ROHDE&SCHWARZ

USER MANUAL

Analog/Digital IO Module 2

R&S®TS-PIO2

User Manual

for ROHDE & SCHWARZ Analog/Digital IO Module 2 R&S TS-PIO2

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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 ±10 % shall apply to the nominal voltage and ±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_{rms} > 30 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.

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.

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	Adver-tencia: 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 ±10 % sobre el voltaje nominal y de ±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_{eff} > 30 V se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

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

Funcionamiento

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

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. 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.

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 (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.
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.

Additional safety instructions:

- Any alteration to the basic equipment is prohibited, unless carried out by R&S authorized persons.
- In case that a module is inserted which is specified for an analog bus operation < 60 VDC, then this limit is also restrictively valid for the total system.
- The voltage limits for exposed voltage-carrying parts under DIN EN61010-1/6.3 must on no account be exceeded.
  If the use of higher voltages is required, this may be done only after consultation with R&S.
- The total power which may be drawn from the secondary side depends on the format of the relevant backplane segment (typically 250VA).
- When installing in racks, the ventilation of the system must be such that the specified data sheet values of 0 ... 50 °C are adhered to.

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 ISO 9001 und ISO 14001 zertifiziert.

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

Dear Customer,
You have decided to buy a Rohde&Schwarz product. 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 ISO 9001 and ISO 14001.

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- 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 ISO 9001 et ISO 14001.

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

ROHDE&SCHWARZ

1171.0200.11 V 04.01

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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.

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Content

5th Issue 09.11

5th Issue 09.11

Figures

5th Issue 09.11

5th Issue 09.11

Tables

5th Issue 09.11

5th Issue 09.11

1 Usage

1.1 General

The Analog/Digital IO Module R&S TS-PIO2 can be operated on the R&S CompactTSVP and R&S PowerTSVP test platforms. The card receives its ground-free power supply from a Rear-I/O module of type R&S TS-PDC. The R&S TS-PIO2 is controlled by the CAN bus present in the R&S CompactTSVP and R&S PowerTSVP.

The R&S TS-PIO2 module provides 16 combined analog / digital input channels and 16 combined analog / digital output channels. The channels are arranged in groups of four. The last output channel in each group has special properties. These include a enhanced accuracy, adjustable current limiting, a higher maximum output current and the capability of using sense lines. Some of the settings for a channel can be made channel-specifically or group-specifically (the same for all channels in a group). Each channel also provides the user with a 100-Ohm precision resistor with contact available via the front side connector.

Each of the 16 output channels can be operated in the one of the following operating modes:

- Analog output
- Digital static output
- Digital dynamic output
- Arbitrary waveform
- Square wave

All 16 input channels are wired to comparators and also to the input of an analog/digital converter. The limits of the comparators are adjustable. This makes the following evaluations of a signal possible:

- Voltage measurements against module ground
- Differential voltage measurements between two channels
- Digital evaluation

5th Issue 09.11

Timing control of bit sampling and measurement data recording as well as output of digital bit patterns and analog arbitrary waveform values run in parallel for all IO channels through a central sequence control. Four memory units with a depth of 5000 values each are available on the module for digital and analog inputs and outputs. The sequence control can be started by various trigger sources. The sampling interval can be adjusted in a range from 200 µs to 1 sec.

The output channels can generate a square wave independently of sequence control. The level, frequency, and duty cycle are also adjustable.

Inputs and outputs can also be flexibly connected via relays. Each output can be connected to either the front side connector or the corresponding input. The inputs of each channel can also be connected to the front side connector or the TSVP analog bus.

5th Issue 09.11

1.2 Features of the R&S TS-PIO2

Features R&S TS-PIO2
Potential-free
16 input channels and 16 output channels
Output voltage range ±27 V
Input voltage range ±7 V, ±14 V, ±28 V
Maximum output current for the 12 standard channels 25 mA, 100 mA for the extended channels
Sense lines and programmable current limiting for the extended channels
Differential voltage measurement (optional)
High accuracy; resolution 24 bits
Maximum sampling rate during measurement and update rate for output 5 kHz
Memory for 4 x 5000 values (analog and digital measurement values; digital bit pattern and arbitrary waveform output)
Access to analog bus
Trigger options via PXI trigger bus
Self-test capability
Soft Panel for interactive operation
LabWindows/CVI driver available

Table 1-1 Features R&S TS-PIO2

5th Issue 09.11

1.3 Features of the TS-PDC module

The Rear I/O Module R&S TS-PDC is used as a floating DC voltage source for the Analog/Digital IO Module R&S TS-PIO2. It contains two identical DC/DC converters. The following floating voltages are obtained from an input voltage of 5 VDC:

– +15 VDC ±5%, 0.5A (2x)

– -15 VDC ±5%, 0.5A (2x)

– +5 VDC ±5%, 0.5A (2x)

– +3.3 VDC ±5%, 0.25A (2x)

1.4 Safety instructions

WARNING!

The R&S CompactTSVP/ R&S PowerTSVP production platform and the Analog/Digital IO Module R&S TS-PIO2 are designed so that users can operate at voltages up to 125 V. The requirements according to EN61010-1 for operation with "hazardous live" voltages must be observed.

For additional details see Chapter 5.1.17 and the leaflet entitled "Safety Instructions" in the user manual for the R&S CompactTSVP/ R&S PowerTSVP production platform.

5th Issue 09.11

2 View

Figure 2-1 shows the Analog/Digital IO Module R&S TS-PIO2 without the accompanying Rear I/O Module R&S TS-PDC.

The Rear I/O Module R&S TS-PDC is shown in Figure 2-2 .

Figure 2-1 View of the R&S TS-PIO2

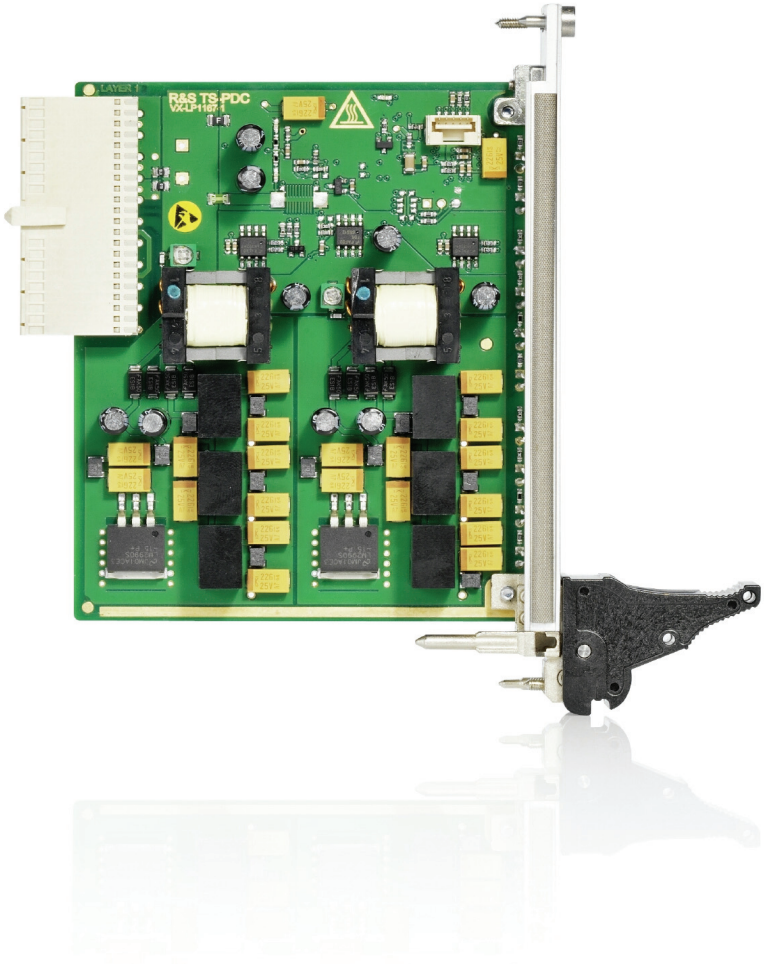

Figure 2-2 View of the Rear-I/O Module R&S TS-PDC

NOTE:

The Module R&S TS-PDC exists in 3 different models:

- **Grouted in a black housing - version up to 1.8 (1157.9804.02 obsolete)**
- **Encapsulated in metal housing with cooling fins - version 1.9 (1157.9804.02 obsolete)**
- **Without case - version from 2.0 (1157.9804.12 actual version)**

5th Issue 09.11

3 Block Diagrams

Figure 3-1 shows the simplified functional block diagram of the Analog/Digital IO Module R&S TS-PIO2 and the Rear I/O Module R&S TS-PDC in the R&S PowerTSVP .

Figure 3-2 shows the block diagram of the Analog/Digital IO Modules R&S TS-PIO2 .

Figure 3-3 shows the block diagram of the Rear I/O Module R&S TS-PDC.

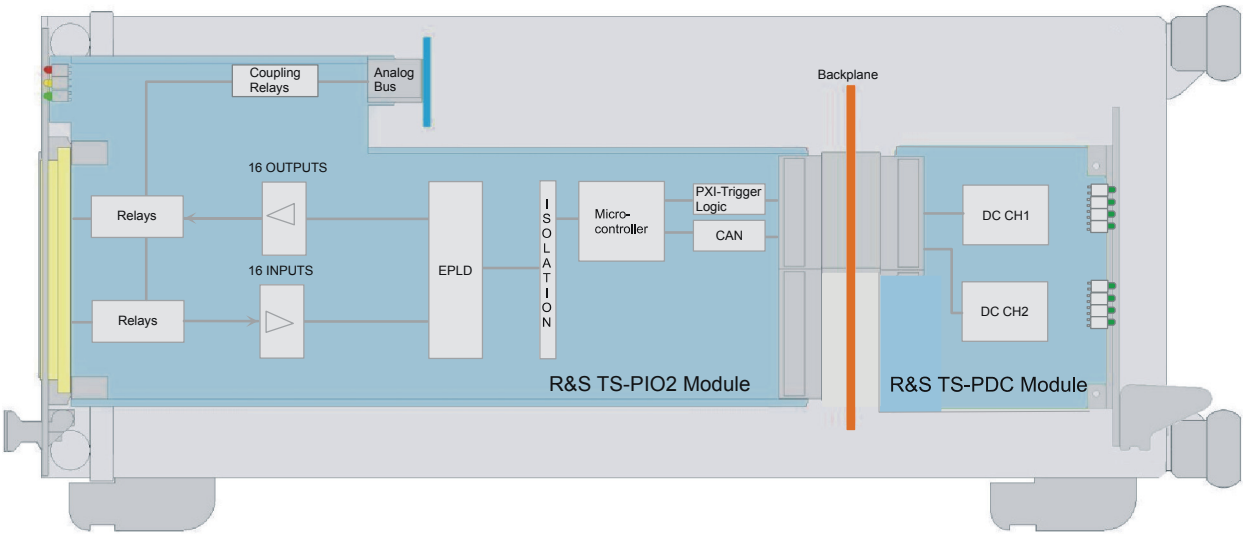

Figure 3-1 Functional block diagram of R&S TS-PIO2 with R&S TS-PDC in the R&S PowerTSVP

