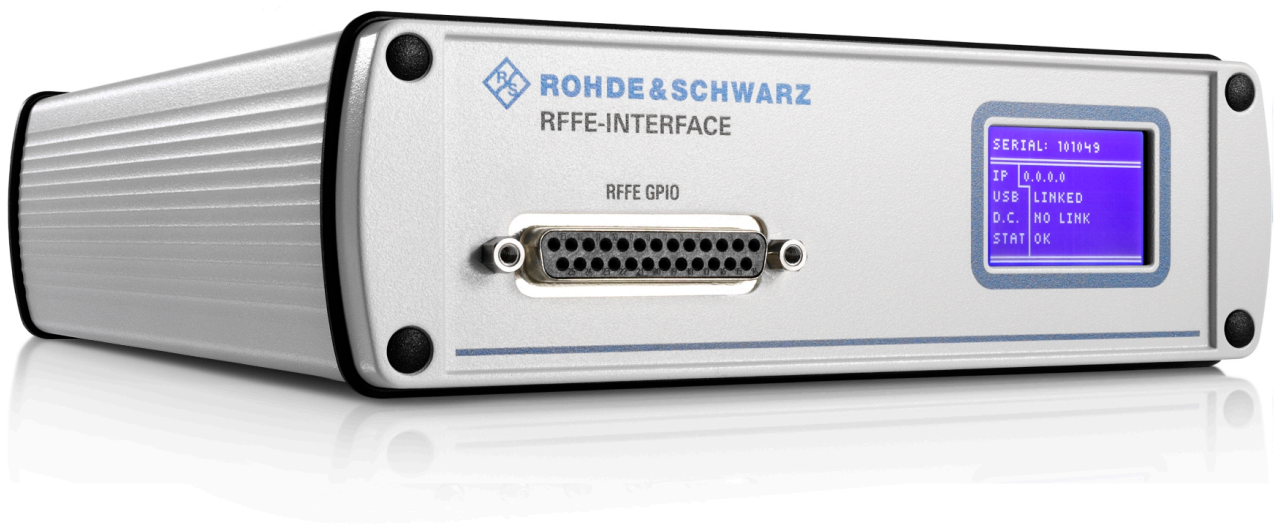


R&S® ZN-Z15

RFFE Interface (external)

User Manual



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ROHDE & SCHWARZ

Test & Measurement

User Manual

This manual describes the external RFFE/GPIO (MIPI) interface R&S®ZN-Z15 that is available in the following variants:

- R&S®ZN-Z15 Variant 02 (order no. 1325.5905.02)
- R&S®ZN-Z15 Variant 03 (order no. 1325.5905.03) including voltage/current measurements

It also covers the following accessories that are shipped with this product:

- R&S®ZN-Z25, RFFE Cable with Adaptors (order no. 1334.3424.02)

The software contained in this product uses several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).

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

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Trade names are trademarks of their owners.

Throughout this manual R&S® is abbreviated as R&S.

Basic Safety Instructions

Always read through and comply with the following safety instructions!

All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Safety labels on products

The following safety labels are used on products to warn against risks and dangers.

| Symbol | Meaning | Symbol | Meaning |
|---|--|---|---------------------|
|  | Notice, general danger location Observe product documentation |  | ON/OFF Power |
|  | Caution when handling heavy equipment |  | Standby indication |
|  | Danger of electric shock |  | Direct current (DC) |

Basic Safety Instructions

| Symbol | Meaning | Symbol | Meaning |
|---|---|--|--|
|  | Caution ! Hot surface |  | Alternating current (AC) |
|  | Protective conductor terminal To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth |  | Direct/alternating current (DC/AC) |
|  | Earth (Ground) |  | Class II Equipment to identify equipment meeting the safety requirements specified for Class II equipment (device protected by double or reinforced insulation) |
|  | Frame or chassis Ground terminal |  | EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1. |
|  | Be careful when handling electrostatic sensitive devices |  | EU labeling for separate collection of electrical and electronic devices For additional information, see section "Waste disposal/Environmental protection", item 2. |
|  | Warning! Laser radiation For additional information, see section "Operation", item 7. | | |

Signal words and their meaning

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



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



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



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



Indicates information considered important, but not hazard-related, e.g. messages relating to property damage.

