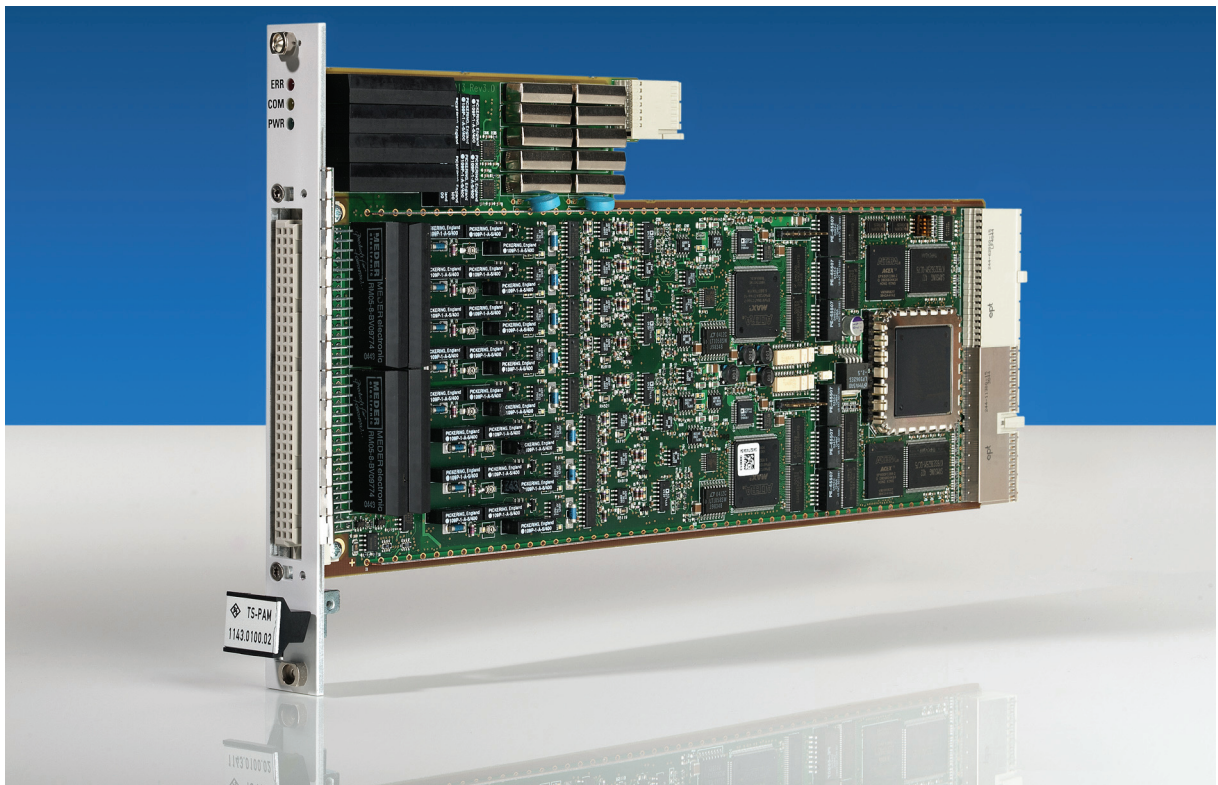




ROHDE & SCHWARZ

USER MANUAL



Analyzer Module

R&S®TS-PAM

User Manual

for ROHDE & SCHWARZ Analyzer Module R&S TS-PAM

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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 $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ to the nominal frequency.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

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

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
3. Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If the product does not have a power switch for disconnection from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
6. The product may be operated only from TN/TT supply networks fused with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages $V_{rms} > 30 \text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.

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

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).

Repair and service

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

Batteries and rechargeable batteries/cells

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

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

Transport

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

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

Waste disposal

1. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
2. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Informaciones elementales de seguridad

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

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

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







Informaciones elementales de seguridad

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

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

Símbolos y definiciones de seguridad

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

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

Palabras de señal y su significado

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



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



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



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



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

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

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

Estados operativos y posiciones de funcionamiento

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

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

Seguridad eléctrica

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

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, se deberá considerar el enchufe del cable de conexión como interruptor. En estos casos se deberá asegurar que el enchufe siempre sea de fácil acceso (de acuerdo con la longitud del cable de conexión, aproximadamente 2 m). Los interruptores de función o electrónicos no son aptos para el corte de la red eléctrica. Si los productos sin interruptor están integrados en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.
6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión $U_{\text{eff}} > 30 \text{ V}$ se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.