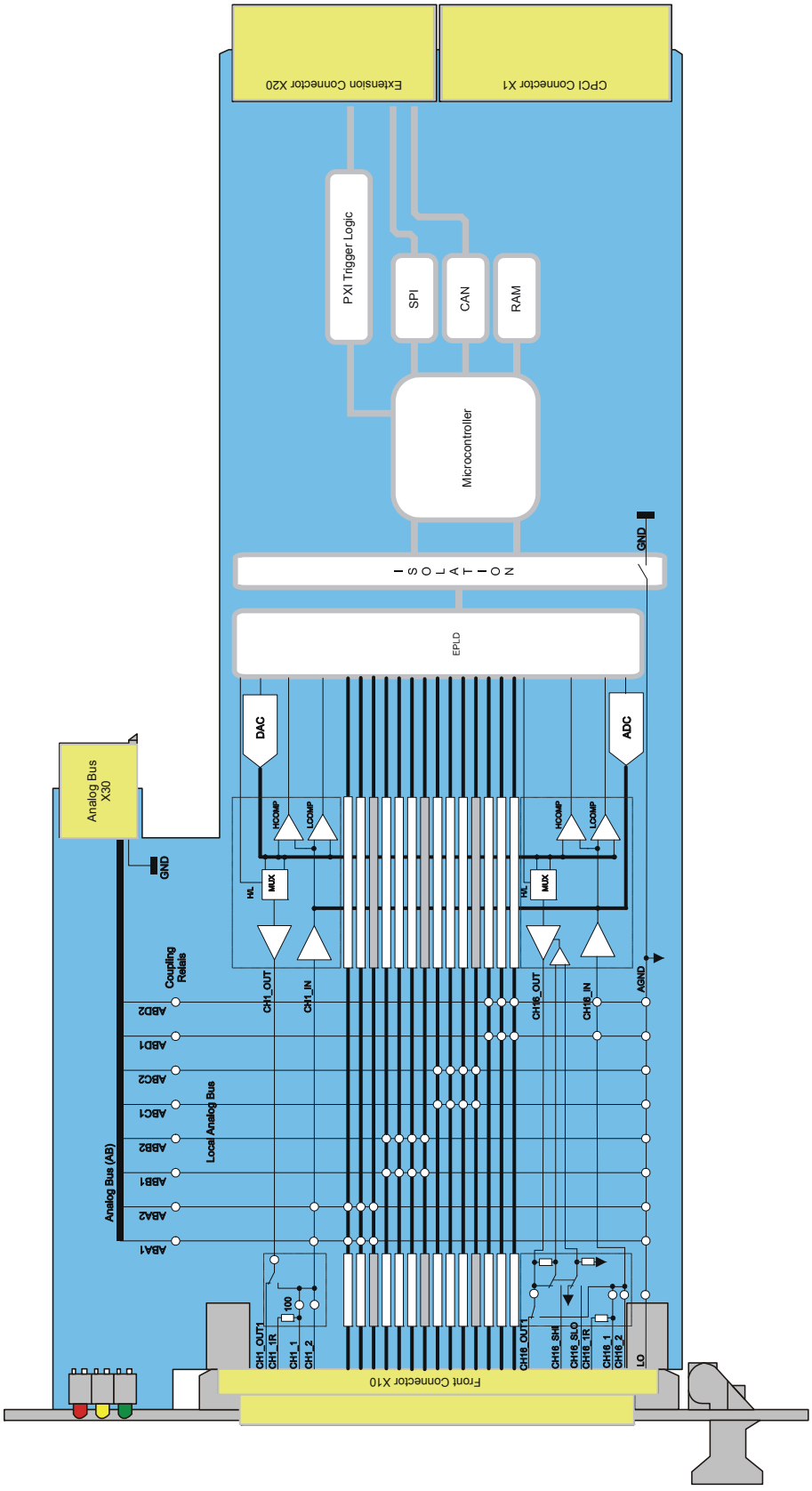

Figure 3-2 Block diagram Analog/Digital IO Module R&S TS-PIO2

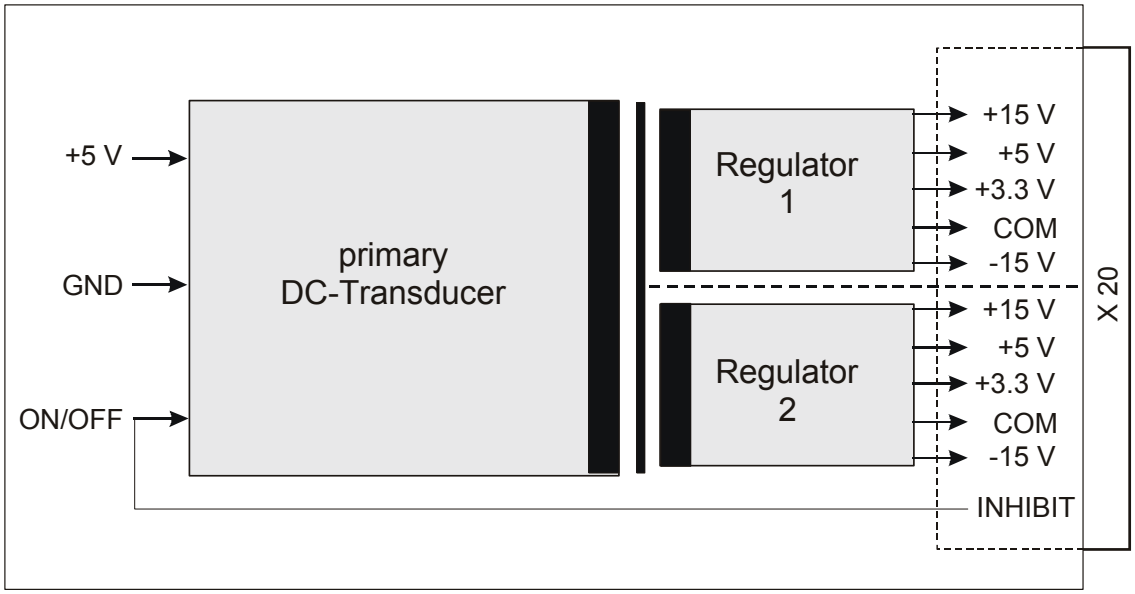

Figure 3-3 Block diagram Rear-I/O Modul R&S TS-PDC

5th Issue 09.11

4 Layout

4.1 Mechanical layout of the module R&S TS-PIO2

The Analog/Digital IO Module R&S TS-PIO2 is designed as a long plug-in card for front installation in test platforms R&S CompactTSVP or R&S PowerTSVP.

The front-side connector X10 is used to connect test objects. The connector X30 connects the module with the analog bus backplane in the R&SCompactTSVP /R&S PowerTSVP. The connectors X20/X1 connect the module with the CompactPCI backplane/PXI control backplane.

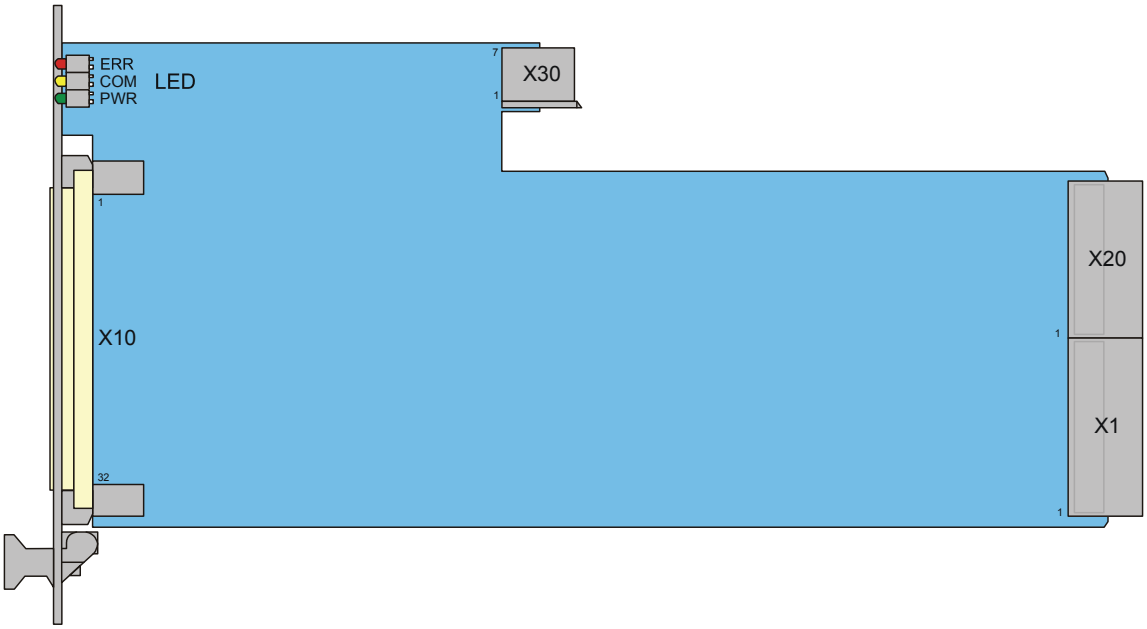

Figure 4-1 Arrangement of the connectors and LEDs on the module R&S TS-PIO2

Name	Use
X1	cPCI Connector
X10	Front Connector
X20	cPCI Connector
X30	Analog Bus Connector

Table 4-1 Connectors on the R&S TS-PIO2

4.2 Display elements of the module R&S TS-PIO2

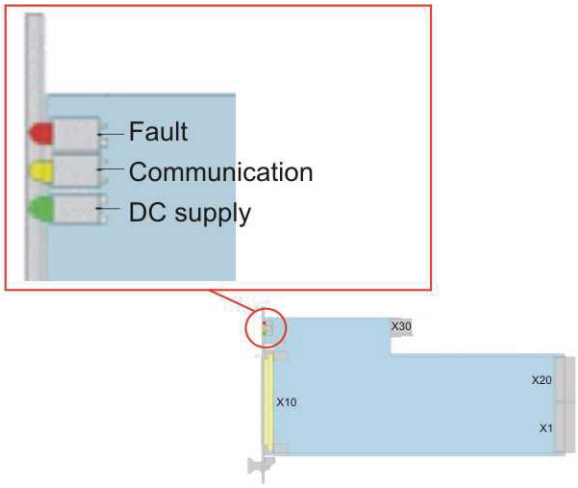

Figure 4-2 Arrangement of the LEDs on the module R&S TS-PIO2

On the front side of the module R&S TS-PIO2 there are three LEDs which show the current status of the module. The LEDs have the following meaning:

LED	Description
red	Fault condition: Lights up when a fault is detected on the R&S TS-PIO2 module during the power-on test after the supply voltage is switched on. This means that there is a hardware problem on the module. (also see section 8: Self-test)
yellow	Communication: Lights up when data is exchanged across the interface.
green	Supply voltage OK: Lights up when all necessary supply voltages are present (incl. the R&S TS-PDC voltages).

Table 4-2 Display elements on the module R&S TS-PIO2

5th Issue 09.11

4.3 Mechanical layout of R&S TS-PDC

The rear I/O Module R&S TS-PDC is designed for rear installation in the R&S CompactTSVP/R&S PowerTSVP. The height of the module's circuit board is 3 HE (134 mm). The module is fastened in place by two fastening screws on the front baffle plug connector X20 connects module R&S TS-PDC with the extension backplane in the R&S CompactTSVP/R&S PowerTSVP. Module R&S TS-PDC must always be used with the correct Rear-I/O slot for the main module (for example module R&S TS-PIO2).

CAUTION!

The module R&S TS-PDC must always be plugged into the corresponding rear I/O slot (same slot code) of the module R&S TS-PIO2 .
If it is not correctly plugged in (e.g. cPCI/PXI standard modules in the front area) both modules may be destroyed.

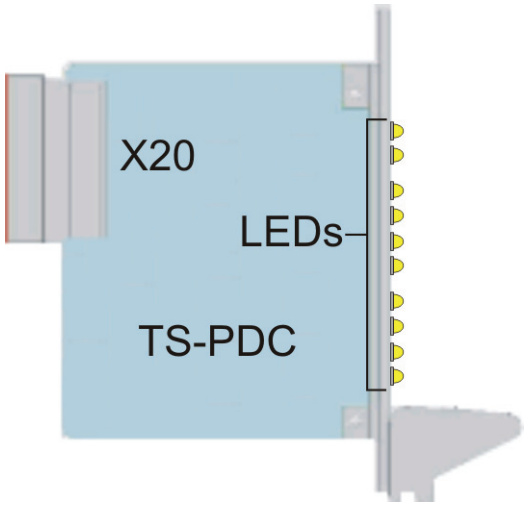

Figure 4-3 Arrangement of the connector and LEDs on the module R&S TS-PDC

Name	Use
X20	Extension (rear I/O)

Table 4-3 Connector of the module R&S TS-PDC

4.4 Display elements of the R&S TS-PDC Module

4.4.1 R&S TS-PDC Version lower than 2.0 (1157.9804.02)

The actual status of the module is signalized by 8 green LEDs, whereat each LED indicates the presence of an output voltage.

In fault-free operation all 8 LEDs must light up simultaneously.

4.4.2 R&S TS-PDC from Version 2.0 (1157.9804.12)

The actual status of the module is signalized by 10 LEDs.

In the switched-on state the green LED PWR indicates the power-on state. In fault-free operation additionally the 8 green LEDs for each generated output voltage light up.

In the case of overload or over temperature the module shuts down by itself. The error is signalized by the red LED ERR.

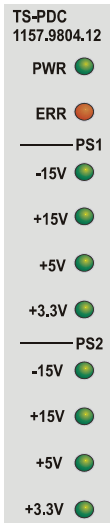

Figure 4-4 LEDs on the R&S TS-PDC module from Version 2.0

5 Function Description

5.1 Function description of the R&S TS-PIO2 module

5.1.1 General

The Analog/Digital IO Module R&S TS-PIO2 makes 16 IO channels (CH1 to CH16) available. The channels are arranged in four groups from A to D. The last output channel of each group (CH4, CH8, CH12 and CH16) has special properties.

