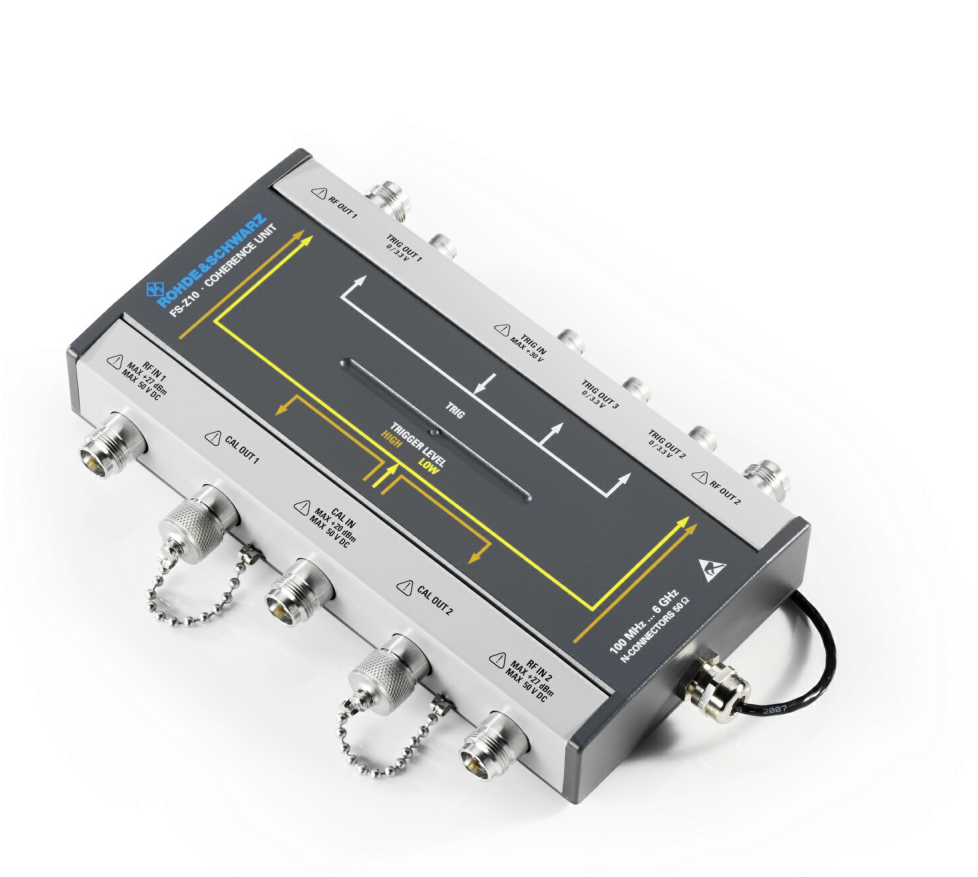


R&S[®] FS-Z10

Coherence Unit

Manual



1173.0008.32 – 01

The Manual describes the following R&S®FS-Z10 models and options:

- Model 1

The firmware of the instrument makes use of several valuable open source software packages. the most important of them are listed below, together with their corresponding open source license. The verbatimlicense texts are provided on the user documentation CD-ROM (included in delivery).

Package	Link	License
Xitami	http://www.xitami.com	2.5b6

Rohde&Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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The following abbreviations are used throughout this manual:

R&S®FS-Z10 is abbreviated as R&S FS-Z10 .

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 attached 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 intention 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 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.

Symbols and safety labels

							
Notice, general danger location Observe product documentation	Caution when handling heavy equipment	Danger of electric shock	Warning! Hot surface	PE terminal	Ground	Ground terminal	Be careful when handling electrostatic sensitive devices

					
ON/OFF supply voltage	Standby indication	Direct current (DC)	Alternating current (AC)	Direct/alternating current (DC/AC)	Device fully protected by double (reinforced) insulation

Tags 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 the possibility of incorrect operation which can result in damage to the product.

In the product documentation, the word ATTENTION is used synonymously.

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

Operating states and operating positions

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

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, pollution severity 2, overvoltage category 2, 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.
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 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 death.

Electrical safety

If the information on electrical safety is not observed either at all 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 an earthing contact and protective earth connection.
3. Intentionally breaking the protective earth connection 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 the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 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, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused 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. 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 $V_{\text{rms}} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, 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 PE terminal on site and the product's PE 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 fused 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.

Basic Safety Instructions

14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1. Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", 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. 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).

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

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

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.
5. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
6. 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.
7. 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.
8. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.

2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal

1. 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.
2. 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.

Informaciones elementales de seguridad

Es imprescindible leer y observar 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 adjunto 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.

Informaciones elementales de seguridad

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.

Símbolos y definiciones de seguridad

							
Aviso: punto de peligro general Observar la documentación del producto	Atención en el manejo de dispositivos de peso elevado	Peligro de choque eléctrico	Advertencia: superficie caliente	Conexión a conductor de protección	Conexión a tierra	Conexión a masa	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)

					
Tensión de alimentación de PUESTA EN MARCHA / PARADA	Indicación de estado de espera (Standby)	Corriente continua (DC)	Corriente alterna (AC)	Corriente continua / Corriente alterna (DC/AC)	El aparato está protegido en su totalidad por un aislamiento doble (reforzado)

Palabras de señal y su significado

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



PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.



ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.



ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.



AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.

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

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

Estados operativos y posiciones de funcionamiento

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

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, grado de suciedad 2, categoría de sobrecarga eléctrica 2, 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.
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, pueden causarse lesiones o 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, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión $U_{\text{eff}} > 30 \text{ V}$ se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

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

Funcionamiento

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

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. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

Informaciones elementales de seguridad

6. 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.
7. 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).
8. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

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

Eliminación

1. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polveros 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.
2. 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.

Kundeninformation zur Batterieverordnung (BattV)

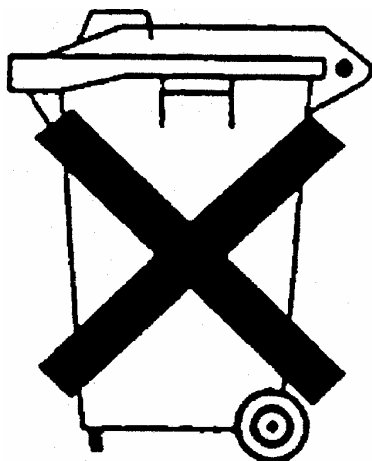
Dieses Gerät enthält eine schadstoffhaltige Batterie. Diese darf nicht mit dem Hausmüll entsorgt werden.

Nach Ende der Lebensdauer darf die Entsorgung nur über eine Rohde&Schwarz-Kundendienststelle oder eine geeignete Sammelstelle erfolgen.

Safety Regulations for Batteries (according to BattV)

This equipment houses a battery containing harmful substances that must not be disposed of as normal household waste.

After its useful life, the battery may only be disposed of at a Rohde & Schwarz service center or at a suitable depot.



Normas de Seguridad para Baterías (Según BattV)

Este equipo lleva una batería que contiene sustancias perjudiciales, que no se debe desechar en los contenedores de basura domésticos.

Después de la vida útil, la batería sólo se podrá eliminar en un centro de servicio de Rohde & Schwarz o en un depósito apropiado.