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

Funcionamiento

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

5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).

Reparación y mantenimiento

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

Baterías y acumuladores o celdas

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

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Mantener baterías y celdas fuera del alcance de los niños. En caso de ingestión de una celda o batería, avisar inmediatamente a un médico.
5. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.

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.

Environmental commitment

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

Cher client,

Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde&Schwarz a été homologué, entre autres, conformément aux normes 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

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1 Applications

1.1 General

This manual describes the function and operation of the Analyzer Module R&S TS-PAM (wave form analyzer) for use in the Test System Versatile Platform R&S CompactTSVP. The hardware is designed as a CompactPCI module which occupies only one slot in the front side of the TSVP. The accompanying Rear I/O Module R&S TS-PDC (DC/DC Transformer Module) is plugged into the same slot on the back side.

The following analyses are possible using the Analyzer Module R&S TS-PAM and the Signal Analysis Library:

- Voltage and voltage changes with different qualifications
- Time measurements
- Events
- Wave-form comparison

The wave form analyzer is able to record electrical signals on two measuring paths (channels) at a high sampling rate of 20 MHz or on up to eight measuring paths (channels) in the „Scan“operation (quasi simultaneous) at a the low sampling rate of 5 MHz. The signals can be evaluated after acquisition with respect to parameters such as voltage, time, frequency, events. The measurement options can, in many cases, replace a digital voltmeter (DVM), a timer/counter or a digital oscilloscope. The Analyzer Module R&S TS-PAM covers the application range above a fast sampling voltmeter (e.g. R&S TS-PSAM or data acquisition module with scanner).

A wide range of trigger options for acquisition of the correct measuring interval and automatic analysis options in the actual production environment, where no optical evaluation of the signals can take place, ensure the reproducibility of the measurements.

The Test System Versatile Platform R&S CompactTSVP TS-PCA3 allows you to plug in measuring and control modules according to industry standard CompactPCI or PXI. Apart from this, Rohde & Schwarz modules use an expanded printed circuit board format and have access to a special analog measurement bus.

1.2 Features of the R&S TS-PAM

Features R&S TS-PAM
Two fully independent, floating acquisition units with working voltage up to 125 VDC
Acquisition modes with up to 8 single-ended or 4 differential channels
High sampling rate 20 MSamples/s for two channels
Multi channel signal recording for up to 8 channels at 5 MSamples/s
Synchronous acquisition of 8 programmable comparator signals and PXI-trigger additionally
Wide dynamic range with 14 bit resolution
Input ranges ± 0.2 VDC up to ± 100 VDC (125 V max.))
3:1 relay multiplexer per channel
2 x 1 MSamples memory depth
Analog and digital trigger signals
Analog measurement bus access to 8 bus lines
Selftest capabilities
Soft front panel support for direct operation
LabWindows/CVI driver support
R&S GTSL test software library in DLL format

Table 1-1 Features R&S TS-PAM

1.3 Features of the R&S TS-PDC Module

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

- +15 VDC $\pm 5\%$, 0.5A (2x)
- -15 VDC $\pm 5\%$, 0.5A (2x)
- +5 VDC $\pm 5\%$, 0.5A (2x)
- +3.3 VDC $\pm 5\%$, 0.25A (2x)



2 View

Figure 2-1 shows the Analyzer Module R&S TS-PAM 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 .