Channel	Group	Analog bus access	Note
CH1	A	ABa1, ABa2	
CH2	A	ABa1, ABa2	
CH3	A	ABa1, ABa2	
CH4	A	ABa1, ABa2	Extended channel
CH5	B	ABb1, ABb2	
CH6	B	ABb1, ABb2	
CH7	B	ABb1, ABb2	
CH8	B	ABb1, ABb2	Extended channel
CH9	C	ABc1, ABc2	
CH10	C	ABc1, ABc2	
CH11	C	ABc1, ABc2	
CH12	C	ABc1, ABc2	Extended channel
CH13	D	ABd1, ABd2	
CH14	D	ABd1, ABd2	
CH15	D	ABd1, ABd2	
CH16	D	ABd1, ABd2	Extended channel

Table 5-1 Channels and corresponding groups

5th Issue 09.11

The outputs of the various channels are capable of functioning in the following operating modes:

- Analog
- Digital Static
- Digital Dynamic
- Waveform
- Square Wave

The individual modes are described in greater detail in the following chapters.

Some of the settings for a channel can be made channel-specifically or group-specifically. The following illustration is a graphical representation showing the possible settings for channel outputs in group A. The output level depends on the contents of the level registers and the state of the pattern register. With square wave output, the corresponding switch is switched cyclically between H and L while a „1“ is entered in the pattern register for this channel.

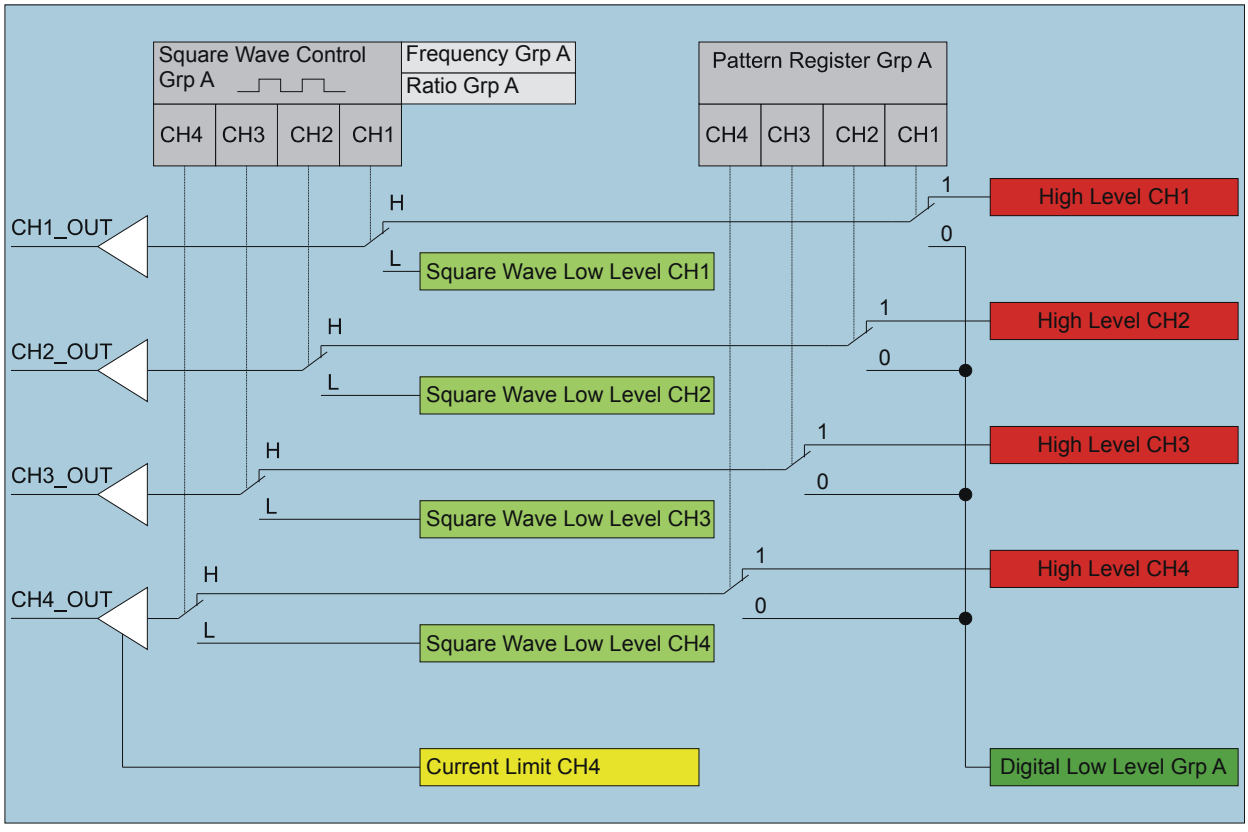

Figure 5-1 Channel- and group-specific parameters of the outputs (group A)

5th Issue 09.11

5.1.2 Application examples

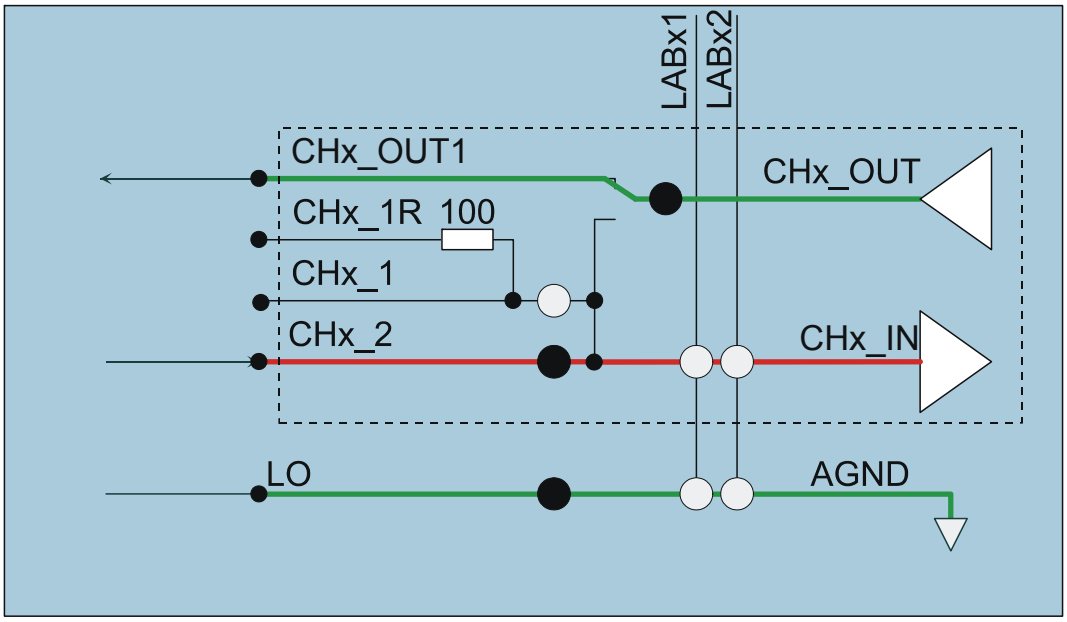

Figure 5-2 Independent use of input and output

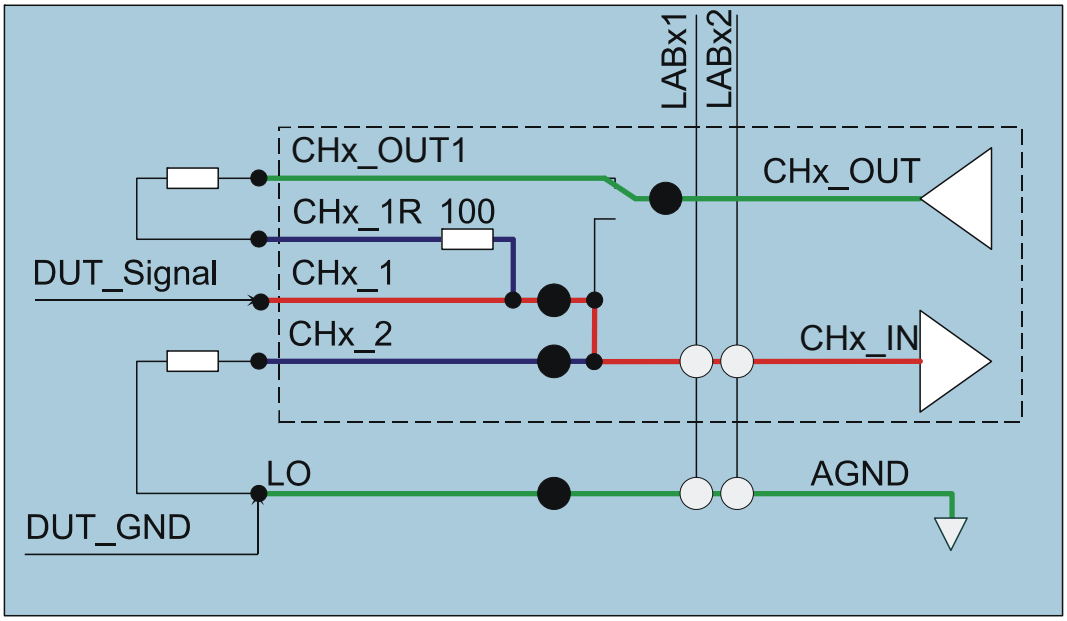

Figure 5-3 Switchable loads (pull-up and pull-down of digital inputs)

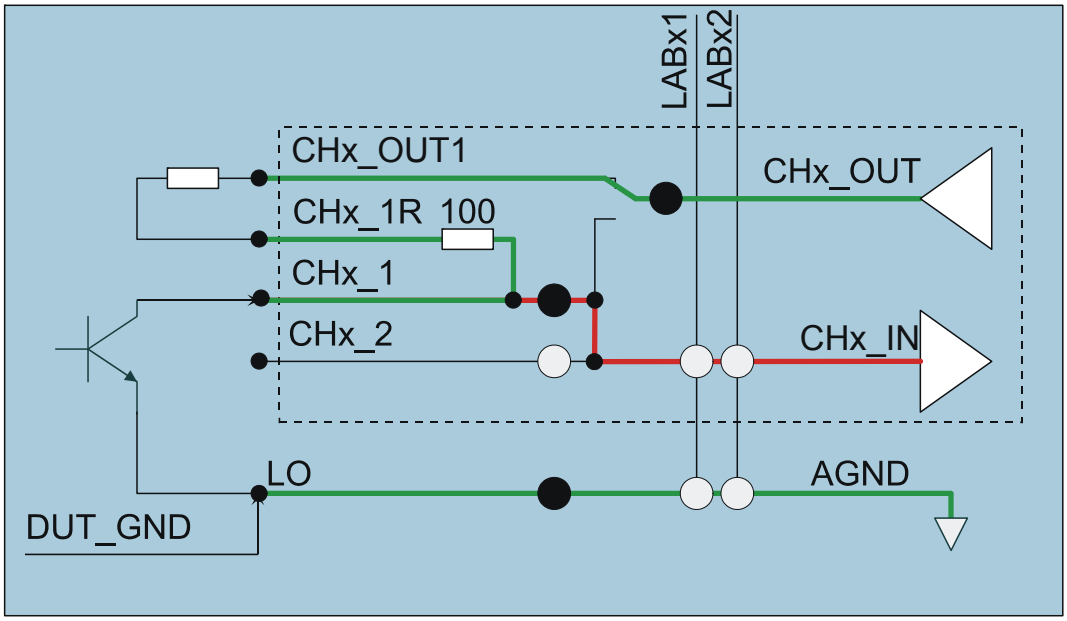

Figure 5-4 Test of „Low-Side“ outputs (OC, OD, optocoupler, switch, etc.)

