBm
Preamble Power		-46.50 dBm

Fig. 6-11: WiMAX Signaling: Preamble Power

4. To determine the output path loss of your mobile phone, subtract the reported "RSSI Mean" from the "Preamble Power" of the downlink signal. In the example above, the output path loss equals to  $(-46.5 - (-80.0)) \text{ dB} = 33.5 \text{ dB}$ .
5. Enter the path loss as an "External Attenuation". The R&S CMW will increase its "TX Power Data Carrier" to ensure a correct input power at the MS receiver.



The RSSI scale covers DL powers between  $-123 \text{ dBm}$  and  $-40 \text{ dBm}$ . The 1-dB step width of the RSSI scale and the accuracy of the RSSI measurement at the MS limits the accuracy of the measured output path loss values. Ensure that the "Preamble Power" of your DL signal is within the RSSI range.

### 6.2.3.4 Other Network Standards

The measurement method outlined above is also suitable for determining path loss values for other network standards; [table 6-1](#) gives an overview of the necessary R&S CMW configuration and the essential settings.

As a general rule the R&S CMW must be equipped with a signaling application (option R&S CMW-KSxxx) plus a measurement application (option R&S CMW-KMxxx) for every measured network standard.

### Input path loss

After the R&S CMW has established a connection with the EUT, the reported EUT output power is displayed by some signaling applications. If the EUT does not report its output power, configure a known output power, e.g. send TPC bits to the EUT so that it sends at its known maximum power.

The R&S CMW input power can be determined using the measurement application.

The input path loss is the difference between the EUT output power and the measured input power:

Input path loss = EUT output power – R&S CMW input power

### Output path loss

The R&S CMW generator power corresponds to the downlink/forward signal power that the R&S CMW uses for the connection; it is defined in the configuration dialog of the signaling application.

For some network standards, the received signal level is reported by the EUT and displayed by the signaling application.

The output path loss is the difference between the two values:

Output path loss = R&S CMW generator power – Received signal level of EUT

In CDMA2000 and 1xEV-DO networks the received signal level is not reported by the MS/AT. Instead, the output path loss can be determined in an access probe measurement; see notes in the following table.



### Accuracy considerations

The EUT reports its output power and the received signal power as digital values (power steps). Each value denotes a power range, which necessarily limits the accuracy of the measurement method. The accuracies quoted below correspond to the distance between the reported power steps.

---

Table 6-1: Path loss measurements for different network standards using the R&amp;S CMW

Standard	R&S CMW model	Software options	Firmware version	Input path loss		Output path loss			
				EUT output power (UL)	R&S CMW input power (UL)	Resolution	R&S CMW generator power (DL)	Received signal level of EUT (DL)	Resolution
WiMAX	R&S CMW270	R&S CMW-KS700	≥V1.0.10.1	reported UL TX Power (Data Carrier Power)	Subcarrier Power > Data Power	0.5 dB	TX Power Data Carrier	RSSI Mean (-40 dBm at max.)	1 dB
	R&S CMW500	R&S CMW-KM700							
GSM	R&S CMW280	R&S CMW-KS200	≥V1.0.15.0	RF Settings > TCH/PDCH > Circuit Switched > PCL	Burst Power	1 dB	RF Settings > TCH/PDCH > Reference Level	RX Level (-48 dBm at max.)	1 dB
	R&S CMW500	R&S CMW-KM200							
LTE	R&S CMW500	R&S CMW-KS500	≥V2.1.20	known EUT power	TX Power	-	Downlink Power Levels > RS EPRE	RSRP (-44 dBm at max.)	1 dB
		R&S CMW-KS550							
WCDMA	R&S CMW280	R&S CMW-KS400	≥V1.0.15.20	known EUT power	UE Power (RMS)	-	RF Settings > RF Power Downlink > Output Power (lor) / dBm + Physical Downlink Settings > P-CPICH Level / dB	CPICH RSPC(-25 dBm at max.)	1 dB
	R&S CMW500	R&S CMW-KM400							
CDMA2000	R&S CMW500	R&S CMW-KS800	≥V1.0.15.0	known EUT power	MS Power (1.23 MHz BW)	-	CDMA power <sup>1)</sup>	<Power offset> - (MS Power (1.23 MHz BW) - <Input path loss>) <sup>2)</sup>	-
		R&S CMW-KM800							
1xEV-DO	R&S CMW500	R&S CMW-KS880	≥V1.0.15.0	known EUT power	AT Power (1.23 MHz BW)	-	CDMA power <sup>1)</sup>	<Power offset> - (AT Power (1.23 MHz BW) - <Input path loss>) <sup>2)</sup>	-
		R&S CMW-KM880							

1) See standard 3GPP2 C.S0011-A, "Range of Open Loop Output Power". To obtain access probes with constant power, configure the signaling application as follows: "Network > Access Probes > Access Probes: Ignore, Probe Increment 0 dB".