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

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

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 degree 2.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the mains-supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

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 IEC 60950-1 / EN 60950-1 or IEC 61010-1 / EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

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

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 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. 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 (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

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

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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1 Introduction

An RFFE - GPIO Extension for the R&S ZNx Family

The trend in mobile radio communication is towards higher scale of integration of external components such as filters, switches, low noise and power amplifiers. In addition to the traditional RF measurements, T&M equipment must also handle new features and developments, such as DUT configuration via GPIO and handler I/O interfaces and via the MIPI® RFFE interface.

For these kind of applications the R&S ZNB can be equipped with an internal RFFE - GPIO extension board (option R&S ZNB-B15), offering a 25 pin female connector interface with 2 independent RF Front-End (RFFE) interfaces according to the MIPI® Alliance "System Power Management Interface Specification" and 10 General Purpose Input/Output (GPIO) pins.

However, as more and more applications require these kinds of interfaces and with the advent of the mutiport analyzer R&S ZNBT a more flexible solution was required. The external RFFE interface R&S ZN-Z15 is equipped with the same RFFE - GPIO interface as the R&S ZNB-B15. It can be connected to and controlled by any R&S ZNB or R&S ZNBT. The connection can be established via USB, LAN or Direct Control.



- In the initial release only connection via Direct Control is supported.
- A Direct Control connection requires the Device Control option "B12" on the master R&S ZNB or R&S ZNBT.
To establish the Direct Control connection, the analyzer has to be switched off. Otherwise the R&S ZN-Z15 is not properly detected.
- The external RFFE interface allows to store multiple sequences of RFFE commands and GPIO voltage settings, which can then be triggered in various ways (sequencer mode).
Note however that RFFE read is not supported in sequencer mode
- Variant 03 of the R&S ZN-Z15 (order no. 1325.5905.03) additionally supports voltage / current measurement with switchable source resistance
- For more information about the voltage control levels of the RFFE and GPIO see [Chapter 3, "Instrument Functions"](#), on page 15

After connecting the R&S ZN-Z15 to an analyzer of the R&S ZNx family there is no need to perform any kind of calibration or alignment procedure. The analyzer firmware automatically detects and supports the external RFFE interface.

About this Manual

The user manual is included on the CD-ROM supplied with the delivery. Beyond the "getting started" chapters it contains descriptions of all instrument functions and of the remote control of the instrument. In addition, it contains notes on preventative maintenance for the R&S ZN-Z15 and on troubleshooting on the basis of the warnings and error messages that the instrument emits.

The user manual is organized into the following chapters:

- Putting the Instrument into Operation
- Instrument Functions
- Application
- Operation (via Remote Control)
- Maintenance
- Appendix

The most recent version of the user manual is available on the [Internet](#).

2 Putting the Instrument into Operation

The section below describes how to put the external RFFE interface R&S ZN-Z15 into operation and how to establish external connections.

NOTICE**Risk of instrument damage**

Note that the general safety instructions also contain information on operating conditions that prevent damage to the instrument. The instrument's data sheet can contain additional operating conditions.

2.1 Instrument Tour

This chapter describes the control elements and connectors on the front and rear panel of the R&S ZN-Z15.

2.1.1 Front Panel

The front panel of the external RFFE interface provides the 25-pin [RFFE/GPIO Interface Connector](#) and, to its right, a [Mini display](#).



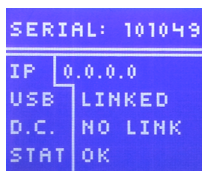
Figure 2-1: R&S ZN-Z15 Front Panel

RFFE/GPIO Interface Connector



25 pin female D-sub connector providing 2 independent RF Front-End (RFFE) interfaces and 10 General Purpose Input/Output (GPIO) ports. For details see [Chapter 3, "Instrument Functions"](#), on page 15.

Mini display



The miniature display on the front panel of the R&S ZN-Z15 provides the following instrument information:

- Serial number `Serial`
- IP address `IP` (see [Chapter 2.3.4, "LAN"](#), on page 14)
- USB link state `USB: LINKED` or `NO LINK` (see [Chapter 2.3.3, "USB"](#), on page 14)
- Direct Control state `D.C.: LINKED` or `NO LINK` (see [Chapter 2.3.2, "Direct Control"](#), on page 13)
- Operational status `STAT: OK` or `Error <error code>` (see [Table 5-1](#))

2.1.2 Rear Panel

This section shows all interfaces on the back of the R&S ZN-Z15.