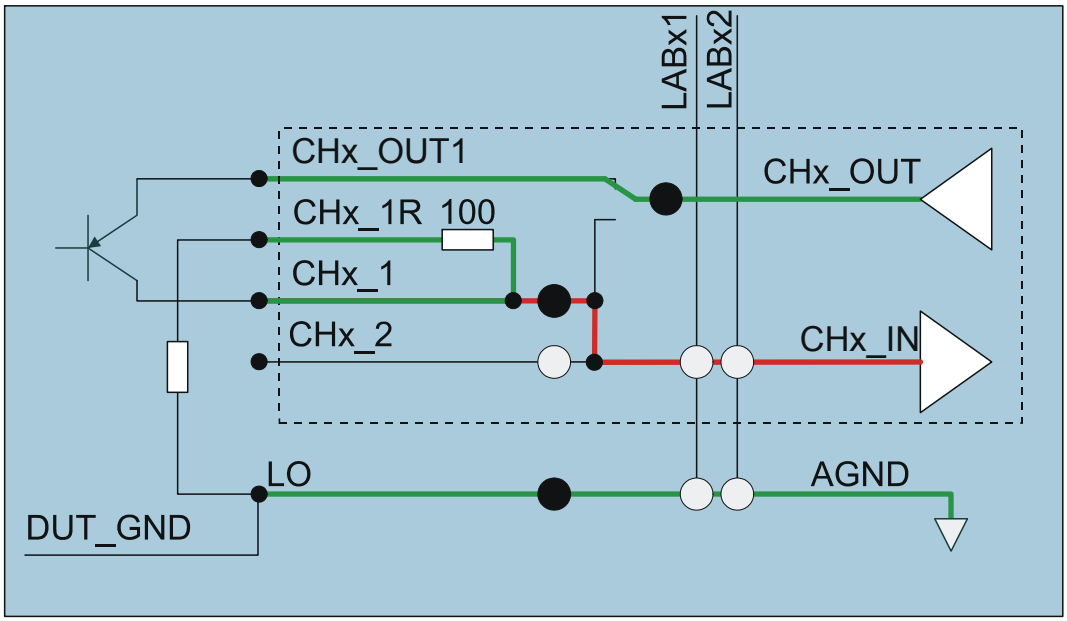

Figure 5-5 Test of „High-Side“ outputs (OC, OD, optocoupler, switch, etc.)

5th Issue 09.11

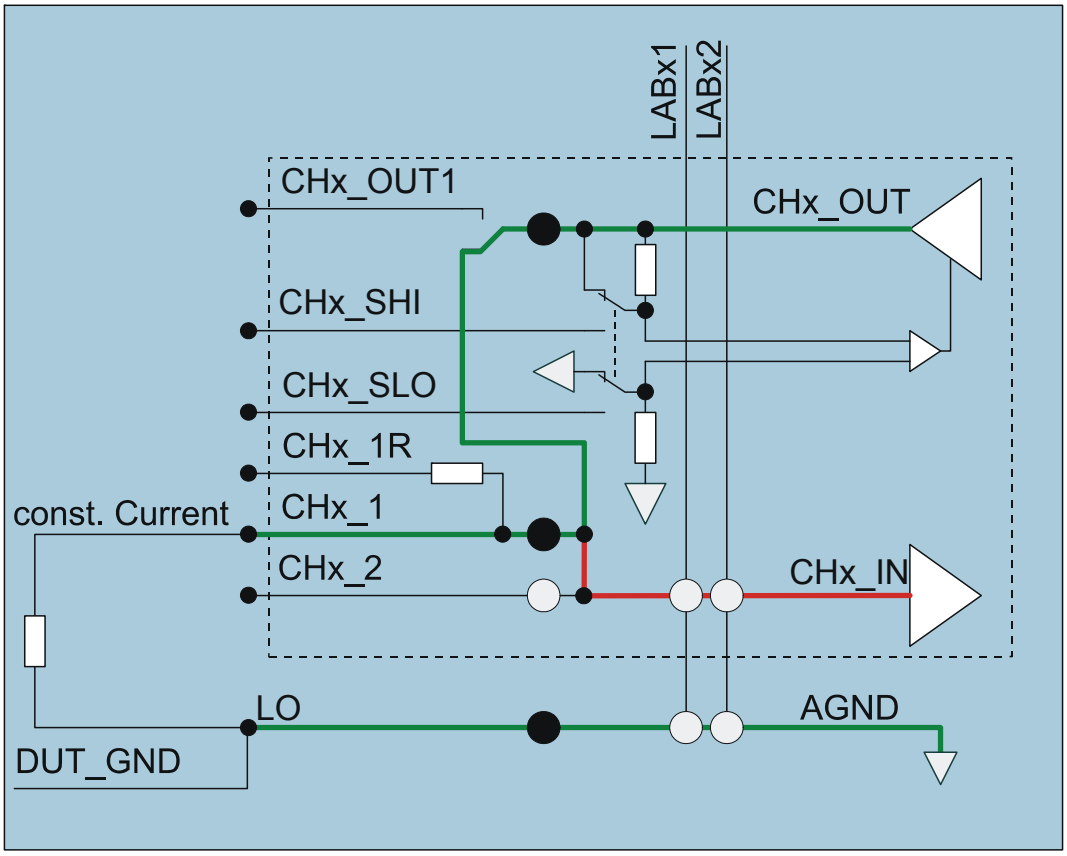

Figure 5-6 Extended channel for implementing current interfaces (0.5 mA …100 mA, actuators)

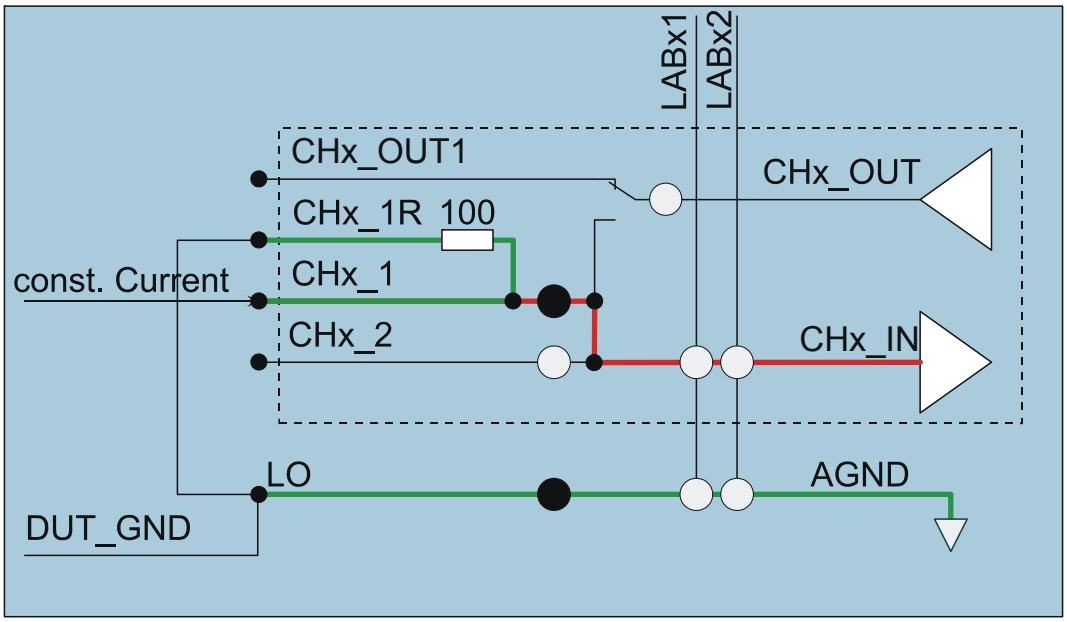

Figure 5-7 Evaluation of current interfaces (sensors)

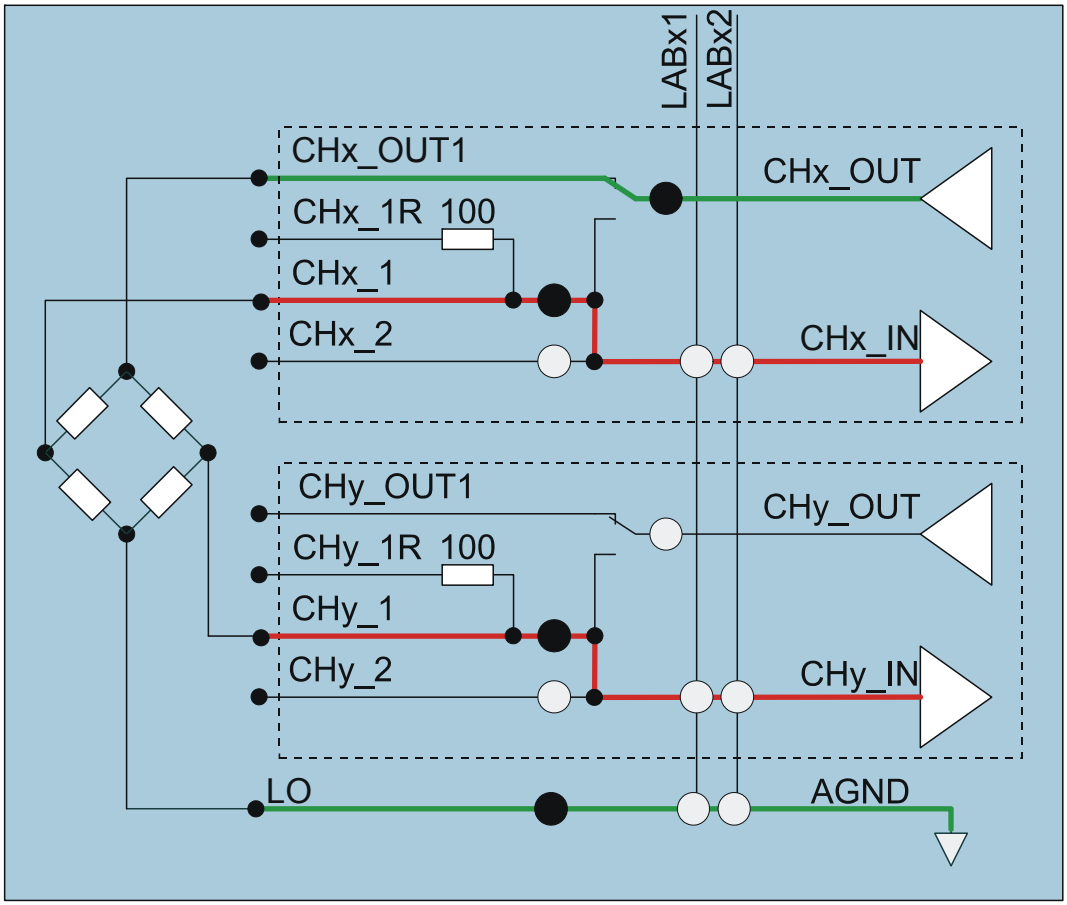

Figure 5-8 Differential measurement on bridge sensors

5.1.3 Signal wiring

5.1.3.1 General

All signal wiring of the R&S TS-PIO2 module is performed with the aid of relays. Since relays have an operate and release time as well as a bounce time, you should wait until the signals are stable in a test program before wiring connections. Function `rspio2_IsDebounced` can be used to determine whether the switching processes are complete. `rspio2_WaitForDebounce` waits until all switching processes are complete and then returns control to the test program.

CAUTION!

To avoid destroying the relay contacts, the relays should only be switched with currents in the specified range.

5.1.3.2 Module ground wiring

The module ground (potential-free common reference point of IO channels, AGND) can be connected via relays with the front side connector (LO) and with each line of the analog bus (ABxy).

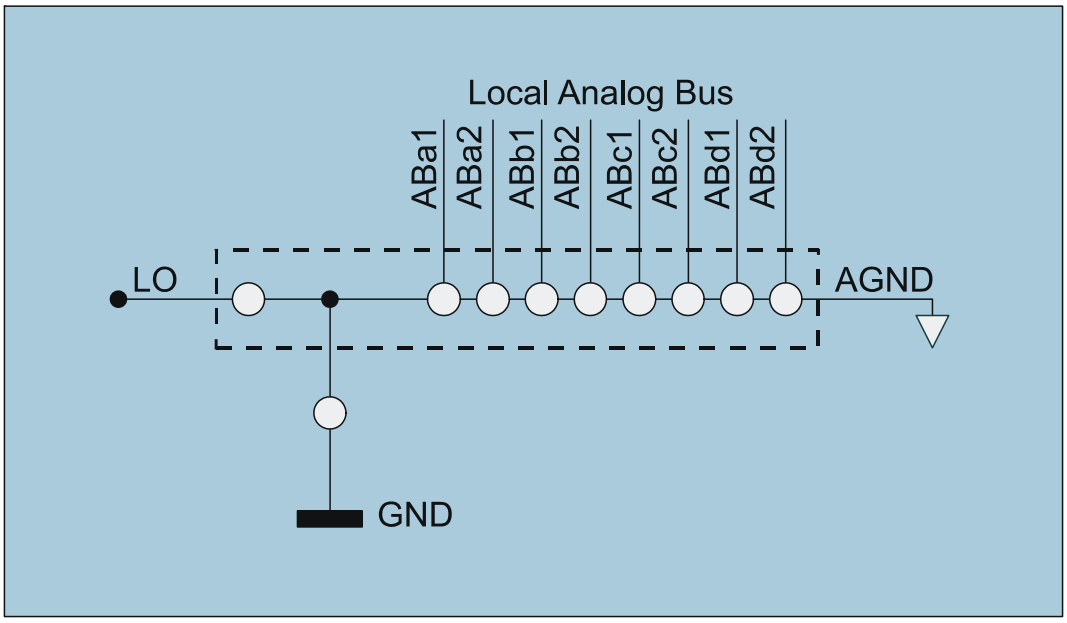

Figure 5-9 Relays for wiring the module ground

The following functions are available to operate these relays:

- `rspio2_Connect`
- `rspio2_Disconnect`
- `rspio2_DisconnectAll`

Function `rspio2_DisconnectAll` can be used to break all connections created with`rspio2_Connect` with a single function call.