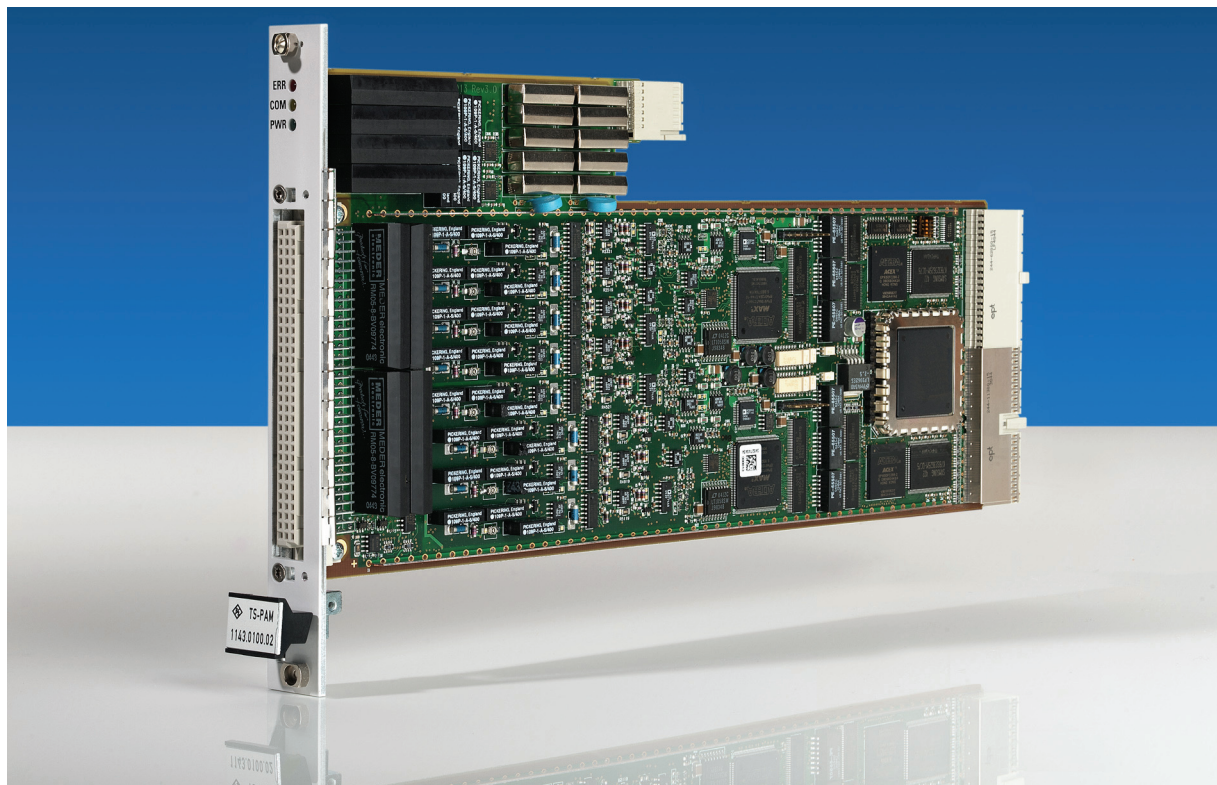


Figure 2-1 View of the R&S TS-PAM

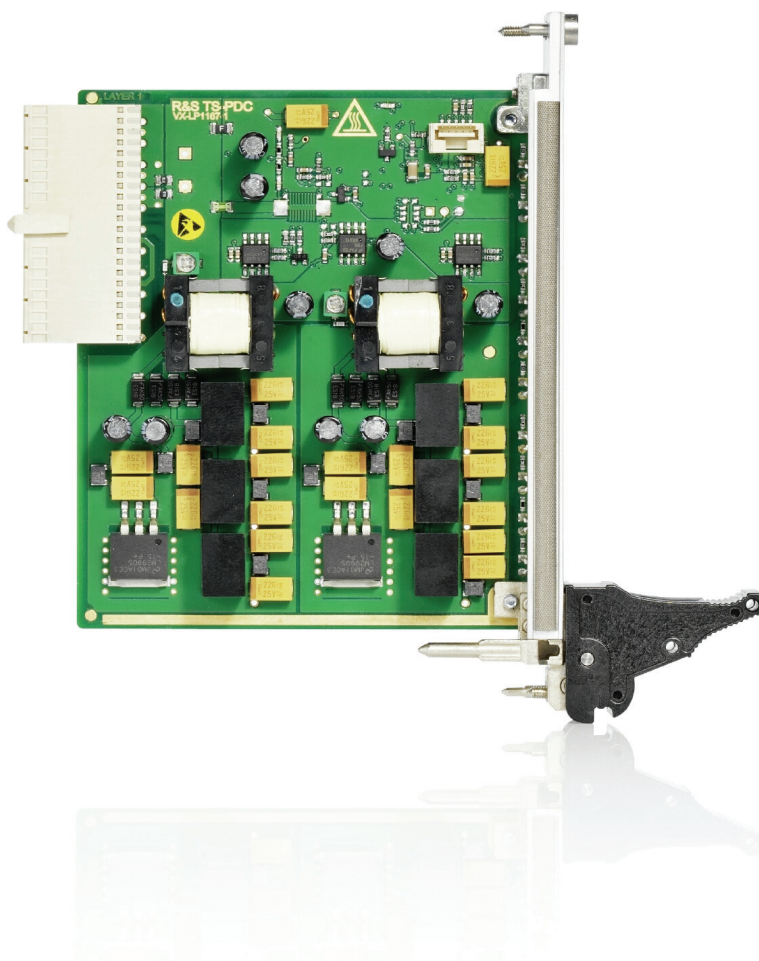


Figure 2-2 View of the Rear I/O Module R&S TS-PDC



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)

3 Block Diagram

Figure 3-1 shows the simplified functional block diagram of the Analyzer Module R&S TS-PAM and the Rear I/O Module R&S TS-PDC in the R&S CompactTSVP .