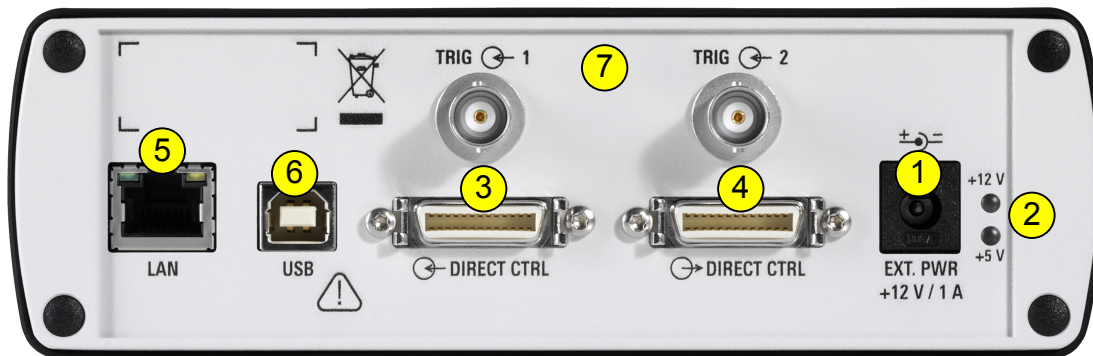


Figure 2-2: R&S ZN-Z15 Rear Panel

Table 2-1: Rear panel elements

| Index | Label | Description |
|-------|-----------------------|---|
| 1 | 12 V DC IN | Connector for the +12V/1A external DC power supply |
| 2 | LEDs | DC power supply status <ul style="list-style-type: none"> Green and orange LED on: 12 V external power supply voltage Only orange LED on: insufficient input voltage at external power supply |
| 3 | DIRECT CTRL \ominus | DIG-IQ connectors: Direct Control (Prog Bus) interface, incoming (from R&S ZNB/ZNBT) and outgoing (to other Direct Control devices); see Chapter 2.3.2, "Direct Control" , on page 13 |
| 4 | DIRECT CTRL $\omin�$ | |
| 5 | LAN | RJ-45 connector to integrate the instrument to a Local Area Network, primarily for remote control purposes; see Chapter 2.3.4, "LAN" , on page 14 |
| 6 | USB | Type B (slave) high speed USB connector, for remote control; see Chapter 2.3.3, "USB" , on page 14 |
| 7 | TRIG $\omin�$ 1, 2 | BNC connectors for incoming 5 V TTL external signals whose falling edges can trigger RFFE command execution and/or GPIO voltage changes (sweep sequencer mode) |

See the R&S ZN-Z15 Data Sheet for interface specification details.

2.2 Preparing the Instrument

This section covers the basic steps to set up the external RFFE interface and to put it into operation.

⚠ CAUTION

Safety precautions

Be absolutely sure to follow the instructions in the sections below to prevent injury to people or damage to the instrument. This is particularly important the first time that you use the instrument. In addition, be sure to observe the general safety notes at the beginning of this manual.

2.2.1 Unpacking the Instrument

The external RFFE interface together with its accessories (external DC power supply, USB cable, RFFE/GPIO interface cable and adaptors, product documentation) is delivered in a cardboard box.

Proceed as follows to unpack its contents:

1. Open the cardboard box and remove the R&S ZN-Z15 from its foam slider box and PE flat bag
2. Check the shipment for completeness by comparing it with the shipping document and the accessory lists for the various items.
3. Check the R&S ZN-Z15 for any damage. If there is any damage, immediately contact the shipping company that delivered the instrument. In this case, be absolutely certain that you keep the cardboard box and packing materials.



Packing materials

We recommend that you retain the packaging. It is advisable to keep the original packing material in order to prevent control elements and connectors from being damaged if the instrument has to be transported or shipped at a later date.

2.2.2 Setting up the Instrument

The R&S ZN-Z15 is designed for indoor use and can be set up on a level surface in a horizontal position. It is not designed for rack mounting.

NOTICE

Potential damage caused by electrostatic discharge



Electrical discharges can damage components of the instrument or a connected instrument under test.

For this reason, the instrument must only be operated at a workplace that is protected against electrostatic discharge.

The following methods can be used separately or in combination to protect against electrostatic discharges:

- Protective wrist strap with a ground conductor
- Conductive floor covering combined with use of a heel grounder

NOTICE

EMI Suppression

To suppress electromagnetic interference (EMI), the instrument may only be operated when it is closed and all covers are in place. The instrument's EMC rating is specified on the data sheet.