NOTE:

`rspio2_DisconnectAll` has no effect on the configuration of outputs, coupling relays, or the ground relay.

The potential-free module ground can also be connected to ground with the aid of the ground relay (see Section 5.1.3.6)

5.1.3.3 Switching inputs

The inputs of each channel can be switched via a multiplexer to the front side connector (CHx_1 or CHx_2) or the TSVP analog bus (see Table 5-1 channels and corresponding groups).

The following functions are available to operate these relays:

- `rspio2_Connect`
- `rspio2_Disconnect`
- `rspio2_DisconnectAll`

Function `rspio2_DisconnectAll` can be used to break all connections created with`rspio2_Connect` with a single function call.

NOTE:

`rspio2_DisconnectAll` has no effect on the configuration of outputs, coupling relays, or the ground relay.

5th Issue 09.11

5.1.3.4 Switching outputs

Function `rspio2_ConfigureOutputMux` configures the switching state of the outputs of a channel. The following settings are possible:

- Output disconnected
- Output connected with front side connector (CHx_OUT1)
- Output connected with corresponding input (CHx_IN)

NOTE:

Please note that function `rspio2_DisconnectAll` does not affect this setting!

5.1.3.5 Coupling relay

The coupling relays connect the local analog bus (LAB) on the module with the analog bus in the R&S CompactTSVP or R&S PowerTSVP. The function `rspio2_ConfigureCoupling` defines the status of the coupling relays.

NOTE:

Please note that function `rspio2_DisconnectAll` does not open these relays!

5.1.3.6 Ground relays

The R&S TS-PIO2 module has a ground relay that can be used to connect the potential-free module ground (AGND) with ground (GND).

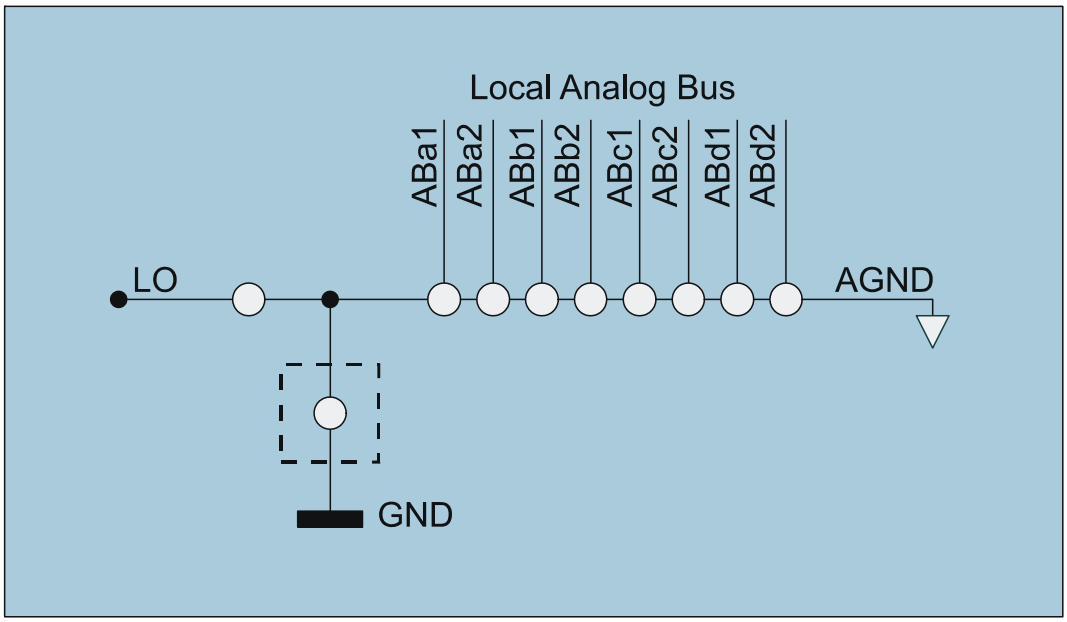

Figure 5-10 Ground relay

The module is operated ground-free in its basic state. This state can be changed using the function `rspio2_ConfigureGround`.

NOTE:

Please note that function `rspio2_DisconnectAll` does not open the ground relays!

NOTE:

For technical reasons, a non-switched R&S TS-PIO2 module (no connection of signals to the front side connector or analog bus) is automatically grounded through the ground relay. This relay is automatically opened again before new switching is performed. This applies if the R&S TS-PIO2 module is configured ground-free.

5.1.4 Using sense lines

To compensate for voltage drops in the power supply to the external load, the extended channels (CH4, CH8, CH12 and CH16) of R&S TS-PIO2 can be set to external sensing. Two additional lines directly to the test object are required for this purpose. The measured difference in voltage on these lines is automatically controlled to the target voltage by R&S TS-PIO2.

The sense lines on the front side connector (CHx_SHI und CHx_SLO) are switched using function `rspio2_ConfigureRemoteSensing`..

5.1.5 Adjusting current limiting

The extended channels (CH4, CH8, CH12 and CH16) of the R&S TS-PIO2 make it possible to adjust current limiting. The set value is independent of the mode of a channel and is always applied to it. Function `rspio2_ConfigureChannelCurrentLimit`facilitates this setting.

5.1.6 Output of static voltages

In the basic state of the module, all outputs are in the „Analog“ operating mode. If necessary, this mode can also be selected with function `rspio2_ConfigureChannelMode`.

The voltage can be adjusted channel-specifically with function `rspio2_ConfigureChannelLevels`. Parameter „Output High Level“ determines the output voltage.

5.1.7 Output of static digital bit patterns

A channel can be switched to „Digital Static“ mode using function `rspio2_ConfigureChannelMode`. Any number of channels can be operated in this mode. Depending on which bit pattern is programmed, either the channel-specific voltage „Output High Level“ or the voltage assigned to a group „Output Digital Low Level“ is generated.

5th Issue 09.11

Pattern value	Generated voltage	Setting function of the voltage value
0	Output Digital Low Level	`rspio2_ConfigureGroup`
1	Output High Level	`rspio2_ConfigureChannelLevels`

Table 5-2 Output Voltages in Mode„Digital Static“ and „Digital Dynamic“

The pattern value for channels in „Digital Static“ mode can be set with function`rspio2_SetDigitalOutputState`. One parameter of this function serves as a mask so that the individual channels can be operated.

NOTE:

When switching from the „Analog“, „Waveform“ or „Square Wave“ mode to „Digital Static“ mode, level „Output High Level“ is generated (pattern value „1“).

5.1.8 Output of dynamic digital bit patterns

In the „Digital Dynamic“ operating mode, the output voltage of the relevant channels is determined by a digital bit pattern which is updated cyclically after sequence control begins (see Section 5.1.13).

This mode can be selected for a channel using function `rspio2_ConfigureChannelMode`. Any number of channels can be switched to this mode.

The high and low level for the relevant channels can be set like in „Digital Static“ mode (see Section 5.1.7).

Before sequence control begins, the bit pattern must be loaded into the R&S TS-PIO2 module. Function `rspio2_SetDigitalDynamicMemory` is used for this purpose. A maximum of 5000 values can be written to memory. If fewer values have been stored in memory than sequence control needs to generate, the last value is repeated.

5th Issue 09.11

NOTE:

When switching from „Analog“, „Waveform“ or „Square Wave“ mode to „Digital Dynamic“ mode, level „Output High Level“ is generated (pattern value „1“). If level „Output Digital Low Level“ should be present before dynamic bit pattern output begins, pattern value „0“ must first be set in the „Digital Static“ mode.

5.1.9 Output of arbitrary waveforms

One of the 16 channels can be switched to the „Waveform“ mode using function `rspio2_ConfigureChannelMode`. To do this, the pattern register value is set to “1” for that channel. After sequence control has started (see Section 5.1.13), the output voltage of this channel is determined by the values in arbitrary waveform memory. The values are transferred to the „High Level“ register.

Function `rspio2_SetAnalogWaveformMemory` is used to transfer the values to the R&S TS-PIO2 module. As in the case of digital bit patterns, a maximum of 5000 values can be written to memory. If fewer values have been stored in memory than sequence control needs to generate, the last value is repeated.

NOTE:

Operating modes „Waveform“ and „Square Wave“ cannot be selected simultaneously within one group.

5.1.10 Output of square wave signals

For a channel to generate a square wave signal, the „Square Wave“ operating mode must first be activated with function `rspio2_ConfigureChannelMode`. Multiple channels can be operated simultaneously in this mode.

When square wave signals are generated, both the high and low level can be adjusted channel-specifically using function `rspio2_ConfigureChannelLevels`. When square wave generating stops, the „Output High Level“ is always generated. The frequency and duty cycle are always determined for the corresponding group. This is done with function `rspio2_ConfigureSquareWave`. The frequency and duty cycle can also be changed while the signal is being

generated.

When adjusting the square wave signal, the rise and fall times of channels specified on the data sheet must be taken into consideration. The extended channels have longer times.

Output of square wave signals is finally started for a group with function `rspio2_SquareWaveEnabled`. The same function is used to stop generating square wave signals. The parameters of the function make it possible to start output for several groups synchronously.

Generation of square wave signals is independent of sequence control for recording of measurement values and of the output of digital bit patterns and arbitrary waveforms.

NOTE:

if the output of a square wave signal is enabled for a group, the following settings cannot be modified for any channels in that group:

- **Output High Level**
- **Output Square Wave Low Level**
- **Output Current Limit**
- **Output Digital Low Level**
- **Input Digital High Threshold**
- **Input Digital Low Threshold**

5.1.11 Recording digital measurement values

Each input is directed to two comparators with adjustable trip levels. This makes it possible to implement a hysteresis for evaluating signals. The limits can be set using function `rspio2_ConfigureGroup`. This makes it possible to set individual limits for each group of channels.

The result of the signal evaluation of a channel is „1“ if the input level is greater than value „Input Digital High Threshold“. The result of the signal evaluation of a channel is „0“ if the input level is less than value „Input Digital Low Threshold“.

If the input level is between limit values, the last state is always retained.

Digital measurement values are recorded in parallel to the voltage measurement. The process is started with sequence control (see Section 5.1.13). The results can be retrieved with function

5th Issue 09.11

`rspio2_FetchDigital`.

5.1.12 Voltage measurements

Two methods are available for voltage measurement on inputs:

Method	Note
Single Ended	The level is measured between one input (CHx_IN) and module ground (AGND or LO on the front side connector)
Differential	The level between two inputs is determined by taking the difference. The following combinations of inputs are possible: CH1 - CH9 CH2 - CH10 CH3 - CH11 CH4 - CH12 CH5 - CH13 CH6 - CH14 CH7 - CH15 CH8 - CH16

Table 5-3 Methods for voltage measurement

The following measurement ranges can be set:

- 7 V
- 14 V
- 28 V

Voltage measurement can be configured with function `rspio2_ConfigureAnalogMeasurement`.

Recording of measurement values is monitored by sequence control (see Section 5.1.13). The setting of the the time interval also determines the conversion time of the ADC and thus the input bandwith and accuracy that can be achieved. Because of this, parameter „Sample Interval“ of function `rspio2_ConfigureSampling` is meaningful even if only one measurement value („Sample Count“ = 1) will be recorded!

5th Issue 09.11

Interval			Input Bandwidth	Accuracy
200 µs	<= Sample Interval	< 1 ms	High	Lower
1 ms	<= Sample Interval	< 10.0 ms	Medium	Higher
10.0 ms	<= Sample Interval	<= 1 s	Low	Best

Table 5-4 Effect of „Sample Interval“ on bandwidth and accuracy

Recording of measurement values is started by sequence control (see Section 5.1.13). The results can be queried with function `rspio2_FetchAnalog`. If you are only interested in the average value of all the samples recorded, it can be retrieved with `rspio2_FetchAverage`.

5.1.13 Triggering and sequence control

Measurement values are recorded and output of digital bit patterns is monitored by a central control system. Function `rspio2_ConfigureSampling` can be used to define the number of „Samples“ that will be recorded or generated. The time interval between the „Samples“ can be adjusted with this function.