Consignes de sécurité pour batteries (selon BattV)

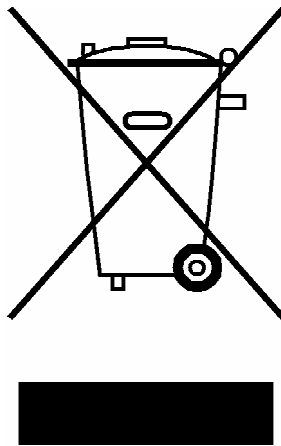
Cet appareil est équipé d'une pile comprenant des substances nocives. Ne jamais la jeter dans une poubelle pour ordures ménagères.

Une pile usagée doit uniquement être éliminée par un centre de service client de Rohde & Schwarz ou peut être collectée pour être traitée spécialement comme déchets dangereux.

Customer Information Regarding Product Disposal

The German Electrical and Electronic Equipment (ElektroG) Act is an implementation of the following EC directives:

- 2002/96/EC on waste electrical and electronic equipment (WEEE) and
- 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).



Product labeling in accordance with EN 50419

Once the lifetime of a product has ended, this product must not be disposed of in the standard domestic refuse. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Rohde & Schwarz GmbH & Co. KG has developed a disposal concept for the environmental-friendly disposal or recycling of waste material and fully assumes its obligation as a producer to take back and dispose of electrical and electronic waste in accordance with the ElektroG Act.

Please contact your local service representative to dispose of the product.



Qualitätszertifikat

Certificate of quality

Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde&Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde&Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO9001 und ISO14001 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. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde&Schwarz quality management system is certified according to standards such as ISO9001 and ISO14001.

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 respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde&Schwarz a été homologué, entre autres, conformément aux normes ISO9001 et ISO14001.

Engagement écologique

- ▮ Produits à efficience énergétique
- ▮ Amélioration continue de la durabilité environnementale
- ▮ Système de gestion de l'environnement certifié selon ISO 14001



ROHDE & SCHWARZ
EC Certificate of Conformity



Certificate No.: 2007-77

This is to certify that:

Equipment type	Stock No.	Designation
FS-Z10	1171.6509.02	Coherence Unit

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 electromagnetic compatibility
(2004/108/EC)

Conformity is proven by compliance with the following standards:

EN 61326 : 1997 + A1 : 1998 + A2 : 2001 + A3 : 2003

EN 55011 : 1998 + A1 : 1999 + A2 : 2002, Klasse B

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.

Affixing the EC conformity mark as from 2007

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

Munich, 2007-11-27

Central Quality Management MF-QZ / Radde

Customer Support

Technical support – where and when you need it

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

Up-to-date information and upgrades

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

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Documentation Overview

The user documentation for the R&S FS-Z10 is divided as follows:

1 Introduction

Many modern applications (e.g. multiple input multiple output, PA radar) require the synchronous transmission of two or more signals. The hardware properties of the transmitters result in timing shifts, gain differences and phase offsets between the RF signals. These parameters are difficult to estimate and might additionally also result from the cables used to connect the device under test (DUT) to the signal analyzers or from differences between the internal clocks of the analyzers used. Therefore, the task of the coherence unit remote software is to perform an accurate measurement of these differences by compensating effects that do not originate from the DUT itself. In addition the software enables the user to compensate these signal differences and save the compensated signals on a local drive.

The measurement requires a Rohde & Schwarz coherence unit, two Rohde & Schwarz spectrum analyzers (R&S FSQ or R&S FSG as master analyzer and R&S FSQ, R&S FSL or R&S FSG as secondary analyzer), a signal generator (e.g. R&S SMU) to generate a reference signal and a desktop PC to run the software.

The coherence unit remote software includes the following features:

- Coherence measurement of two RF-signals regarding phase, timing and gain differences.
- Calibration mode to measure the properties of the cables used to connect the device under test to the Coherence Unit.
- Automatic compensation of signal-differences (phase, timing and/or gain) resulting from these cables.
- Optional compensation of differences (phase, timing and/or gain) between the two signals received from the device under test.
- Measurement result list and capture buffer overview of both RF-signals
- Measurements in single- or continuous-mode.
- Automatic configuration of the analyzers using the settings specified in the graphical user interface.
- Save compensated or non-compensated IQ-signals in 32bit floating point or text format to your hard drive.

The Coherence Unit combined with the corresponding software provides an easy and cost-efficient way to measure differences in phase, timing and gain between two radio frequency signals. Unwanted distortions (e.g. temperature changes of the cables) which could decrease the accuracy of such a measurement will be compensated automatically using a reference signal created by a signal generator. This means that the measured signal differences will only result from the device under test itself. In addition to the actual measurement it is also possible to compensate the measured differences and store the corrected IQ-data in a file.

2 System Overview

2.1 Measurement Task

In order to measure the coherence between two RF signals, the problem is not only the signal analysis itself, but also the fact that additional disruptive factors caused by the test environment must be accounted for. Such factors include:

- Thermal fluctuations that affect the channel characteristics and therefore interfere with the results.
- Additional inaccuracies caused by cables with different properties.
- Trigger offsets between the connected analyzers.
- Local oscillator phase offsets between the connected analyzers.