To prevent influences that cause disturbances, the following conditions must be adhered to:

- Use suitable double-shielded cables.
- Don't use any USB cables that are longer than 1 m.
- Only use USB devices that maintain the permitted EMC values.
- For the LAN connection (Ethernet), use shielded CAT6 or CAT7 RJ-45 cables (F/STP or S/STP)

2.2.3 Connecting the R&S ZN-Z15 to the DC Power Supply

Use the 12V/1A external power supply that is shipped with the instrument.

NOTICE

Possible damage to the instrument

Before you connect the instrument to the DC power supply and turn it on, you must ensure observance of the following points in order to prevent damage to the instrument:

- The housing covers must be in place, and their screws must be fastened.
- The instrument must be dry.
- The instrument should only be operated in the horizontal position on an even surface.
- The ambient temperature must be within the range specified in the data sheet.
- It must be ensured that none of the voltage levels at the inputs exceed permissible limits.
- It must be ensured that the instrument outputs are not overloaded or incorrectly connected.

2.2.4 Turning the Instrument On and Starting

As soon as the R&S ZN-Z15 is connected to the DC power, it starts loading the firmware (mini display: "ZNZ15 FPGA loading...") and performs a self-test.

As soon as the firmware is successfully loaded, the instrument is ready for operation via Direct Control.

2.2.5 Switching the Instrument Off

To switch the R&S ZN-Z15 off, disconnect the DC power.

2.2.6 Function Check

The R&S ZN-Z15 automatically monitors the most important instrument functions when it is turned on.

2.3 Connecting External Devices

Apart from the RFFE GPIO interface, the R&S ZN-Z15 is equipped with different interfaces for establishing a remote control connection, typically from a VNA of the R&S ZNx family.



The VNA firmware only supports a single RFFE interface (external or internal) per R&S ZNB/ZNBT.

2.3.1 RFFE GPIO

The R&S ZN-Z15 is shipped together with a high-quality RFFE/GPIO interface cable (and a set of adaptors) R&S ZN-Z25. Use this interface cable (and suitable adaptors) to connect the R&S ZN-Z15 to the DUT. For details on the RFFE/GPIO interface see [Chapter 3, "Instrument Functions"](#), on page 15.

2.3.2 Direct Control

The Direct Control interface allows to establish a direct connection between the measurement bus of a vector network analyzer R&S ZNB/ZNBT and the FPGA controlling the RFFE and GPIO interfaces. As Direct Control bypasses the external RFFE interface's microcontroller it significantly reduces the reaction times compared to management via USB or LAN.

The FPGA is put on the measurement bus by connecting the external RFFE interface's "Direct Control IN" interface to the analyzer's "DIRECT CTRL" interface. Cascading of Direct Control connections is possible via "Direct Control OUT" (see [Table 2-1](#)).



- The R&S ZNB/ZNBT must be equipped with the Device Control option "B12".
To establish a Direct Control connection, the analyzer has to be switched off. Otherwise the R&S ZN-Z15 is not properly detected.
- The 5V output of "Direct Control OUT" is limited to 150 mA.
- The VNA firmware only supports a single RFFE interface (external or internal) per R&S ZNB/ZNBT.

A suitable connection cable is provided with option R&S ZN-B121 (order no. 1323.9290.00).

2.3.3 USB

Currently not supported.

2.3.4 LAN

Currently not supported.

3 Instrument Functions

The external RFFE interface R&S ZN-Z15 is equipped with a 25 pin female D-sub connector, providing 2 independent RF Front-End (RFFE) interfaces according to the MIPI® Alliance "System Power Management Interface Specification" and 10 General Purpose Input/Output (GPIO) ports.