The following actions are performed by sequence control in each time slot:

- A digital bit pattern is generated if at least one output is in „Digital Dynamic“ mode
- An analog waveform value is generated if a channel is running in „Waveform“ mode
- A pulse is generated on the configured trigger lines
- A digital bit pattern is read
- A measurement value is read

Various trigger sources are available to start sequence control:

5th Issue 09.11

Trigger source	Note
Immediate	Sequence control starts immediately when function `rspio2_Initiate` is called
External	Ground referenced TTL input XTI1 on the front side connector; positive signal edge triggers sequence control
Software	Sequence control is started with function `rspio2_SendSoftwareTrigger`
PXI0 … PXI7	Positive signal edges on the PXI trigger lines start sequence control

Table 5-5 Trigger sources

Function `rspio2_ConfigureTriggerSource` determines the trigger source. Function `rspio2_Initiate` is used to enable the previously configured trigger source. Sequence control is in the „Initiated“ state. As soon as the trigger event has occurred, the control system switches to the „Sampling“ state. After the set number of „Samples“ has been read in or generated, sequence control returns to its basic state. Then the data that was read in can be retrieved with the corresponding functions (`rspio2_FetchAnalog`, `rspio2_FetchAverage`, `rspio2_FetchDigital`). These functions have a „Timeout“ parameter. If sequence control has not expired during the time that was transferred, an error is returned. Otherwise the results are returned.

NOTE:

If sequence control is in the „Initiated“ or „Sampling« mode, some functions cannot be performed. In that case, those functions return an error message. If necessary, sequence control can be switched to its basic state with the `rspio2_Abort` function.

5.1.14 Generating trigger signals

The R&S TS-PIO2 module is capable of generating trigger signals on the following lines:

Name	Note
XTO1	Ground referenced TTL output XTO1 on the front side connector
PXI0 … PXI7	PXI trigger lines on the backplane

Table 5-6 Trigger outputs

For a change to occur on the trigger lines, an event must be assigned to the selected line that generates the trigger pulse. The following settings are possible:

Name	Note
General Purpose Trigger	Function `rspio2_InitiateTrigger` generates a pulse approximately 1 µs in length on the configured trigger lines.
Sequence Start	A pulse approximately 1 µs in length is generated on the configured trigger lines when sequence control starts.
Sample Clock	A pulse approximately 1 µs in length is generated in each time slot of sequence control on the configured trigger lines.

Table 5-7 Events for generating a trigger pulse

The polarity of the trigger signal can also be determined for the individual outputs. The output drivers for the PXI trigger lines can also be switched off.

All settings are made with the aid of function `rspio2_ConfigureTriggerOutput`.

5th Issue 09.11

5.1.15 Autocorrection

To make it possible to achieve higher levels of accuracy, a process must be started under some circumstances to determine new correction values automatically. This process is performed with the aid of function `rspio2_PerformAutoCorrection`. It takes about one minute to determine the correction values. The function is not finished until the process is complete. After the correction procedure, the R&S TS-PIO2 module is in its reset state.

If the requirements for accuracy are not as great, function `rspio2_PerformFastAutoCorrection` can be performed. This process takes only about 2 seconds to complete.

The autocorrection must be performed after no more than 24 hours of operating time, or if the temperature on the R&S TS-PIO2 module changes by 5 degrees Celsius. The driver monitors these parameters. Function `rspio2_QueryDeviceState` can be used to query whether the correction procedure must be started.

NOTE:

Function `rspio2_QueryDeviceState` always requests an autocorrection if the R&S TS-PIO2 module has just been turned on or reset by a hardware reset.

5.1.16 Excess temperature protection

There are four temperature sensors on the R&S TS-PIO2 module. If one of these sensors reports an inadmissible temperature, the module switches off automatically. The functions for switching signals and activating outputs return an error message in this state. Complete operation of R&S TS-PIO2 is not possible until the temperature is in the permissible range and use of the protective measure has been acknowledged by calling function `rspio2_reset`. Function `rspio2_QueryDeviceState` can be used to query the state of temperature monitoring.

5.1.17 Instructions for operation with voltages dangerous to the touch

In conformity with EN 61010-1, the following voltage limit values are considered „Hazardous live“.

- 70 V DC
- 33 V AC eff
- 46.7 V AC peak

WARNING!

When operating the Analog/Digital IO Module R&S TS-PIO2 above these voltage limit values, the requirements of EN61010-1 must be observed.

The Analog/Digital IO Module R&S TS-PIO2 and Test System Versatile Platform R&S CompactTSVP / R&S PowerTSVP are designed for a maximum voltage of 125 V between ground-free measurement devices, analog busses, and GND. Care must be taken to ensure that this limit is not exceeded at any time, even as the sum of voltages, and thus not as a results of alternating signals.

Figure 5-11 shows a typical permissible voltage configuration between analog busses and ground.

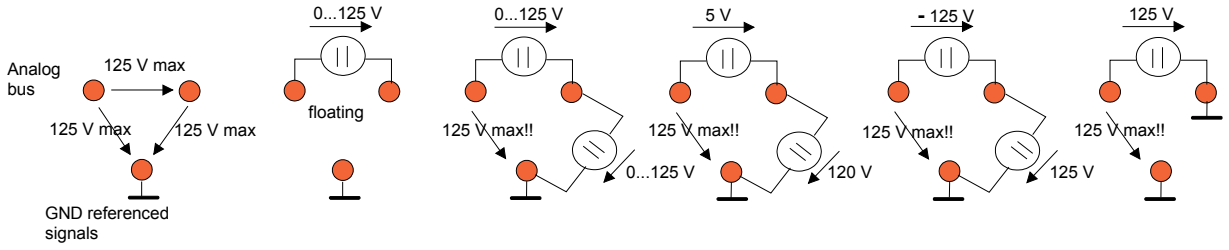

Figure 5-11 Permissible voltages on analog bus lines

For reasons of fire prevention in conformity with EN 61010-1, we recommend limiting the current or output for DC sources to 150 VA.

5.2 Description of functions of the module R&S TS-PDC

The Rear I/O Module R&S TS-PDC is configured as a primary reference DC/DC converter. The input voltage (5 VDC) is transferred to two secondary potentials and rectified to the nominal voltage by line controllers. The status of the output voltage is displayed in each case by an LED.

The following DC voltages are generated:

– +15 VDC, 0.5A (2x)

– -15 VDC, 0.5A (2x)

– +5 VDC, 0.5A (2x)

– +3.3 VDC, 0.25A (2x)

5th Issue 09.11

5th Issue 09.11

6 Commissioning

6.1 Installation of the R&S TS-PIO2 module

To install plug-in module R&S TS-PIO2 , proceed as follows:

- Shut down and turn off the R&SCompactTSVP / R&SPowerTSVP.
- Select a suitable front side connection slot. For more information, see the operating manual for „CompactTSVP R&S TS-PCA3“ or„PowerTSVP R&S TS-PWA3“, in both cases Section “Permitted module configurations”.
- Remove the appropriate front plate section on the R&S CompactTSVP / R&S PowerTSVP housing by loosening the two screws.

CAUTION!

Check the backplane connectors for bent pins! Any pins that are bent must be straightened!
Failure to observe this instruction may result in permanent damage to the backplane!

- Press in the module applying moderate pressure.
- The upper catch pin of the R&S TS-PIO2 module must be guided into the right hole, while the lower catch pin is guided into the left hole of the R&S CompactTSVP / R&S PowerTSVP housing.

CAUTION!

When the R&S TS-PIO2 module is connected, it must be guided with both hands and carefully pressed into the backplane connector.

- When the R&S TS-PIO2 module is correctly inserted, you will feel it reach a definite mechanical limit
- Tighten the upper and lower screws on the front plate of the R&S TS-PIO2 module.

NOTE:

Install the Rear-I/O R&S TS-PDC module as described in Section 6.2.

5th Issue 09.11

6.2 Installation of the R&S TS-PDC module

To install the plug-in module, proceed as follows:

- Previous installation of the R&S TS-PIO2 module is required.
- Select the appropriate Rear-I/O slot for module R&S TS-PIO2.
- Loosen the two screws and remove the appropriate back plate section on the TSVP housing.

CAUTION!

For use in a CompactTSVP R&S TS-PCA3 beginning with serial number 100109, a R&S TS-PDC module with at least version number V1.4 (serial number greater than 1003xx) is required.

CAUTION!

Check the backplane connectors for bent pins! Any pins that are bent must be straightened!
Failure to observe this instruction may result in permanent damage to the backplane!

- Press in the module applying moderate pressure.

CAUTION!

When the R&S TS-PDC module is connected, it must be guided with both hands and carefully pressed into the backplane connector.

- The rear I/O module R&S TS-PDC must be inserted with extra caution, making certain the connector is correctly guided into the socket opening in the backplane. It must not be inserted at an angle or with incorrect alignment, etc. The short circuit board guides alone do not ensure absolutely reliable guiding.
- Multiple adjacent R&S TS-PDC modules should be inserted in order “from left to right” and removed in the opposite order. Because the spaces are so narrow, care must be taken not to damage any components on the solder side of the module.
- When the R&S TS-PDC module is correctly inserted, you will feel it reach a definite mechanical limit
- Tighten the upper and lower screws on the front plate of the R&S TS-PDC module.

5th Issue 09.11

7 Software

7.1 Driver software

A LabWindows IVI driver that supports the class IVI SWTCH is available for the functions of the Analog/Digital IO Module R&S TS-PIO2. The driver is a component of the ROHDE & SCHWARZ GTSL software program. All functions of the driver are documented extensively in online Help and in the LabWindows/CVI Function Panels.

The following software modules are installed during driver installation:

Module	Path	Note
rspio2.dll	<GTSL directory>\Bin	Driver
rspio2.hlp	<GTSL directory>\Bin	Help file
rspio2.fp	<GTSL directory>\Bin	LabWindows CVI Function Panel File, Function Panels for CVI Development Environment
rspio2.sub	<GTSL directory>\Bin	LabWindows CVI attribute file. This file is required by several „Function Panels“.
rspio2.lib	<GTSL directory>\Bin	Import library
rspio2.h	<GTSL directory>\Include	Header file for driver

Table 7-1 Driver installation R&S TS-PIO2

NOTE:

The IVI and VISA library of National Instruments are required to operate the driver.

5th Issue 09.11

7.2 Soft Panel

A Soft Panel is available for the Analog/Digital IO Module R&S TS-PIO2 (Figure 7-1). The Soft Panel requires the IVI driver. The Soft Panel facilitates interactive operation of the module. Output of measurement values is in graphical format.

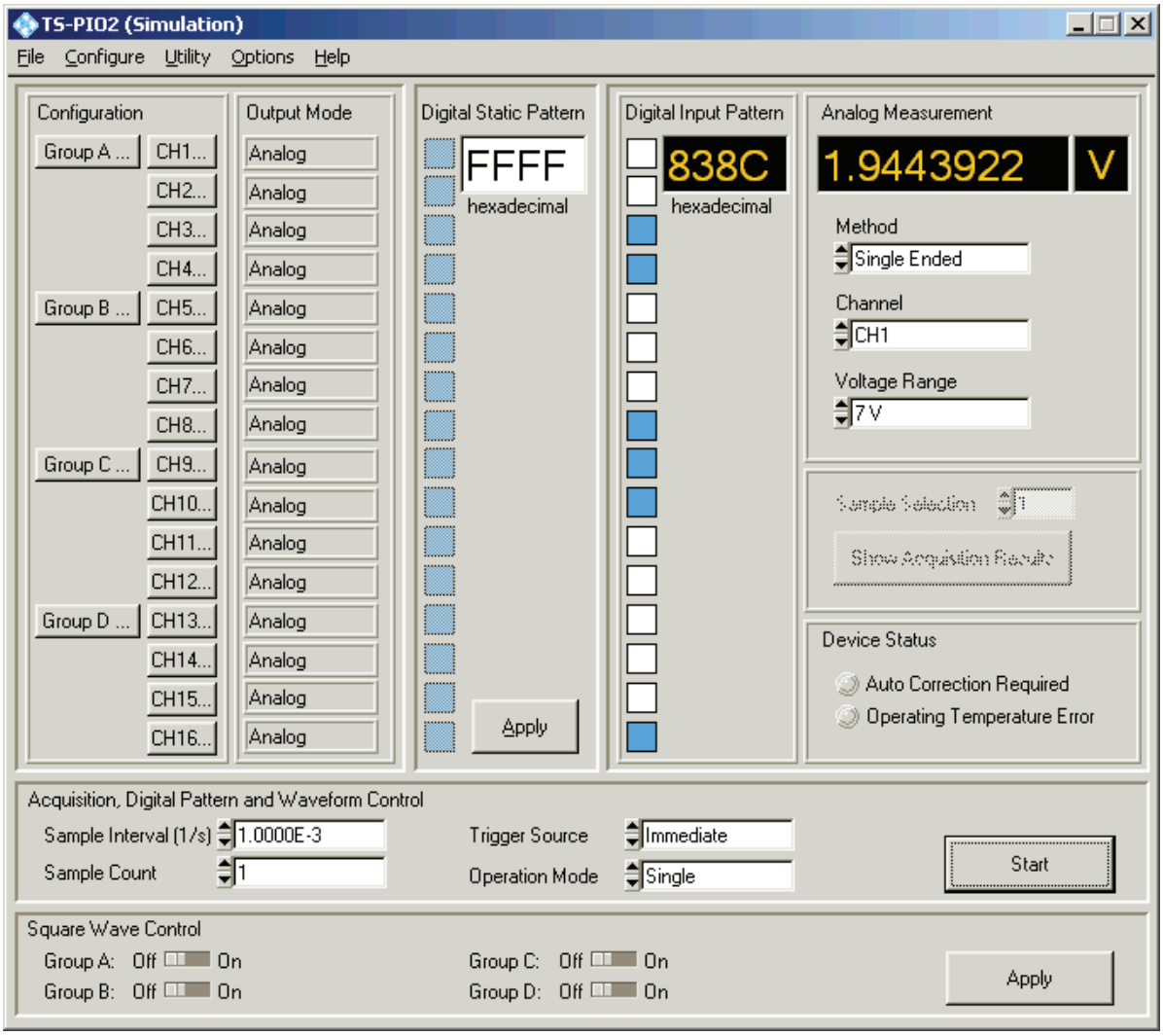

Figure 7-1 Soft Panel R&S TS-PIO2

NOTE:

The operation of the Soft Panel is described in the "R&S GTSL Software Description".