Figure 3-2 shows the block diagram of the Analyzer Modules R&S TS-PAM .

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

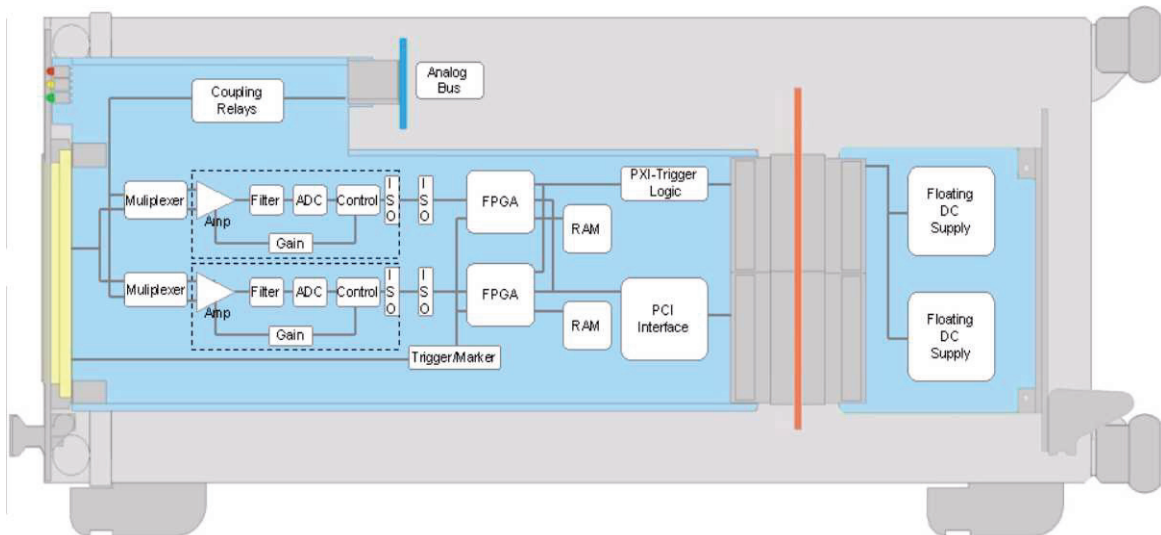


Figure 3-1 Functional block diagram of R&S TS-PAM with R&S TS-PDC in the R&S CompactTSVP