2) When transmitting access probes, the MS/AT applies the open loop condition: the sum of the mean input power plus the mean output power is equal to a constant "Open Loop Power Offset". The mean output power of the MS/AT is the access probe power measured by the R&S CMW plus the input path loss determined previously. Open loop power offset values are specified in standard TIA-1030-C, depending on the band class and the spreading rate. Consequently the path loss measurement must be repeated for different band classes.

## 6.2.4 Determining Path Loss Values: R&S CMU200

External input and output attenuation factors are reported in the "RF IN/OUT" tab of the "Connection Control" dialog, which is provided for all network tests. The procedure for determining the path loss is analogous for all networks. The following examples show the necessary steps for a GSM mobile phone and a WCDMA UE.

### 6.2.4.1 Preparatives (GSM or WCDMA)

1. Connect the N connector of your RF Diagnostic Chamber R&S DST200 to the bidirectional RF connector RF 2 of the R&S CMU200, preferably using the high-quality RF cable supplied with the RF Diagnostic Chamber.
2. Place a fully functional and proven MS on the EUT table.
3. Switch on the R&S CMU200 and the MS.

### 6.2.4.2 GSM Path Loss

1. For a GSM MS, access the GSMxxx-MS function group (where xxx corresponds to the GSM band of your MS), "Signaling" test mode, to establish a call between the R&S CMU200 and the MS, setting the MS to a definite Power Control Level (PCL).  
A PCL 15 for a GSM900 mobile phone corresponds to a nominal transmitter output power of 13 dBm. For more information refer to your operating manual for the GSMxxx-MS software options (R&S CMU-K20/-K21/-K22/-K23/-K24...), stock no. 1115.6088.12.
2. Open the "Overview" dialog to display all measurement results that are relevant for determining the path loss values.

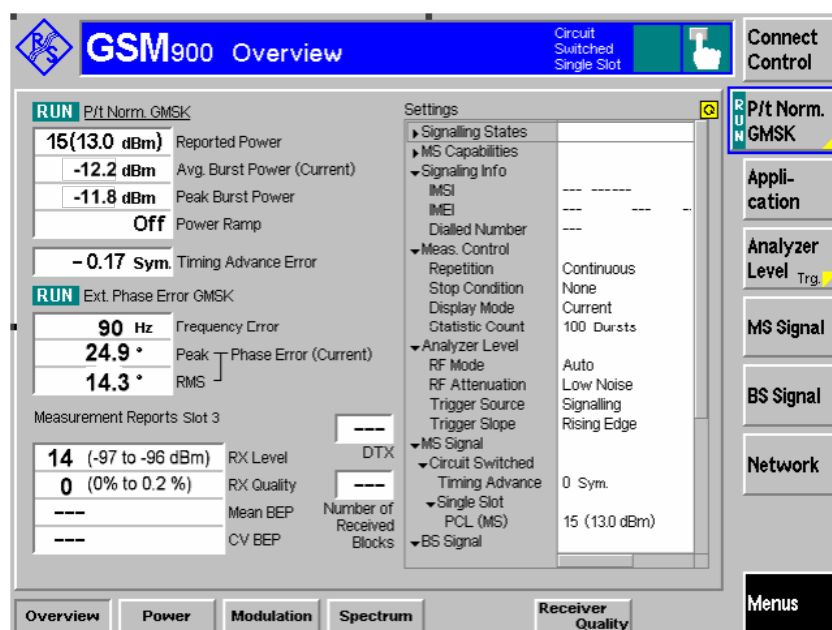


Fig. 6-12: GSM900 Signaling: Overview dialog

3. To determine the output path loss of your mobile phone, subtract the reported "RX Level" at the MS from the output level of the R&S CMU ("BS Signal – TCH Level – Used TS"). In the example above, assuming a "Used TS" level of  $-70$  dBm, the output path loss equals to  $(-70.0 - (-96.5))$  dB = 26.5 dB.
4. To determine the input path loss of your mobile phone, subtract the measured "Avg. Burst Power (Current)" from the "Reported Power" of the MS. In the example above, the input path loss equals to  $(13.0 - (-12.2))$  dB = 25.2 dB.
5. Press the "Connect. Control" softkey and the "RF IN/OUT" hotkey to report the path loss values to the R&S CMU200. Set the "Ext. Att. Output" equal to the output path loss and the "Ext. Att. Input" equal to the input path loss (see [GSM900 Signaling: RF IN/OUT tab](#)).