3.1 Pin Assignment

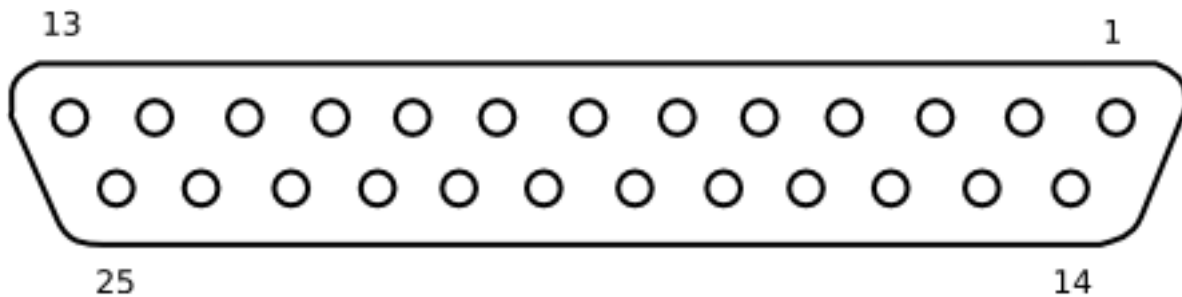


Figure 3-1: D-sub 25 pin female connector, front view

Table 3-1: PIN mapping RFFE - GPIO extension board connector

| PIN number | Comment |
|-----------------|---------------------------------------|
| 1, 3, 5, 11, 22 | Ground |
| 2 | RFFE1_VIO |
| 4 | RFFE2_VIO |
| 6 | GPIO 2 |
| 7 | GPIO 4 |
| 8 | GPIO 6 |
| 9 | GPIO 8 |
| 10 | GPIO 9 |
| 12, 13, 24, 25 | For future use, please do not connect |
| 14 | RFFE1_CLK |
| 15 | RFFE1_DATA |
| 16 | RFFE2_CLK |
| 17 | RFFE2_DATA |

| PIN number | Comment |
|------------|---------|
| 18 | GPIO 1 |
| 19 | GPIO 3 |
| 20 | GPIO 5 |
| 21 | GPIO 7 |
| 23 | GPIO 10 |

A 2m ribbon cable for connecting a DUT to the RFFE GPIO interface – along with a set of adaptors – is shipped with the R&S ZN-Z15. It splits the 25 pin connector of the RFFE GPIO interface to four 10-pin socket connectors. The adaptors provide several different pin configurations.



This interface cable/adaptor kit can also be ordered separately from Rohde & Schwarz (R&S ZN-Z25, order no. 5202.9238.02). For a detailed pin description see the R&S ZN-Z25 data sheet.

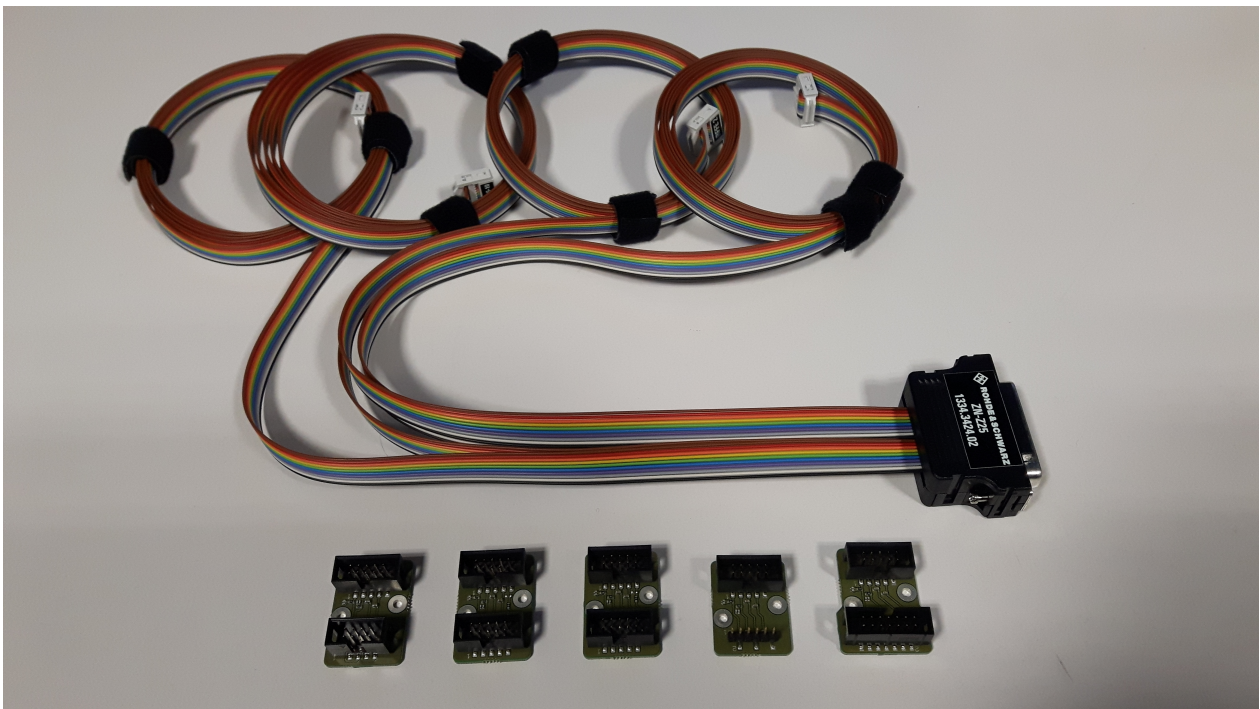


Figure 3-2: RFFE GPIO Interface Cable with Adaptors R&S ZN-Z25

3.2 Interface Description

The values in the table below are typical values. See the R&S ZN-Z15 data sheet for details.