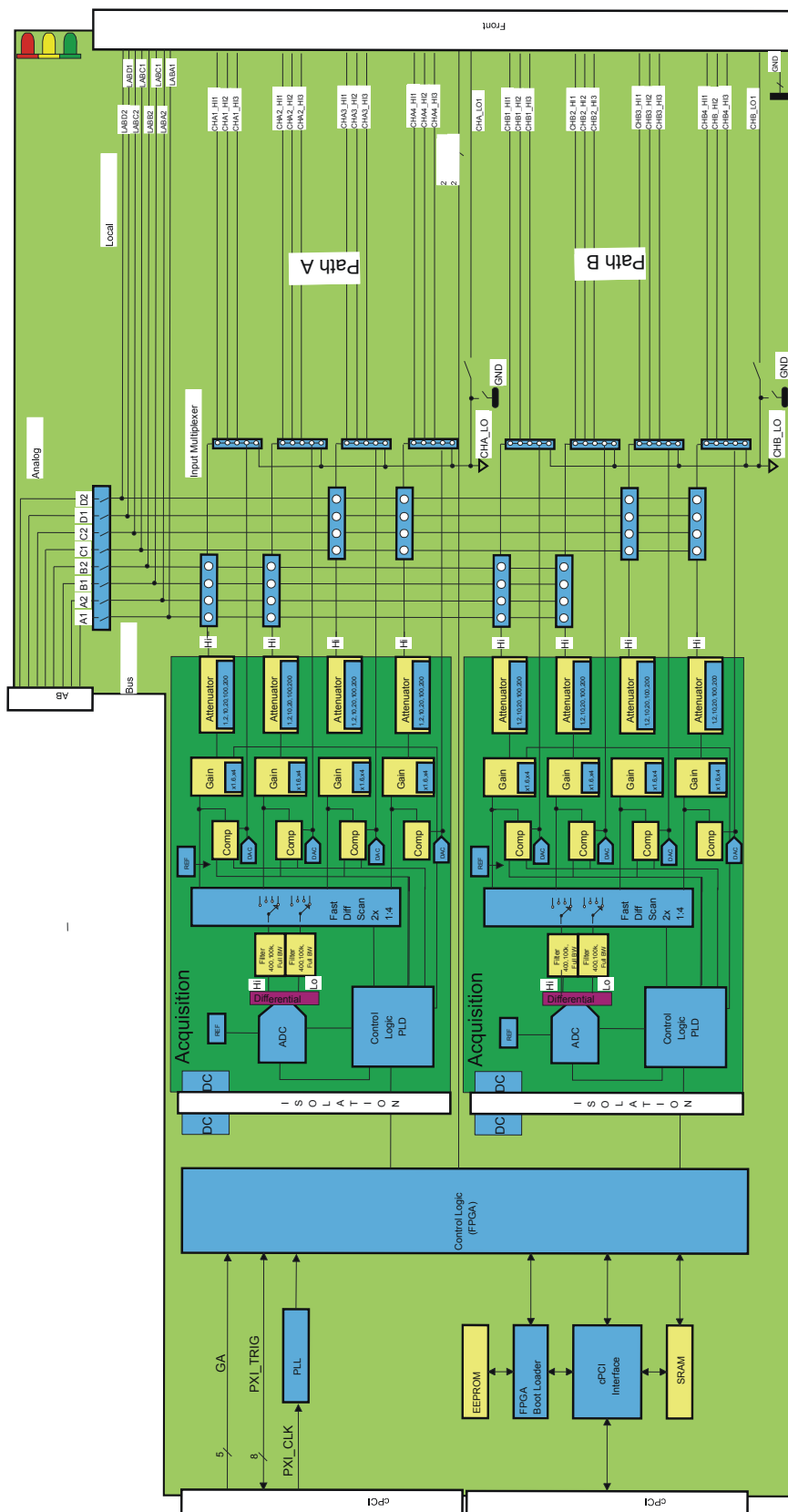


Figure 3-2 Block diagram of Analyzer Module R&S TS-PAM

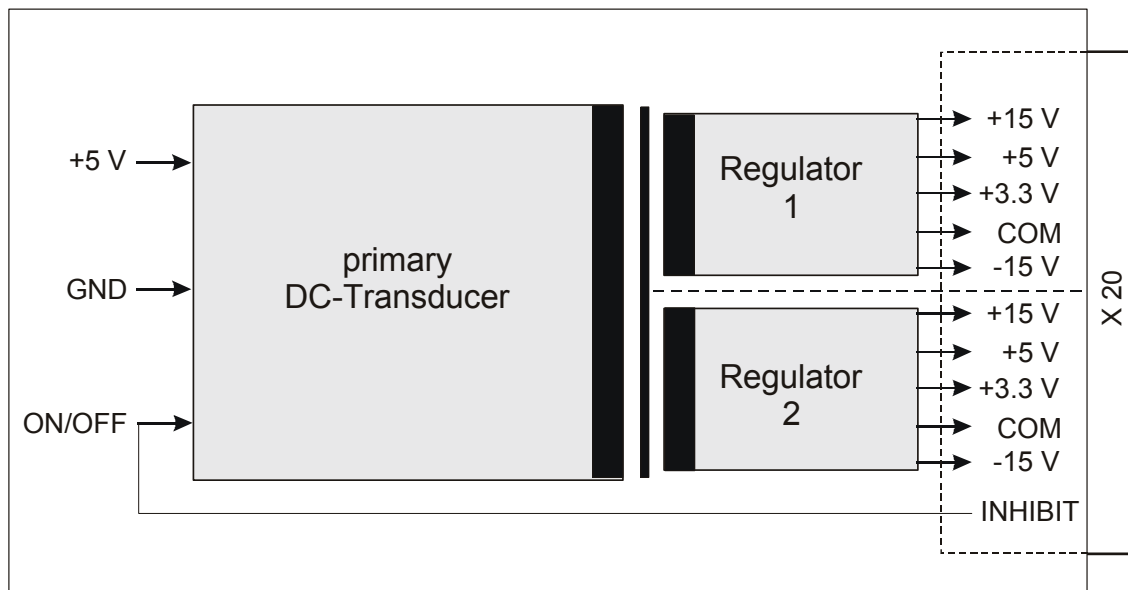


Figure 3-3 Block diagram of Rear I/O Module R&S TS-PDC



4 Design

4.1 Mechanical Design of the Module R&S TS-PAM

The Analyzer Module R&S TS-PAM is designed as a **long cPCI plug-in module** for mounting in the front of the R&S CompactTSVP. The insertion depth is 300 mm. The board height of the module is 4 HU.