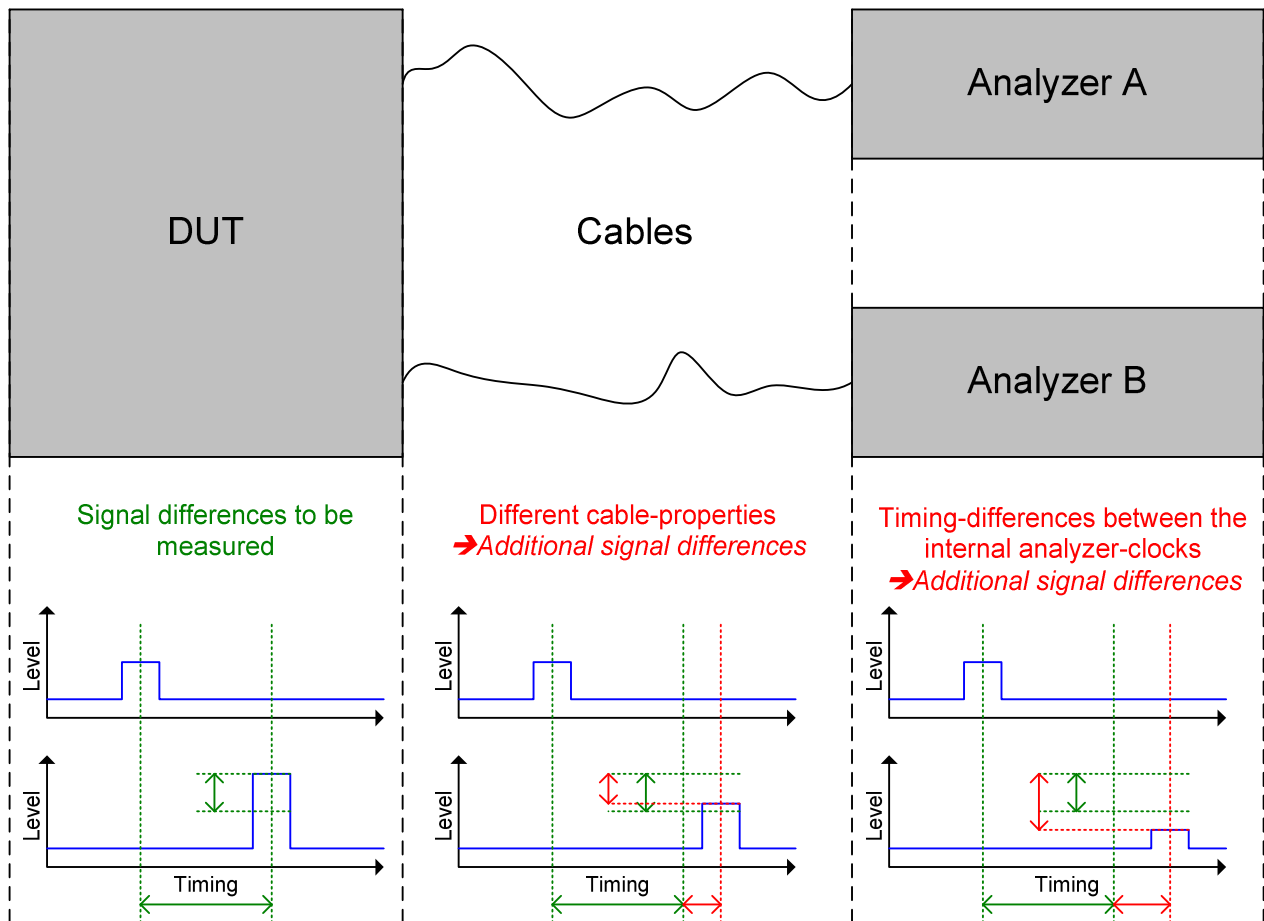


Figure 2-1: Problem description

2.2 General Solution

A general solution would be to avoid the disruptive factors as far as possible. In practice that would mean the following:

- Calibrate the cables used to connect the devices and compensate the cable parameters.
- All measurements have to be performed in an isolated environment with constant temperature.
- The two analyzers have to be synchronized exactly regarding frequency, phase and trigger time.

2.3 Rohde&Schwarz Solution

The solution proposed by Rohde & Schwarz is to use the coherence unit. To avoid the inaccuracies, the coherence unit remote software detects which of the differences between the two signals were caused by the DUT and which were caused by peripheral factors each time a measurement is performed. The signal differences due to peripheral factors have to be compensated by the software to allow an exact measurement of the current test signal. For this reason, a reference signal supplied by an extra signal generator must be measured before analyzing the current test data. The reference signal will be split and sent to both analyzers using the yellow signal path shown in the following figure.

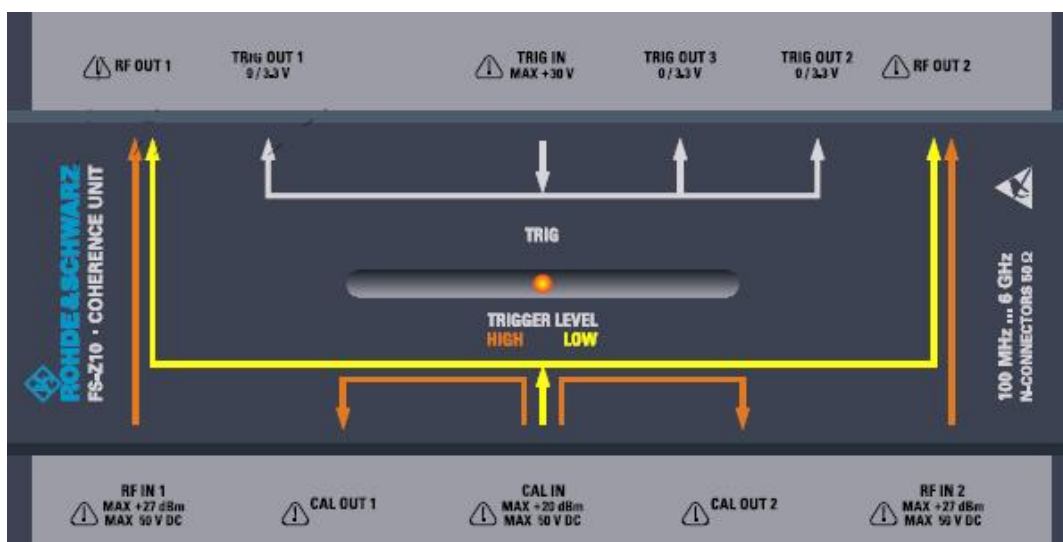


Figure 2-2: Coherence Unit Signal paths

The differences measured in this approach result exclusively from the differences caused by the analyzers and the cables used to connect the coherence unit to the analyzers and will automatically be compensated for the following measurement.

After having detected the periphery properties the system will switch to the orange signal paths shown in the figure above and the actual measurement will be performed on the measurement-part of the signal. The structure of the signal is shown in the following figure:

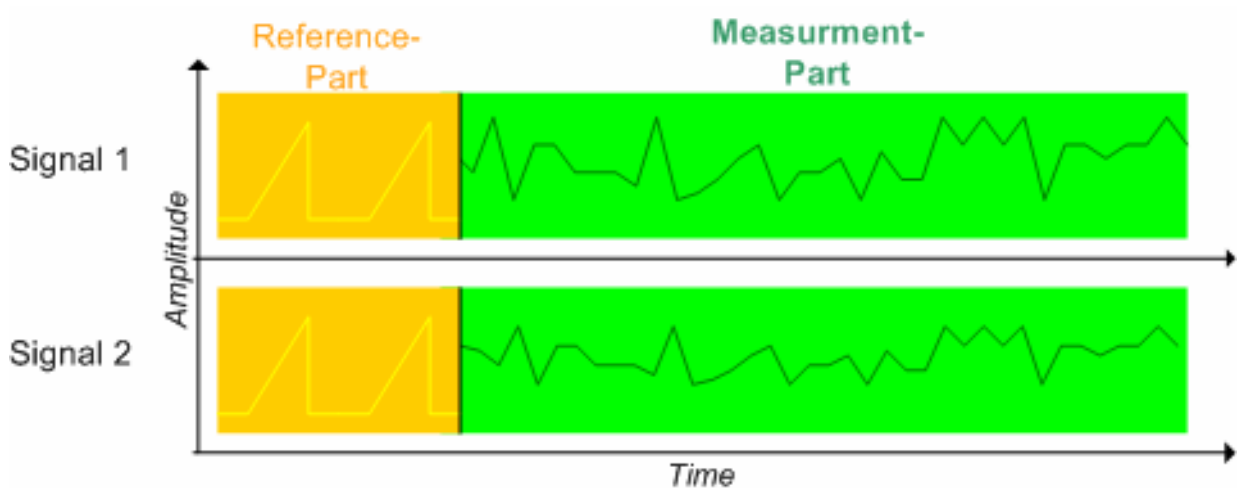


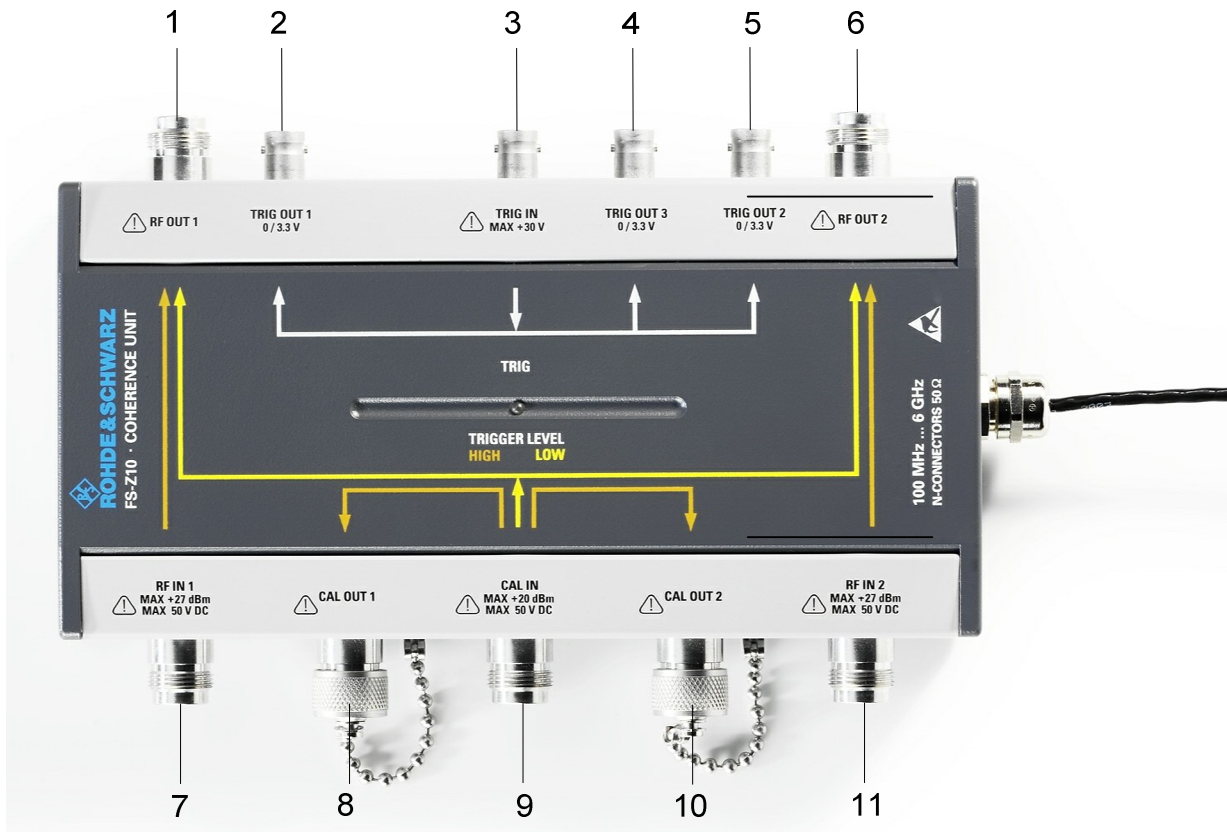
Figure 2-3: Data captured during a measurement

3 Putting into Operation

"Putting into Operation" explains the control elements and connectors of the R&S Coherence Unit with the aid of the front and rear views and describes how to put the device into operation.

Specifications of interfaces can be seen in the data sheet.

3.1 Legend for Front Panel View



Number	Description
1	RF OUT 1; Connect to the RF input of analyzer A.
2	TRIG OUT 1; Connect to the trigger input of analyzer A
3	TRIG IN; Connect to the "NOISE SOURCE CONTROL" output of analyzer A.
4	TRIG OUT 3; Additional trigger output. This output might be used to trigger any additional Coherence Unit (optional).
5	TRIG OUT 2; Connect to the trigger input of analyzer B.
6	RF OUT 2; Connect to the RF input of analyzer B.
7	RF IN 1; Used to connect one of the RF outputs of your device under test to the coherence unit.
8	CAL OUT 1; Only used during calibration. Connect to "RF IN 1" via one of the RF cables that will be used for later measurements.
9	CAL IN; Reference signal input. Connect the RF output of your reference signal generator here.
10	CAL OUT 2; Only used during calibration. Connect to "RF IN 2" via the other one of the RF cables that will be used for later measurements.
11	RF IN 2; Used to connect the other RF output of your device under test to the coherence unit.

3.2 Unpacking the R&S Coherence Box

1. Remove the instrument from its packaging (see separate unpacking instruction) and check the equipment for completeness using the delivery note and the accessory lists for the various items.
2. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. In this case, make sure not to discard the box and packing material.

It is advisable to keep the original packing material in order to prevent control elements and connectors from being damaged in case the instrument is to be transported or shipped at a later date.

4 Installing the Software

4.1 Hardware and Software Requirements

PC Hardware Requirements

	Minimum	Recommended
RAM	512 MByte	1 GByte
Harddisc	15 MByte free space	50 MByte free hard disc space
Monitor	VGA monitor (640x480)	SVGA color monitor, resolution 800x600 or better
IEEE Bus	Optional	Optional

PC Software Requirements

	Minimum	Recommended
OS	Windows XP	Windows XP
VISA		---

4.2 Installation

Installing the Coherence Unit Remote Software requires two steps:

1. Preparing the PC (installing Microsoft .NET Framework 2.0, VISA and additional components).
2. Installing the Coherence Unit software itself.

4.2.1 Preparing the PC

The following steps show how to set up the PC for running the coherence unit remote software.

1. Make sure that the **Microsoft .NET Framework 2.0** is properly installed on your system.
2. Make sure that the **Intel IPP Library** is properly installed on your system.

3. Make sure that **VISA** is properly installed on your system.

Details on each installation step can be found in the following sections.

4.2.1.1 Install Microsoft .NET Framework Version 2.0

To install the coherence unit remote software, Microsoft .NET Framework 2.0 or a later version must be installed. To check if .NET Framework is installed and to install .NET Framework, perform the following steps:

1. Navigate to the installation location (typically the CD ROM drive).
2. Start **Install\Microsoft .NET Framework 2.0\Check for .NET Installed.exe**.

If a message box appears claiming that .NET Framework is not installed:

- ▶ Start **Install\Microsoft .NET Framework 2.0\dotnetfx.exe** and follow the instructions on the screen.

4.2.1.2 Install Intel IPP

The coherence unit remote software makes use of the Intel IPP library. To install the library perform the following steps:

1. Navigate to the installation location (typically the CD ROM drive).
2. Start **Install\IntelIPP\Intel IPP Library Version 4.1\setup.exe** and follow the instructions on the screen.

4.2.1.3 Install VISA

In order to make communication to the instruments possible, VISA (Virtual Instrument Software Architecture) must be installed. This driver allows you to access instruments connected via IEEE/IEC bus or LAN bus to the PC.

1. If a National Instruments IEEE/IEC bus card or any other National Instruments hardware or National Instruments software is used, please visit <http://www.ni.com/visa> to get the latest version for the installed operating system
2. If an Agilent IEEE/IEC card is used, please visit <http://www.agilent.com> and search for the latest VISA version for the installed operating system.
3. If neither a National Instruments nor Agilent hardware or software is available, please contact Rohde & Schwarz for information on how to get an up-to-date VISA version.

4.2.2 Installing the Coherence Unit Remote Software

After installing all required components, the Coherence Unit software can be installed. In order to start this installation process:

1. Navigate to the installation location (typically the CD ROM drive).
2. Start ***Install.exe*** and follow the instructions on the screen.

The software will install the following:

1. The **coherence unit remote software** itself including an uninstall tool.
2. A **start menu** entry in "Programs → R&S Coherence Control".
3. A **desktop shortcut** "R&S Coherence Control".