The signal paths connections of the R&S TS-PIO2 can also be determined by the Soft Panel (Figure 7-2).

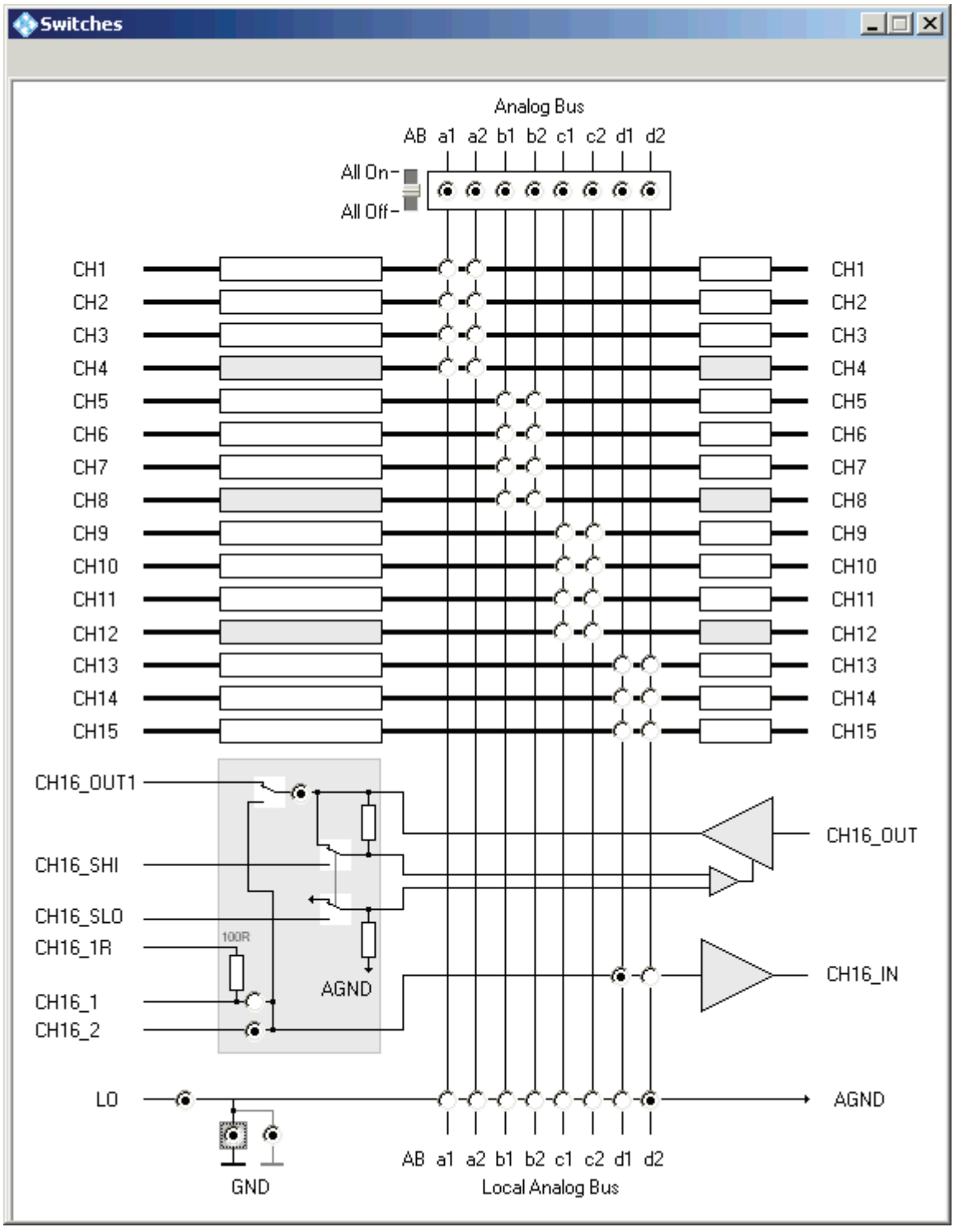

Figure 7-2 Soft Panel R&S TS-PIO2 connections

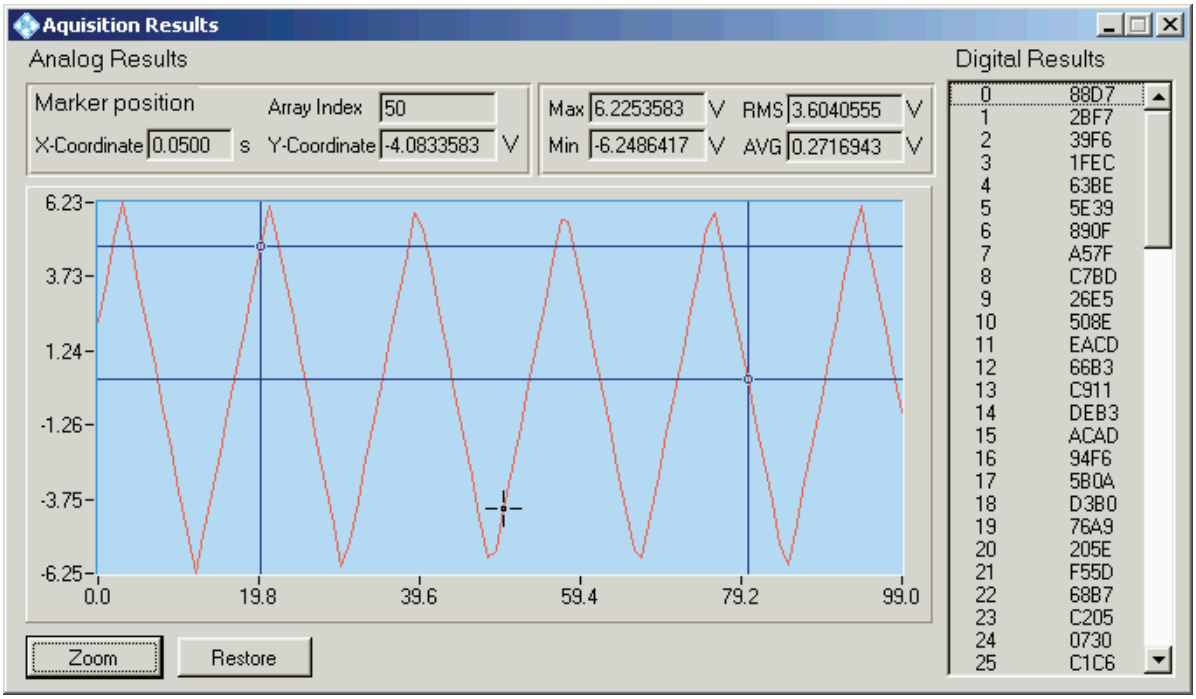

Figure 7-3 Soft Panel R&S TS-PIO2 measurement results

7.3 Sample program R&S TS-PIO2

```
/*
  This example connects all channels to the front connector, configures
  the channels and starts the output/acquisition sequence.

  Error handling is not considered in this sample in order to
  keep it easy to read. The return status should be checked for
  VI_SUCCESS after each driver call.
*/

#include <ansi_c.h>
#include "rspio2.h"


#define SAMPLE_COUNT        16
#define SAMPLE_INTERVAL     1E-3


static ViChar * s_pGrpName[] =
{
  "GRP_A",
  "GRP_B",
  "GRP_C",
  "GRP_D"
};

static ViUInt16 s_digiStim[SAMPLE_COUNT];
static ViUInt16 s_digiResp[SAMPLE_COUNT];
static ViReal64 s_waveform[SAMPLE_COUNT];
static ViReal64 s_measResult[SAMPLE_COUNT];

int main (int argc, char *argv[])
{
  ViSession vi;
  ViStatus  status;
  ViReal64  result;
  ViChar    chName[5], ch1[8], ch2[8];
  ViInt32   idx;

  /*
    open a session to the device driver. The resource descriptor
    depends on the slot number of the module and must be adapted
    to the target system.
  */
  status = rspio2_InitWithOptions ("CAN0::0::2::7::INSTR",
                                   VI_TRUE,
                                   VI_TRUE,
                                   "Simulate=0,RangeCheck=1",
                                   &vi);

  /* configure sample count and interval */
  status = rspio2_ConfigureSampling (vi, SAMPLE_COUNT, SAMPLE_INTERVAL);

  /* fill stimulus buffer */
  for (idx = 0; idx < SAMPLE_COUNT; idx++)
  {
    s_digiStim[idx] = idx;                              /* counter */
    s_waveform[idx] = idx * (10.0 / SAMPLE_COUNT);      /* ramp */
  }

  /* upload samples */
  status = rspio2_SetDigitalDynamicMemory (vi, SAMPLE_COUNT, s_digiStim);
  status = rspio2_SetAnalogWaveformMemory (vi, SAMPLE_COUNT, s_waveform);
```

```
/* configure voltage mesurement at CH16 */
status = rspio2_ConfigureAnalogMeasurement (vi, "CH16", 14.0);

/* configure square wave generation on CH9 and CH10 */
status = rspio2_ConfigureSquareWave (vi, "GRP_C", 2000, 50);



/* generate trigger puls at XTO1 when output/acquisition sequence starts */
status = rspio2_ConfigureTriggerOutput (vi, RSPIO2_TRIG_MASK_XTO1,
                                        RSPIO2_VAL_TRIG_SEQ_START, 0,
                                        RSPIO2_TRIG_MASK_XTO1);

/* configure module earth tied (connect AGND to GND) */
status = rspio2_ConfigureGround (vi, VI_TRUE);

/* connect AGND to front connector */
status = rspio2_Connect (vi, "AGND", "LO");

/* connect all output channel to front connector */
for (idx = 1; idx <= 16; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureOutputMux (vi, chName,
                                      RSPIO2_VAL_OUTMUX_MODE_OUT1);
}

/* connect all input channel to front connector */
for (idx = 1; idx <= 16; idx++)
{
  sprintf(ch1, "CH%d_IN", idx);
  sprintf(ch2, "CH%d_1", idx);
  status = rspio2_Connect (vi, ch1, ch2);
}

/* wait until relays have settled; timeout 500 ms */
status = rspio2_WaitForDebounce (vi, 500.0);

/* configure channel 1 to 8 to mode digital dynamic */
for (idx = 1; idx <= 8; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelMode (vi, chName,
                                        RSPIO2_VAL_CH_MODE_DIGITAL_DYNAMIC);
}

/* configure channel 9 to 10 to mode square wave */
for (idx = 9; idx <= 10; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelMode (vi, chName,
                                        RSPIO2_VAL_CH_MODE_SQUAREWAVE);
}

/* configure channel 11 to 12 to mode digital static */
for (idx = 11; idx <= 12; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelMode (vi, chName,
                                        RSPIO2_VAL_CH_MODE_DIGITAL_STATIC);
}

/* configure channel 16 to mode waveform */
status = rspio2_ConfigureChannelMode (vi, "CH16",
                                      RSPIO2_VAL_CH_MODE_WAVEFORM);
```

```
/* configure current limit for the extented channels */
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH4", 10.0e-3);
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH8", 10.0e-3);
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH12", 10.0e-3);
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH16", 10.0e-3);


/* configure output high level to 3.3 V and square wave low level to 0 V */
for (idx = 1; idx <= 12; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelLevels (vi, chName, 3.3, 0.0);
}

/* configure output level for the analog channels */
status = rspio2_ConfigureChannelLevels (vi, "CH13",  3.3, 0.0);
status = rspio2_ConfigureChannelLevels (vi, "CH14",  5.0, 0.0);
status = rspio2_ConfigureChannelLevels (vi, "CH15", 12.0, 0.0);

/*
   configure group A, B, C for digital IO:

   output digital low level     0.0 V
   input digital high threshold 2.0 V
   input digital low threshold  0.8 V
*/
for (idx = 0; idx <= 2; idx++)
{
  rspio2_ConfigureGroup (vi, s_pGrpName[idx], 0.0, 2.0, 0.8);
}

/* set pattern for the digital static channel CH11 and CH12 */
status = rspio2_SetDigitalOutputState (vi, 0x0C00, 0x0800);

/* enable square wave */
status = rspio2_SquareWaveEnabled (vi, 0x4, 0x4);

/* start output/acquisition sequence with immediate trigger */
status = rspio2_Initiate (vi);

/* fetch the measurement results */
{
  ViInt32 actualPoints;
  ViInt32 maxTime = SAMPLE_COUNT * SAMPLE_INTERVAL * 1000;

  status = rspio2_FetchDigital (vi, maxTime, SAMPLE_COUNT,
                                s_digiResp, & actualPoints);
  status = rspio2_FetchAnalog (vi, maxTime, SAMPLE_COUNT,
                               s_measResult, & actualPoints);
}
```

```
  /* disable square wave generation */
  status = rspio2_SquareWaveEnabled (vi, 0x4, 0x0);
  /* disable all outputs */
  for (idx = 1; idx <= 16; idx++)
  {
    sprintf(chName, "CH%d", idx);

    /* set output high level to 0 V */
    status = rspio2_ConfigureChannelLevels (vi, chName,  0.0, 0.0);

    /* select output high level */
    status = rspio2_ConfigureChannelMode (vi, chName,
                                          RSPIO2_VAL_CH_MODE_ANALOG);
    /* disconnect output channel */
    status = rspio2_ConfigureOutputMux (vi, chName,
                                        RSPIO2_VAL_OUTMUX_MODE_OPEN);
  }

  /* disconnect the rest */
  status = rspio2_DisconnectAll (vi);

  /* configure module earth free again */
  status = rspio2_ConfigureGround (vi, VI_FALSE);

  /* reset module, close the driver session */
  status = rspio2_close (vi);

  return 0;
}
```