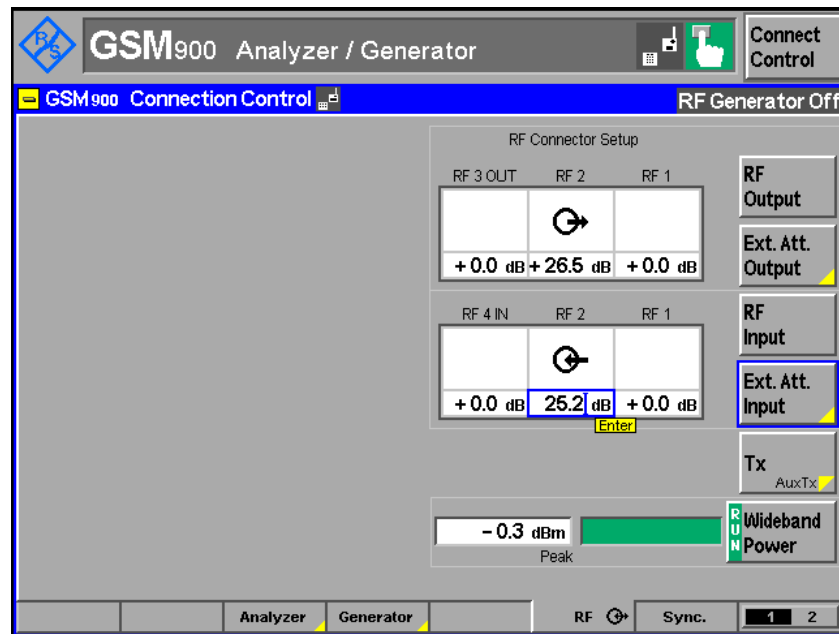


Fig. 6-13: GSM900 Signaling: RF IN/OUT tab

#### 6.2.4.3 WCDMA Path Loss

1. For a WCDMA UE, access the "WCDMA UE" function group, "Signaling" test mode, to establish a call between the R&S CMU200 and the UE. Note the power class (1 to 4) of your UE, which is displayed in the "Connection" tab of the "Connection Control" dialog.
2. Open the "Receiver Quality" measurement dialog and select "Application – UE Report".

The UE reports various parameters characterizing the quality of the radio link, in particular the "CPICH RSCP" (Received Signal Code Power) of the current cell.



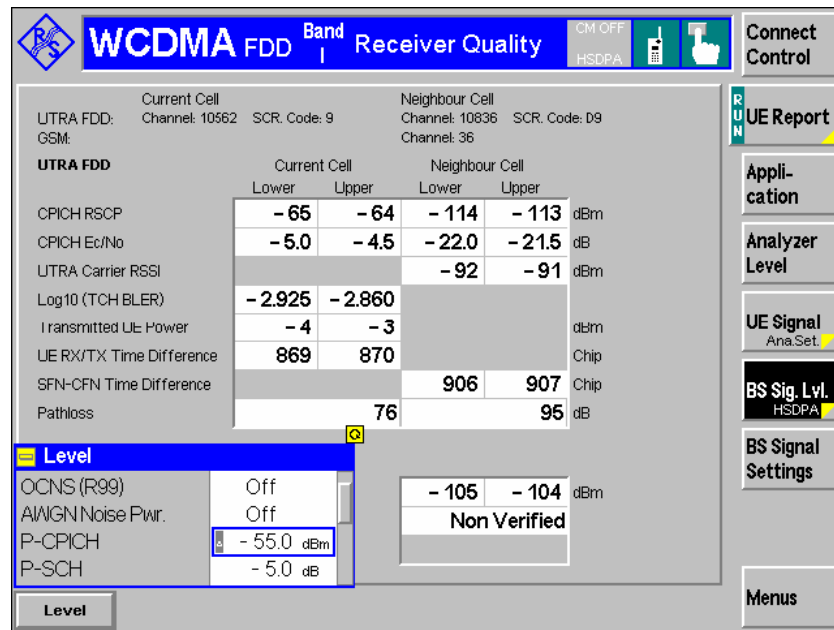


Fig. 6-14: WCDMA Signaling: UE Report dialog

- To determine the output path loss of your mobile phone, subtract the reported "CPICH RSCP" of the current cell from the P-CPICH output level of the R&S CMU ("BS Signal Lvl. – Level – P-CPICH"). In the example above, the output path loss equals to  $(64.5 - 55.0) \text{ dB} = 9.5 \text{ dB}$ .
- Open the "Power" measurement dialog and select "Application – Maximum Power" to command the UE to transmit at its maximum power.

The maximum UE transmitter output power depends on the UE power class; it is +33 dBm for power class 1, +27 dBm for power class 2, +24 dBm for power class 3, and +21 dBm for power class 4 UEs.