After the installation is completed, the software can be started from the start menu entry or via the desktop shortcut.

4.2.3 Uninstalling the Coherence Unit Remote Software



Please ensure that no other software is using the software component before uninstalling it.

All installed components (coherence unit remote software and additional components) can be uninstalled using the "Add or Remove Software" function from the Windows Start menu in "Start -> Settings -> Control Panel -> Add or Remove Software".

The following components are removed by the uninstallation process of the coherence unit remote software:

- ▶ Rohde & Schwarz coherence unit remote software.

4.3 Starting the Software

To start the coherence unit remote software, select "Programs→R&S Coherence Control → Coherence Control" from the Windows start menu or execute the "CoherenceUnit.exe" file in the installation directory.

5 Setting up a Measurement

To achieve best accuracy, it is advisable to calibrate the cables used to connect the DUT to the coherence unit before starting the actual measurement. For this reason, the coherence unit remote software provides a calibration mode and a measurement mode. These two modes require different instrument connections.

Make sure that both analyzers use the external reference clock supplied by the signal generator.

5.1 Calibration Mode

The task of the calibration mode is to measure phase-, timing- and gain-differences caused by the cables used to connect the device under test to the Coherence Unit.

To perform a calibration connect the instruments as shown in the following figure:

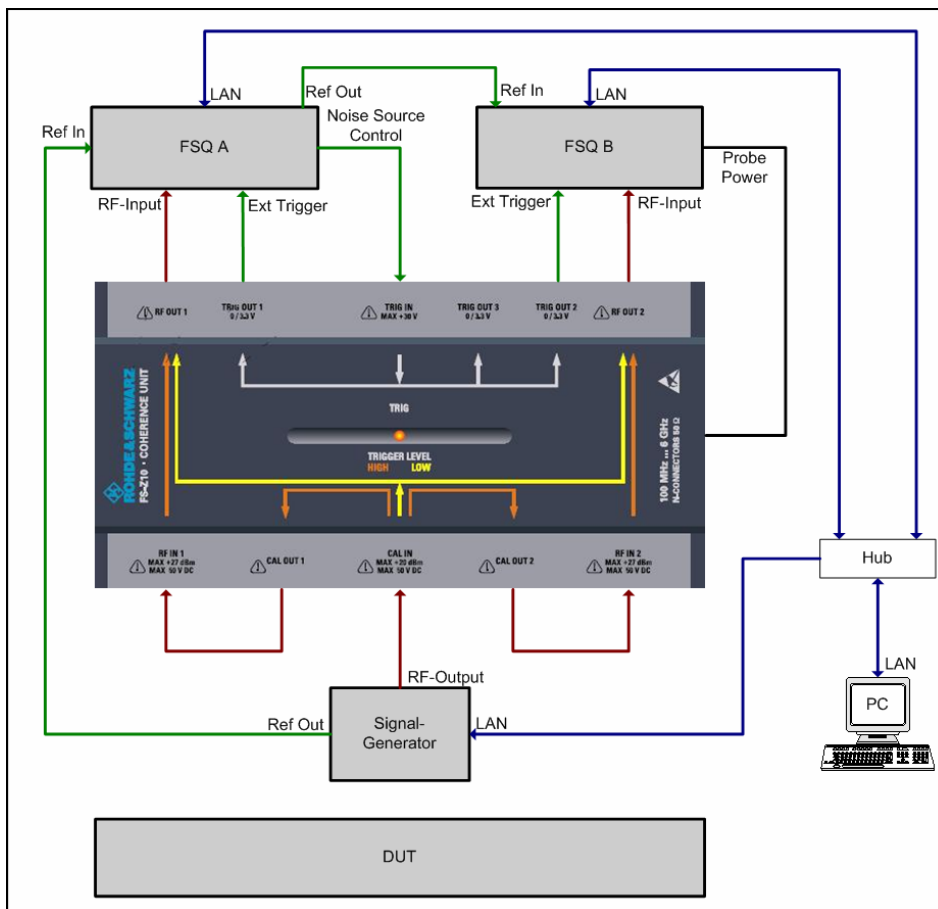


Figure 5-1: Cable Connections for Calibration Mode

5.2 Measurement Mode

The measurement mode denotes the actual test mode. The signal differences which were measured during calibration mode will be compensated automatically.

To perform a measurement connect the instruments as shown in the following figure:

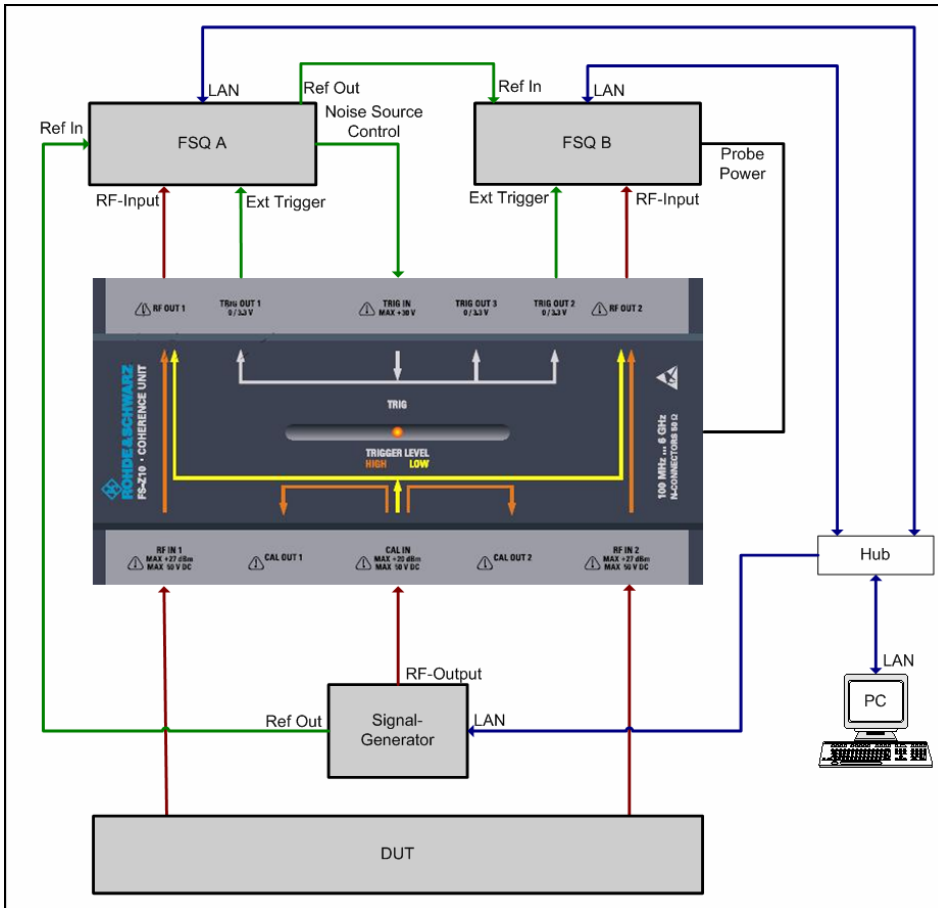


Figure 5-2: Cable Connections for measurement mode

6 Performing a Measurement

6.1 Perform Calibration

The first step is to calibrate your cables using the Calibration Mode. You may also perform a measurement without calibration, though the result accuracy will be lower.