Table 3-2: RFFE Bus Interface

| Output voltage | MIN | MAX | Step size |
|------------------------|-----------|-----------|---|
| IO Low High 1,2 | 0 V | 2.0 V | 1 mV |
| Output current | | | |
| RFFE 1,2 | | 20 mA | |
| Clock frequency | | | |
| RFFE 1,2 | 31.25 kHz | 26000 kHz | Possible values 52000/n kHz with n=1664, ..., 2 |

All remaining data (e.g. rise time) are according to the specification v.1.00 of the MIPI Alliance Group.

Table 3-3: GPIO Interface

| Output voltage | MIN | MAX | Step size |
|-----------------------|-----------------|-------------------|-----------|
| with 12V power supply | -5 V, typ. -6 V | +10 V, typ. +12 V | 5 mV |
| Output current | | | |
| GPIO 1,...,8 | | 20 mA | |
| GPIO 9,10 | | 100 mA | |

Table 3-4: Voltage/Current Measurement (Variant 03 only)

| | Range | Resolution |
|--------------------------------|---------------|-------------|
| Voltage measurement | | |
| RFFE 1 and 2 (VIO/DATA/CLK) | 0 V to +3 V | 100 μ V |
| GPIO 1 to 10 | -5 V to +10 V | 100 μ V |
| Current measurement* | | |

| | | |
|---|------------------------------|------------|
| RFFE 1 and 2 (VIO/DATA/CLK), GPIO 1 to 8 | | |
| 10 Ω source resistance (shunt) | -20 mA to +20 mA | 10 μ A |
| 100 Ω source resistance (shunt) | -2 mA to +2 mA | 1 μ A |
| 1 k Ω source resistance (shunt) | -200 μ A to +200 μ A | 100 nA |
| 10 k Ω source resistance (shunt) | -20 μ A to +20 μ A | 10 nA |
| 100 k Ω source resistance (shunt) | -2 μ A to +2 μ A | 1 nA |
| GPIO 9 and 10 | | |
| | -100 mA to +100 mA | 10 μ A |
| * the current values are valid if the GPIO voltages are within -5 V to +8 V | | |

The output voltages of the RFFE and GPIO signals do not have an offset to compensate additional losses into account. Please adjust the voltage level directly on your board or at the pins of the connected device.

4 Application

Today's mobile radio standards are becoming more and more complex and cover an increasingly growing range of functions. This is also reflected by the frontend modules (FEMs) used in smartphones, where the number of integrated components, such as low-noise amplifiers and filters, is on the rise. This diversity also has an impact on T&M equipment, leading to an increase in the number and types of RF measurements required and in the number of ports to be analyzed. FEMs with 16, 20, 23 or more ports are now typical.

A standardized interface is a key requirement for FEMs in order to ensure interoperability with other components in a mobile phone. For example, other mobile phone components must be able to address the frequency selection filters in a frontend module in order to utilize the more than 12 mobile radio bands plus supplemental services such as WLAN and GPS. A working group within the MIPI® Alliance developed the MIPI® RF frontend (RFFE) interface for this purpose. The external RFFE interface R&S ZN-Z15 supports this interface.



MIPI® Alliance

The MIPI® Alliance is a global, nonprofit organization comprised of a number of companies working together with the objective of defining interface standards for the components used in mobile phones. The MIPI® Alliance views its role as supplemental to existing organizations, such as 3GPP.

Often, settings on the DUT, e.g. the position of an internal switch, must be changed. To handle these tasks, the external RFFE interface R&S ZN-Z15 is equipped with two types of interfaces: ten independent general purpose input output (GPIO) interfaces and two RFFE interfaces. This makes it possible to program MIPI® RFFE interfaces and GPIO pins directly from the analyzer firmware.