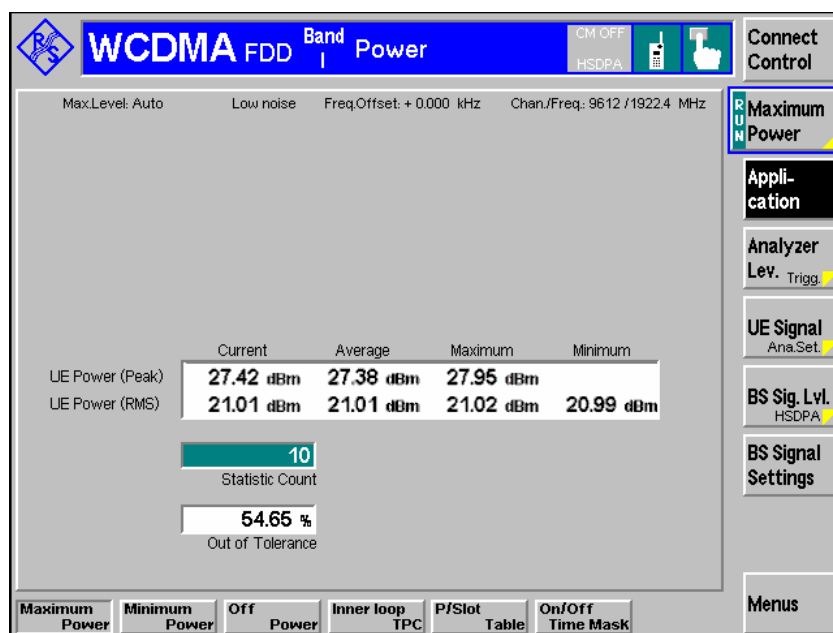


Fig. 6-15: WCDMA Signaling: Maximum Power dialog

5. To determine the input path loss of your UE, subtract the measured "UE Power (RMS)" (preferably, the "Average" value) from the nominal maximum UE transmitter output power. In the example above, assuming a power class 3 UE, the input path loss equals to approx.  $(24 - 21) \text{ dB} = 3 \text{ dB}$ .
6. Press the "Connect. Control" softkey and the "AF/RF IN/OUT" hotkey to report the path loss values to the R&S CMU200. Set the "Ext. Att. Output" equal to the output path loss and the "Ext. Att. Input" equal to the input path loss.

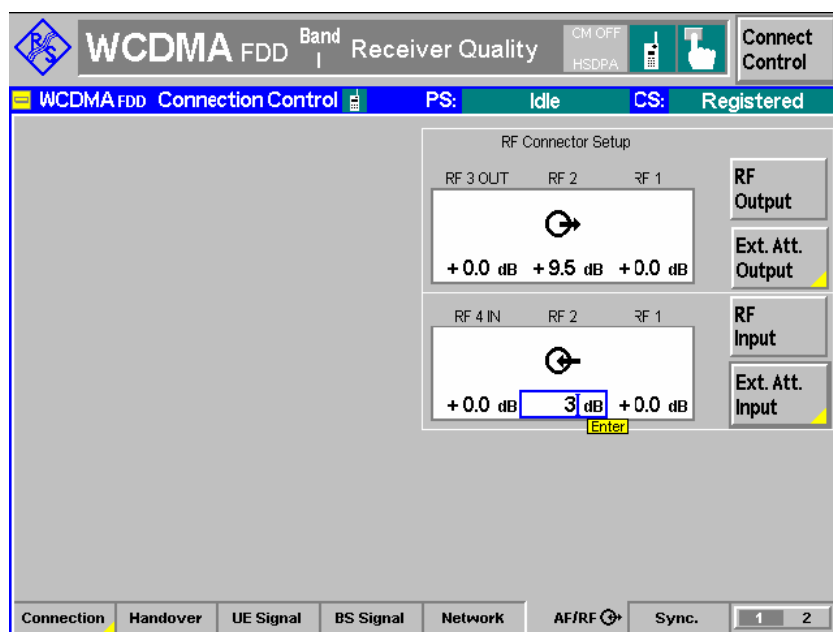


Fig. 6-16: WCDMA Signaling: AF/RF IN/OUT tab

## Glossary: RF Diagnostic Chamber

### A

**AF:** Audio frequency **or** antenna factor

### C

**CTIA:** Cellular Telecommunications & Industry Association

**CWG:** Converged Wireless Group

### D

**DC:** Direct current

**DL:** Downlink

### E

**EMI:** Electromagnetic Interference

**EMS:** Electromagnetic Susceptibility

**EUT:** Equipment under test

### M

**MS:** Mobile phone, mobile station

### O

**OTA:** Over-the-air (tests)

### P

**PC:** Personal computer

**PL:** Path loss

**PTCRB:** PCS Type Certification Review Board

### R

**RAM:** Radio absorbent material

**RF:** Radio frequency

### T

**TA:** Test antenna

**TRD:** Transducer factor

**U**

**UL:** Uplink

**V**

**VNA:** Vector network analyzer

**VSWR:** Voltage standing wave ratio

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