Perform the following steps to do the calibration:

1. Connect your devices as described in chapter 5 (Calibration Mode).
2. Set the addresses of the connected analyzers (or make sure that the analyzer addresses were previously set correctly) in the "Hardware Setup" in the "Settings" menu.
3. It is advisable to configure a reference level in the "Settings" menu which will be similar to that used for measurement of the DUT. Note: If autoleveling is activated the reference level will be configured automatically.
4. Make sure to configure the reference level in the "Settings" menu similar to the reference level you are going to use during your measurements.
5. Configure the "Data Capture Settings" corresponding to the signals you are using in the "Settings" menu.
6. Press the "Calibrate" Key in the hotkey bar.

If the calibration was successful, the calibration-display in the header-bar will switch to "CAL".

Calibration Status: CAL (28.11.2008 16:55:34)
Measurement DVM: 10.64 dB

6.2 Perform the Measurement

Perform the following steps to do the measurement:

1. Connect your devices as described in section 'Setting up a Measurement'
2. Press the "RUN SGL" button for a single measurement or the "RUN CONT" button for continuous measurements.

- View the results of your measurement as graph or result list (switch views via "Display" softkey).

6.3 Explanation of the Results

The screenshot shown in the following figure shows the result list after having performed a calibration and a measurement.

Frequency: 1,00 GHz	Ref Level (A B): 8,00 dB 8,40 dB	Calibration Status: CAL (28.11.2008 16:55:34)
Sample Rate: 1,00 kHz	Capture Length: 5,00 s 5000 Samples	Measurement DVM: -16,22 dB
High Accuracy Mode: On	High Accuracy Service No.: 6321	Serial Number: 100006

	Measurement Result	Calibration Result
Phase Difference (φ) between A and B	-1,45 °	+8,01 °
Timing Difference (τ) between A and B	-1,73 μ s	+2,89 μ s
Gain Difference (g) between A and B	-0,94 dB	-0,16 dB

Underlying Formula: $Signal_B(t) = g \cdot Signal_A(t - \tau) \cdot e^{j \cdot \varphi}$

Difference Vector Magnitude	-16,2154 dB	-21,4817 dB
-----------------------------	-------------	-------------

Figure 6-1: Result list

The column to the right shows the results of the calibration and the column to the left shows the results of the current measurement. The three parameters φ (= phase difference), τ (= timing difference) and g (= gain difference) describe the coherence of signal A and signal B as shown in the following formula:

$$s_B(t) = g \cdot s_A(t - \tau) \cdot e^{j \cdot \varphi}$$

The difference vector magnitude (DVM) is used to check the accuracy of the results. The DVM is calculated by comparing signal A with the fully compensated signal B using the following formula:

$$DVM = 10 \cdot \log_{10} \left(\frac{\sum_t |s_B(t) - s_A(t)|^2}{\sum_t |s_A(t)|^2} \right)$$

6.4 High Accuracy Mode (Optional)

The coherence unit remote software provides the opportunity to use a special high accuracy mode. This mode takes into account effects caused by the coherence unit hardware itself and therefore leads to improved overall accuracy of the results. The properties of your specific device get stored in a special file.

To activate the high accuracy mode, choose "Setup -> Select High Accuracy File" in the coherence unit remote software and select the file corresponding to your coherence unit. Following activation, the "High Accuracy Mode" entry of the header will now show the serial number and the service number of your coherence unit.

Sample Rate: 1,00 KHZ	Capture Length: 5,00 s 5000 Samples	Measurement DVM: -19,54 dB
High Accuracy Mode: On	High Accuracy Service No.: 6321	Serial Number: 100006

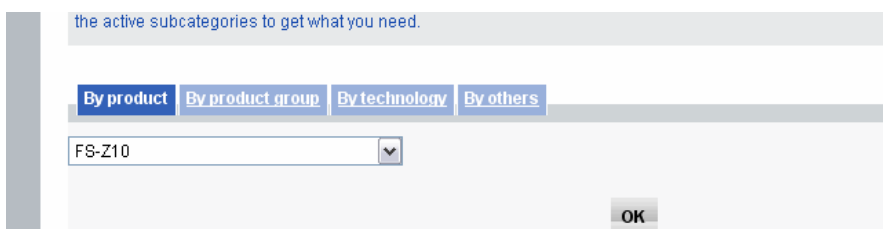
6.5 How to Obtain the High Accuracy Files

The high accuracy files are specific for each coherence unit. To obtain a high accuracy file for your specific device, perform the following steps (Internet access is necessary):

1. Open a browser and go to www.rohde-schwarz.com
2. Select "Service & Support"



3. Select "Download Search"
4. Select the R&S FS-Z10 in the product selection box and click OK



5. Select "Device Specific Data" and click OK
6. Click the high-accuracy data link

Device Specific Data

Description	Last Modified
High Accuracy Calibration Data for R&S®FS-Z10	

7. Enter the device-specific serial number of your coherence unit

High Accuracy Calibration Data for R&S®FS-Z10

Device Specific Download Request

Serial No.



Make sure that your high accuracy file is always up-to-date. You need to download a new file if your coherence unit has been serviced by Rohde & Schwarz.

6.6 Logfile in Continuous Mode

If you are running the software in continuous mode, a logfile will be created. The file will be stored under "**<Program Folder>\Logfile.txt**" and contains information about every sweep since the last time "RUN CONT" was pressed.

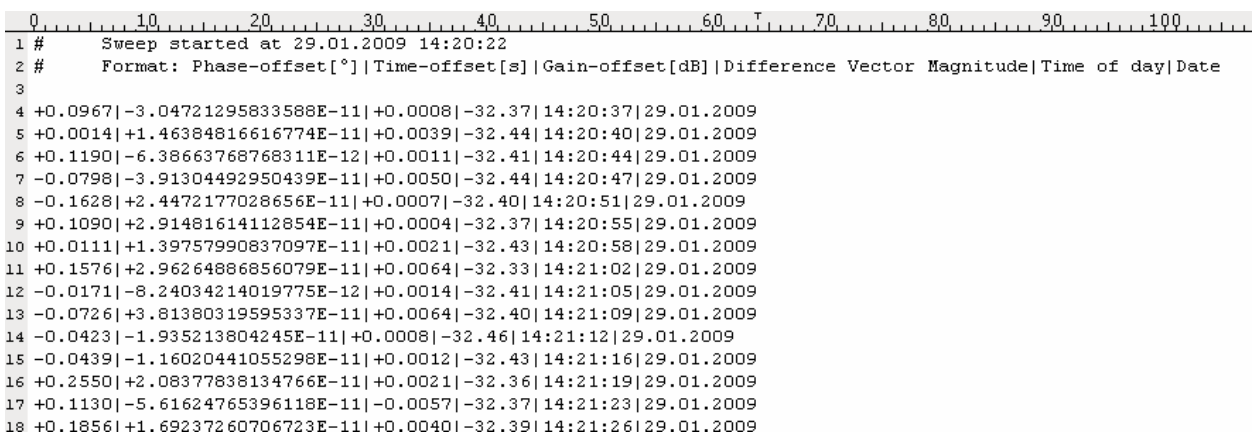
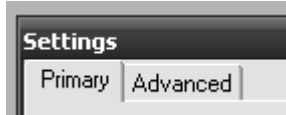


Figure 6-2: Logfile for continuous mode

7 Settings



The *SETTINGS* softkey opens the Settings dialog which contains two tabs: Primary and Advanced. To see the content of the tabs as shown below, click one of the tabs.