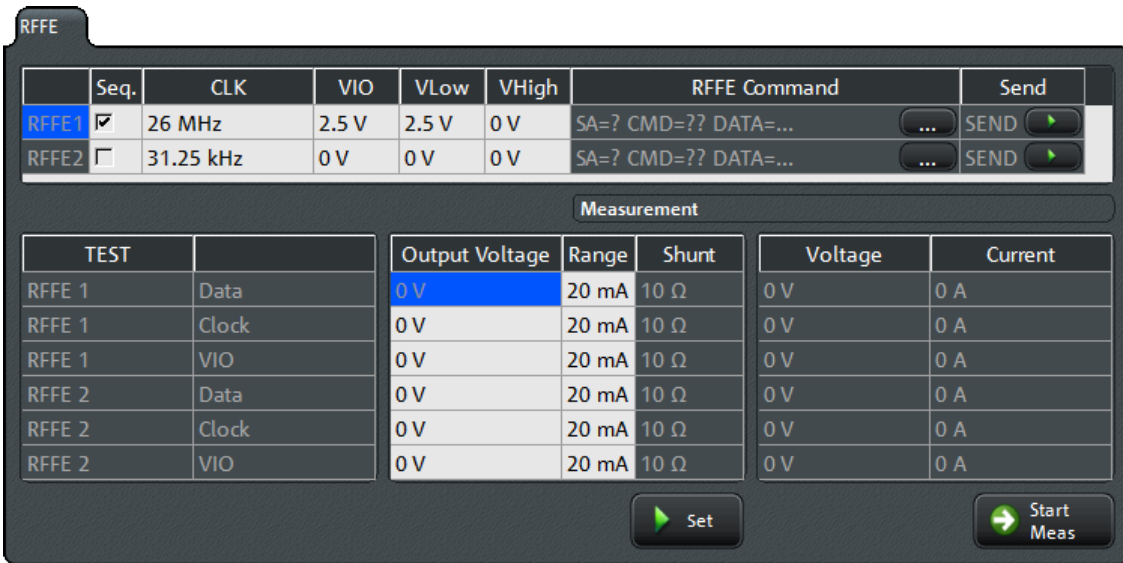


Figure 4-1: RFFE interface programming (R&S ZN-Z15 Var. 03)

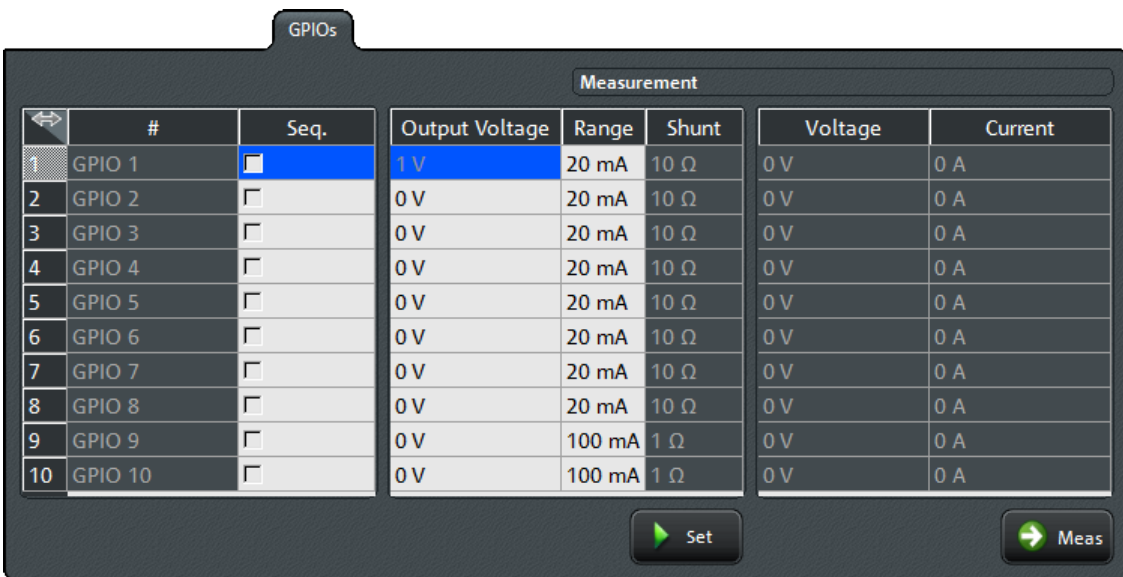


Figure 4-2: GPIO interface programming (R&S ZN-Z15 Var. 03)

Programming of GPIO and RFFE interfaces can be incorporated into the sweep sequence and adapted as required for the individual frequency segments:

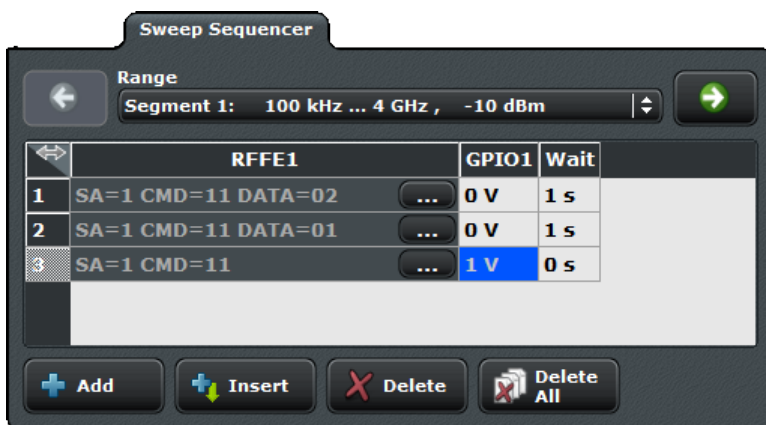


Figure 4-3: Sweep sequencer function of R&S ZNB / R&S ZNBT firmware

In this way the FEM programming can be incorporated into the sweep sequence and adapted as required for the individual frequency segments. The segmented sweep function makes it possible to measure a variety of parameters, including insertion loss, isolation or reflection, in a single sweep for various configurations of the FEM. This results in efficient FEM characterization.

The R&S ZN-Z15 can also be used to read the contents of the registers of a frontend module. This information can be used to improve testing, particularly in production applications. For example, a frontend module ID can be read and subsequently made available during the production process. By reading the registers, the FEM programming can also be verified by checking if the registers were set correctly.



The described functionality is also available via SCPI commands. See the user manual of your R&S ZNB or R&S ZNBT for details.

5 Operation

The external RFFE interface R&S ZN-Z15 is completely remote-controlled; it does not provide any means for manual control.

The green LED and the orange LED on the rear panel indicate the availability of the regular 12V. If only the orange LED is lit this indicates insufficient input voltage.

The R&S ZN-Z15 is equipped with a 102x64 monochrome OLED-Display that displays the following information:

- Serial number of the instrument (for identification purposes)
- IP address
- USB and Direct Control link states
- Operational state of the instrument. This can be either
 - OK if the instrument is error-free or
 - ERROR <error code> with the error code of the last occurred error.

Table 5-1: R&S ZN-Z15 Error Codes

| Error Code | Description |
|------------|---|
| 0 | no error |
| 3 | can't read from FPGA registers |
| 6 | config.ini corrupted (inconsistent config.ini file) |
| 9 | FPGA loading timeout, e.g. old FPGA not triggering PROGBUS_FPGA_LOADED_GPIO |
| 10 | FPGA version is not compatible with μ C version |
| 11 | rffe.ini corrupted (inconsistent rffe.ini file) |
| 20 | temperature alarm FPGA |
| 22 | Voltage difference between -7V and +3V3 is out of range |
| 23 | Voltage difference between +1V2 and Ground is out of range |
| 24 | Voltage difference between +3V3 and Ground is out of range |
| 25 | Voltage difference between +2V5 and Ground is out of range |

| Error Code | Description |
|------------|--|
| 26 | Voltage difference between +1V0 and Ground is out of range |
| 27 | Internal MB_FPGA voltage of +1V0 is out of range |
| 28 | AUX. FPGA voltage of +2.5 V is out of range |

6 Maintenance

The external RFFE interface R&S ZN-Z15 does not require maintenance at regular intervals. Maintenance work is essentially limited to cleaning the instrument.

⚠ CAUTION**Danger of electric shock**

Before cleaning, make sure that the instrument is switched off and that it is disconnected from all power supplies.

NOTICE**Instrument damage caused by cleaning agents**

Cleaning agents contain substances that may damage the instrument. For example, cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

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

Service work

Replacing modules and ordering spare parts is described in the service manual. There you will also find all the ID numbers required for ordering spare parts.

In addition, the service manual contains information on troubleshooting, repairs and replacing modules.

Packing and storage

The storage temperature for the R&S ZN-Z15 is specified in the data sheet. When storing for longer periods, protect the instrument from dust.

Prior to transport or shipping, pack the instrument just as it was originally packed. The anti-static packaging film prevents undesired electrostatic charges.

If you no longer have the original packaging, employ a sturdy cardboard box of a suitable size. Ensure that there is enough padding to keep the instrument from

slipping around inside the package. Wrap the instrument in anti-static film to protect it against electrostatic charging.

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