8 Self-Test

The Analog/Digital IO Module R&S TS-PIO2 has an integrated capability for self-test. The following tests are possible:

- LED test
- Power on test
- TSVP self-test

8.1 LED test

After the system is turned on, all LEDs are lit for about three seconds. This indicates that the required power supply has been applied and all LEDs are in proper order. The following observations may be made about different display states:

LED	Description
One individual LED is not lit	– Hardware problem in the module – LED faulty
No LEDs are lit	+5 V power supply voltage missing

Table 8-1 Observations about the LED test

NOTE:

If diagnostic results indicate a faulty power supply, perform a visual inspection of the LEDs on the corresponding Rear-I/O module R&S TS-PDC. If the results confirm that the power supply voltage has failed, the R&S TS-PDC module must be replaced.

5th Issue 09.11

8.2 Power on test

The power on test runs in parallel to the LED test. If a fault is discovered in the module, the red LED will light up to indicate the fault. The test is limited to checking the cPCI interface and the firmware of the R&S TS-PIO2. Note the following statements describing the different display states of the red and green LED after the LED test has been performed:

LED	Description
PWR LED (green) on	All power supply voltages are present
PWR LED (green) off	At least one power supply of module R&S TS-PIO2 or module R&S TS-PDC is not present
ERR LED (red) off	No error is present
ERR LED (red) is lit or flashing	Hardware error is present (processor is not starting)

Table 8-2 Observations about the power on test

NOTE:

If diagnostic results indicate a faulty power supply, perform a visual inspection of the LEDs on the corresponding Rear-I/O module R&S TS-PDC. If the results confirm that the power supply voltage has failed, the R&S TS-PDC module must be replaced.

5th Issue 09.11

8.3 TSVP self-test

As part of the TSVP self test, an extensive test of the R&S TS-PIO2 module is performed and an exhaustive protocol is generated. This is done with the “Self-Test Support Library”.

The R&S TS-PSAM analog stimulus and measurement module is used as a measurement unit in the TSVP self-test. The functionality of the modules in the system is ensured by measurements via the analog bus.

First the global analog bus and then the local analog bus are tested for inadmissible voltages. After an isolation measurement between the bus lines, all the relays (coupling, matrix, multiplexer) are tested. This is followed by measurements on all accessible components of the module. Then, if possible, triggering via PXI lines is tested.

NOTE:

You can find information about starting the self-test and the order of required work steps as well as a detailed description of parameters and sequences that are tested in the R&S CompactTSVP / R&S Power TSVP Service Manual.

5th Issue 09.11

9 Interface description

9.1 Interface description R&S TS-PIO2

9.1.1 Connector X1

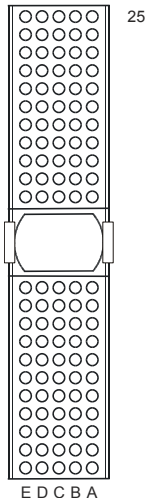

Figure 9-1 Connector X1 (view: plug side)

Pin	F	E	D	C	B	A
25	GND	+5V				+5V
24	GND				+5V	
23	GND		+5V			
22	GND				GND	
21	GND					
20	GND				GND	
19	GND		GND			
18	GND				GND	
17	GND		GND			
16	GND				GND	
15	GND		GND			
12..14						
11	GND		GND			
10	GND				GND	
9	GND		GND			
8	GND				GND	
7	GND		GND			
6	GND				GND	
5	GND		GND			
4	GND				GND	
3	GND		+5V			
2	GND				+5V	
1	GND	+5V				+5V
Pin	F	E	D	C	B	A

Table 9-1 Pin assignment for connector X1

9.1.2 Connector X20

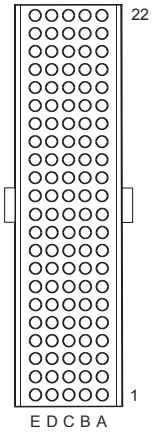

Figure 9-2 Connector X20 (view: plug side)

NC = not connected, NP = not populated

Pin	F	E	D	C	B	A
22		GA0	GA1	GA2	GA3	GA4
21					GA5	
20		+5V_IN	GND	+5V_IN		
19				+5V_IN	GND	
18		PXI_TRIG6	CAN_EN	PXI_TRIG5	PXI_TRIG4	PXI_TRIG3
17		PXI_CLK10	+5V_IN	+5V_IN	GND	PXI_TRIG2
16		PXI_TRIG7	GND		PXI_TRIG0	PXI_TRIG1
15			+5V_IN	+5V_IN	GND	
14						
13						
12	NP	+15V_IN	+18.3V_IN	+20V_IN	AGND	+30V_IN
11	NP					
10		-15V_IN			-30V_IN	AGND
9						
8		+15V_IN	+15V_IN	+15V_IN	+15V_IN	+15V_IN
7						
6		-15V_IN	-15V_IN	-15V_IN	-15V_IN	-15V_IN
5						
4						
3			RRST#		GND	RSDO
2			RSDI			RSCLK
1		+5V_IN	CAN_L	CAN_H	GND	RCS#
Pin	F	E	D	C	B	A

Table 9-2 Pin assignment for connector X20

5th Issue 09.11

9.1.3 Connector X10

Plug type DIN 41612, 96 pin, female

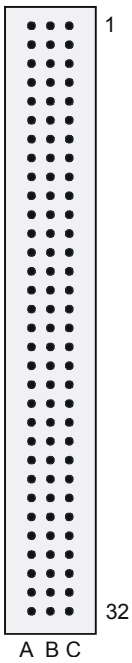

Figure 9-3 Connector X10 (view: front panel)

	A	B	C
1	CH1_OUT1	CH2_OUT1	CH3_OUT1
2	CH1_1R	CH2_1R	CH3_1R
3	CH1_1	CH2_1	CH3_1
4	CH1_2	CH2_2	CH3_2
5	LO	LO	LO
6	LO	CH4_1	CH4_SHI
7	CH4_OUT1	CH4_2	CH4_SLO
8	CH4_1R	CH6_OUT1	CH7_OUT1
9	CH5_OUT1	CH6_1R	CH7_1R
10	CH5_1R	CH6_1	CH7_1
11	CH5_1	CH6_2	CH7_2
12	CH5_2	LO	LO
13	LO	LO	CH8_SHI

Table 9-3 Pin assignment for connector X10 (view front panel)

	A	B	C
14	CH8_OUT1	CH8_1	CH8_SLO
15	CH8_1R	CH8_2	CH11_OUT1
16	CH9_OUT1	CH10_OUT1	CH11_1R
17	CH9_1R	CH10_1R	CH11_1
18	CH9_1	CH10_1	CH11_2
19	CH9_2	CH10_2	LO
20	LO	LO	LO
21	CH12_OUT1	CH12_1	CH12_SHI
22	CH12_1R	CH12_2	CH12_SLO
23	CH13_OUT1	CH14_OUT1	CH15_OUT1
24	CH13_1R	CH14_1R	CH15_1R
25	CH13_1	CH14_1	CH15_1
26	CH13_2	CH14_2	CH15_2
27	LO	LO	LO
28	CH16_OUT1	CH16_1	LO
29	CH16_1R	CH16_2	CH16_SHI
30	GND	GND	CH16_SLO
31	GND	GND	GND
32	XTO1	XTI1	CHA_GND

Table 9-3 Pin assignment for connector X10 (view front panel)

Comment:

The CHA_GND signal is connected with the front plate of the module and via two 10 nF capacitors with GND. The front plate itself has no direct connection to GND. When a test object is connected, the test object GND should be connected to GND. To avoid ripple loops, do not connect GND and CHA_GND.

5th Issue 09.11

9.1.4 Connector X30

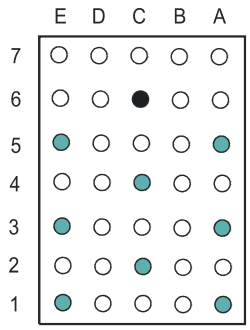

Figure 9-4 Connector X30 (view: plug side)

Pin	E	D	C	B	A
7					
6			GND		
5	ABC1				ABA1
4			ABB1		
3	ABC2				ABB2
2			ABA2		
1	ABD2				ABD1

Table 9-4 Pin assignment for connector X30

9.2 Interface description R&S TS-PDC

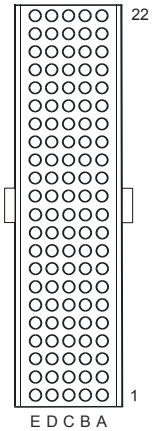

Figure 9-5 Connector X20 (view: plug side R&S TS-PDC)

Pin	Z	A	B	C	D	E	
22	GND						
21	GND		GND or NC *3)				
20	GND			+5V *1)	GND	+5V *1)	
19	GND		GND	+5V *1)			
18	GND				GND or NC *4)		J20
17	GND		GND	+5V *2)	+5V *2)		
16	GND			+5V *2)	GND		
15	GND		GND	+5V *2)	+5V *1)		
14	NC						C
13	NC						O
12	NP	+15V_1	-15V_1	+5V_1	+3.3V_1	COM_1	N
11	NP						N
10	NC	+15V_2	-15V_2	+5V_2	+3.3V_2	COM_2	E
9	NC						C
8	NC	COM_1	COM_1	COM_1	COM_1	COM_1	T
7	NC						O
6	NC	COM_2	COM_2	COM_2	COM_2	COM_2	R
5	NC						
4	NC						
3	GND		GND		RRST#		
2	GND	RSCLK			RSDI		
1	GND	RCS#	GND			+5V *1)	
Pin	Z	A	B	C	D	E	

*1) TS-PDC Version 1.0 is supplied via these pins from +5V, for backplanes up to Version 3.x
*2) TS-PDC Version 1.1 or higher is supplied via these pins or pins from *1)
*3) TS-PDC Version 1.3 or higher: This pin is not connected
*4) TS-PDC Version 1.4 or higher: This pin is not connected

Table 9-5 Pin assignment for connector X20 (R&S TS-PDC)

10 Specifications

NOTE:

Technical data for the Analog/Digital IO Module R&S TS-PIO2 and Rear-I/O module R&S TS-PDC is specified in the corresponding data sheets.
If there are discrepancies between the information in this operating manual and the values of the data sheet, the values of the data sheet take precedence.

5th Issue 09.11