7.1 Primary Settings

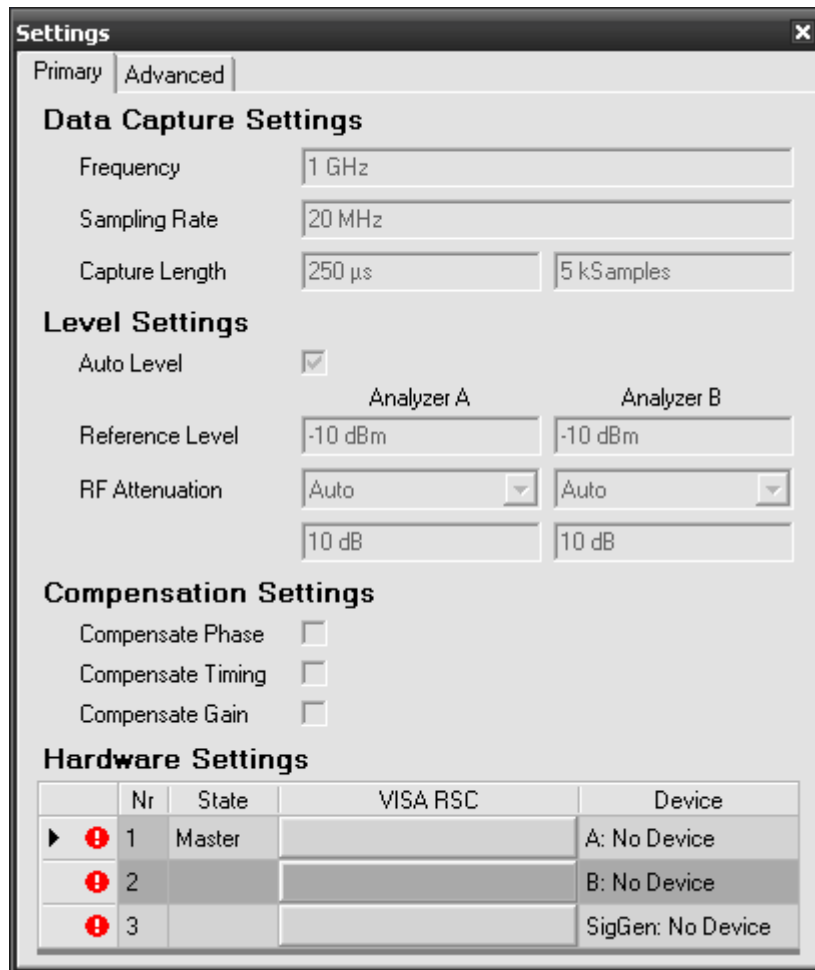


Figure 7-1: Primary settings window (all fields are dimmed because no instruments are connected)

The hardware setup of the connected instruments determines which fields will be available and which will be unavailable.

Frequency

Frequency	<input type="text" value="1 GHz"/>
-----------	------------------------------------

Specifies the *Center Frequency* of the signal to be measured. The maximum frequency depends on the hardware configuration of your instruments.

Sampling Rate

Sampling Rate	<input type="text" value="20 MHz"/>
---------------	-------------------------------------

Specifies the *Sampling Rate* to be used for the measurement. This setting will automatically adjust the maximum signal bandwidth to be measured. Check the manuals of your spectrum analyzers for details about the available bandwidth as a function of the sampling rate used.

The maximum sampling rate depends on the hardware configuration of your instruments.

Capture Length

Capture Length	<input type="text" value="250 μs"/>	<input type="text" value="5 kSamples"/>
----------------	-------------------------------------	---

Specifies the length of the signal to be analyzed, measured in seconds or samples. Note that the total number of samples recorded will be greater because of the reference signal part and the signal overhead, which is necessary to align the data streams.

The maximum number of samples which can be recorded depends on the hardware configuration of your instruments.

Auto level

Auto Level	<input checked="" type="checkbox"/>
------------	-------------------------------------

Determines whether the reference level for measurements is measured automatically (enabled) or entered manually by the user (disabled).

When the Auto Level check box is enabled, the coherence unit remote software will measure the reference level automatically at the start of each measurement sweep. This ensures that the reference level is always set at the ideal level for obtaining accurate results, but will slightly increase the required measurement time.

Reference Level

	Analyzer A	Analyzer B
Reference Level	-10 dBm	-10 dBm

Specifies the *RF Reference Levels* to use when performing measurements, or displays the detected reference levels when *Auto Level* is enabled.

RF Attenuation

RF Attenuation	Auto	Manual
	10 dB	10 dB

RF Attenuation specifies the mechanical attenuation to be applied to the input RF signal. If *Auto* has been selected, the *RF Attenuation* will be set automatically as a function of the current *reference level*.

Compensation Settings

Compensate Phase	<input type="checkbox"/>
Compensate Timing	<input type="checkbox"/>
Compensate Gain	<input type="checkbox"/>

The coherence unit software provides the possibility to compensate phase, timing or gain differences between the two received signals. The differences caused by peripheral factors such as the cables or the internal analyzer clock offsets will always be compensated. The actual signal differences caused by the device under test will only be compensated if the corresponding item is activated in the compensation settings. To perform the compensation, signal B will be modified by the software using a phase shift, a timing offset and a gain offset. The compensated signal will be displayed in capture buffer B and may optionally also be saved to the hard disc (see chapter 8).

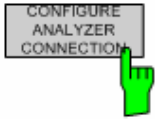
Note: The results displayed in the result list will not be affected by the compensation settings.

Hardware Settings

	Nr	State	VISA RSC	Device
▶	1	Master	TCPIP::10.114.11.75	A: FSG
	2		TCPIP::10.114.10.220	B: FSG
	3		TCPIP::10.114.11.26	SigGen: SMU

The *Hardware Settings* configure the instrument connections. Clicking one of the buttons in the VISA RSC column opens the "Instrument Connection Configuration" dialog.

7.2 Configure Analyzer Connection



In order to communicate with the instruments, the Rohde & Schwarz analyzers and the signal generator must be connected with the PC using either an IEEE/IEC bus or LAN connection. The type of connection and the address can be selected by the <CONFIGURE ANALYZER CONNECTION> softkey:

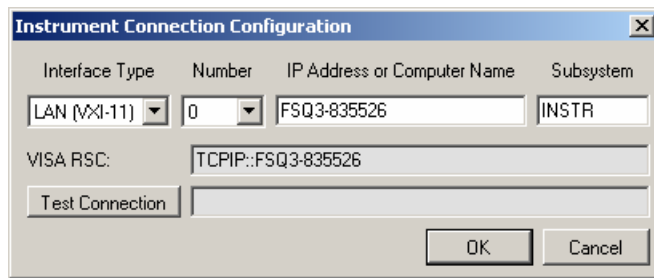


Figure 7-2: Instrument Connection Configuration window

If more than one interface is available on the PC (e.g. because two LAN cards are installed), please select the appropriate interface *Number*. The *Subsystem* does not need to be changed.

Depending on the *Interface Type*, different types of addresses must be entered:

Interface	Description	Address equivalent to ...
GPIB Instrument	IEEE/IEC bus system using the IEEE 488 protocol	Instrument primary GPIB address (0 to 31). Default value is 20 for the R&S FSQ.
LAN VXI-11 protocol	LAN bus system using the VXI-11 protocol (supported with R&S FSQ firmware version 3.65 or later)	Host address as TCP/IP address or computer name. Contact your local IT support if you are not sure what to enter here.
LAN RSIB protocol	LAN bus system using a Rohde & Schwarz-specific protocol (supported with all R&S FSQ firmware versions)	Host address as TCP/IP address or computer name. Contact your local IT support if you are not sure what to enter here.

7.3 Advanced Settings

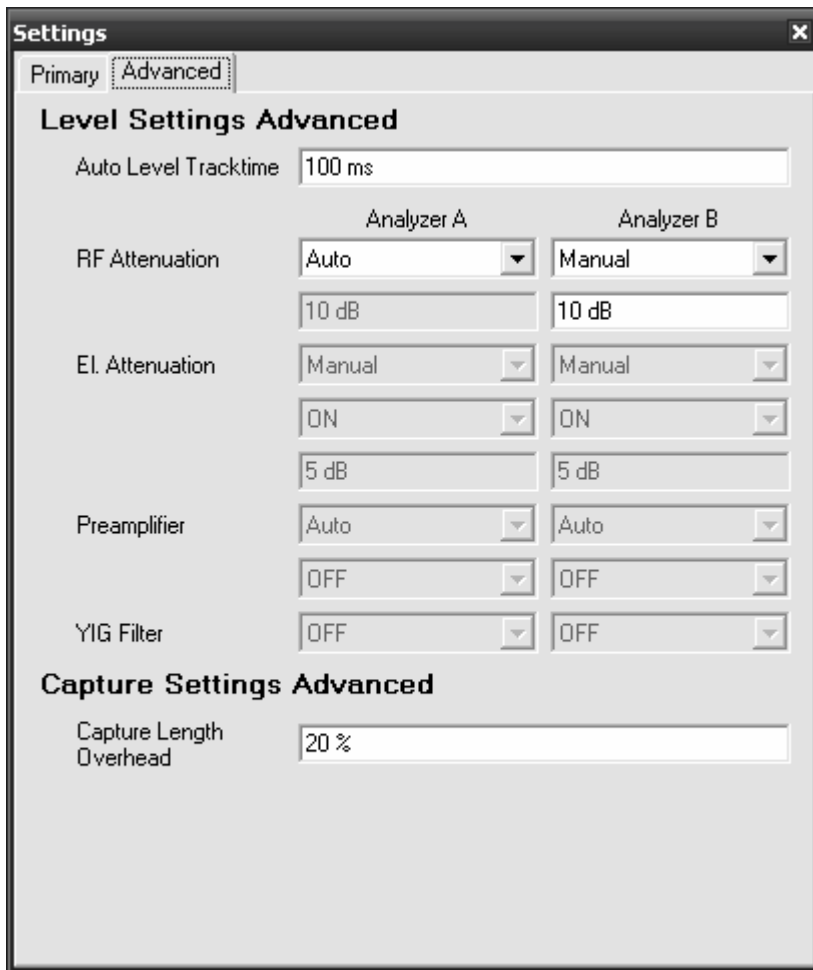


Figure 7-3: Advanced settings window

Auto Level Tracktime

Auto Level Tracktime

Auto Level Tracktime specifies the sweep time used for the auto level measurements. This settings is important for signals with varying signal power (e.g. bursted signals). Make sure that this time is long enough to capture the signal level maximum.

El. Attenuation

El. Attenuation	Manual	Manual
	ON	ON
	5 dB	5 dB

El. Attenuation specifies the electrical attenuation to be applied to the input RF signal. The hardware setup of your instruments determines whether electrical attenuation is available. The attenuation may be set manually or automatically.

Preamplifier

Preamplifier	Auto	Manual
	OFF	OFF

The *Preamplifier* settings specify whether a preamplifier is applied to the RF signal or not. The hardware setup of your instruments determines whether a preamplifier is available.

YIG Filter

YIG Filter	OFF	OFF
------------	-----	-----

The *YIG Filter* settings specify whether a YIG filter is used. The hardware setup of your instruments determines whether a YIG filter is available.

Capture Length Overhead

Capture Length Overhead	20 %
-------------------------	------

In order to get the correct number of valid signal samples specified in the *Capture Length* setting, a certain overhead of samples must be captured. The number of overhead samples necessary depends on the timing difference of the two test signals. The higher the expected timing difference is, the higher the *Capture Length Overhead* should be set.

The percent value refers to the capture length defined in the *Capture Length* setting. For example, a signal overhead of 20 % while using a capture length of 1000 samples would result in an effective capture length of 1200 samples.

8 Export of I/Q Data

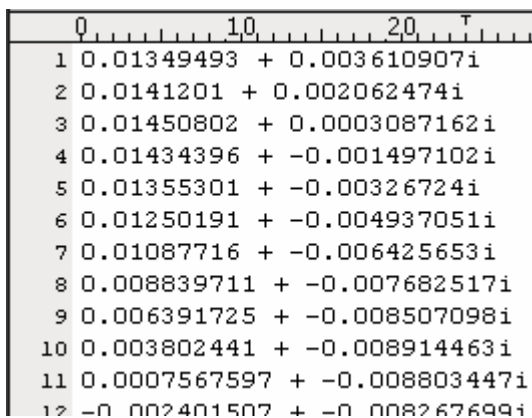
Purpose

The coherence unit remote software is able to process I/Q data from Rohde & Schwarz analyzer hardware. Captured I/Q data can also be stored in various formats for e.g. processing with other external tools or for support purposes.

Format

I/Q data can be formatted either in binary form or as ASCII files. The data is linearly scaled using the unit Volt.

- For **binary format**, data is expected as 32-bit floating point data, Little Endian format (also known as LSB Order or Intel format).
(Example: 0x1D86E7BB in hexadecimal notation will be decoded to $-7.0655481E-3$.)
The data order can be either IQIQIQ or II..IQQ..Q.
- For **ASCII format**, data will be stored as one I/Q pair per line using "+" as separator.



```

0 10 20 T
1 0.01349493 + 0.003610907i
2 0.0141201 + 0.002062474i
3 0.01450802 + 0.0003087162i
4 0.01434396 + -0.001497102i
5 0.01355301 + -0.00326724i
6 0.01250191 + -0.004937051i
7 0.01087716 + -0.006425653i
8 0.008839711 + -0.007682517i
9 0.006391725 + -0.008507098i
10 0.003802441 + -0.008914463i
11 0.0007567597 + -0.008803447i
12 -0.002401507 + -0.008267699i

```

Fig. 8-1: Extract from I/Q data ASCII file

Usage – Export

To export captured I/Q data, select <SAVE> or <SAVE AS> .

The two I/Q data sets received from the two analyzers will be stored in the two files <filename>_A and <filename>_B. The current settings determine whether the I/Q data stored in file B will be compensated or not.

9 Conclusion

The coherence unit combined with the corresponding software provides an easy and cost-efficient means of measuring differences in phase, timing and gain between two radio frequency signals. Unwanted distortions (e.g. temperature changes of the cables) which could decrease the accuracy of such a measurement will be compensated automatically using a reference signal created by a signal generator. This means that the measured signal differences will only result from the DUT itself. In addition to the pure measurement, it is also possible to compensate these differences directly and store the corrected I/Q data into a file.

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