In order to ensure that it is inserted correctly into the R&S CompactTSVP, the front panel is furnished with a locating pin. The module is secured in place with the two retaining screws on the front panel. Front connector X10 is used for connecting the UUTs. Connector X30 connects the R&S TS-PAM module to the analog bus backplane in the R&S CompactTSVP. The Connectors X20/X1 connect the R&S TS-PAM module to the cPCI backplane/PXI control backplane.



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



Name	Use
X1	cPCI connector
X10	Front connector
X20	cPCI connector
X30	Analog bus connector

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

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

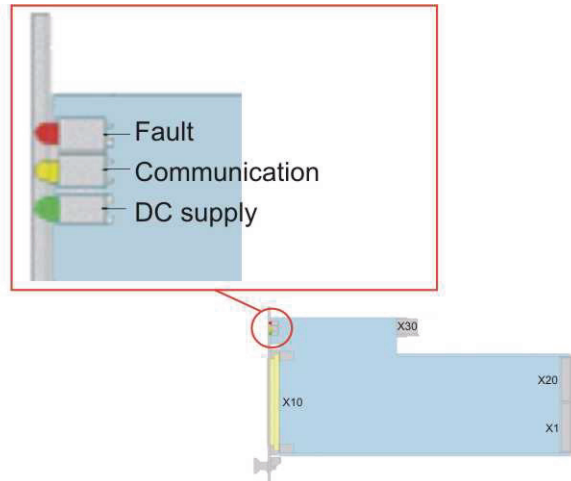


Figure 4-2 Arrangement of the LEDs on the module R&S TS-PAM

On the front side of the module R&S TS-PAM 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-PAM 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-PAM

4.3 Mechanical Design of R&S TS-PDC

The module R&S TS-PDC is a **Rear I/O Module** for insertion in the back side of the R&S CompactTSVP. The printed circuit board height of the module is 3 HU (134 mm). The module is attached with both fastening screws of the front panel. The connector X20 connects the module R&S TS-PDC with the extension back panel in the R&S CompactTSVP. The module R&S TS-PDC must always use the corresponding rear I/O slot for the main module (e.g. module R&S TS-PAM).



WARNING!

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-PAM .

If it is not correctly plugged in (e.g. cPCI/PXI standard modules in the front area) both modules may be destroyed.

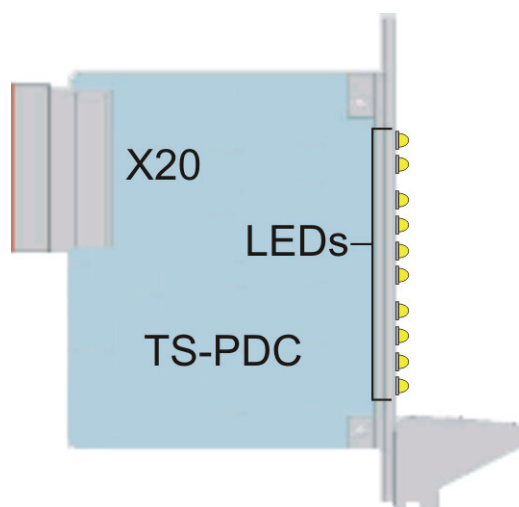


Figure 4-3 Arrangement of the connector and LEDs on the module R&S TS-PDC

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 signaled 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 signaled 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 signaled by the red LED ERR.



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



5 Description of Functions

5.1 Description of Functions of the Module R&S TS-PAM

The Analyzer Module R&S TS-PAM is a signal analyzer similar to a multi-channel digital storage oscilloscope (DSO). It has two acquisition units, which can be operated separately or synchronized. Thus, the R&S TS-PAM functions as two separate digital oscilloscopes or as a digital oscilloscope with twice the number of channels. The two acquisition units are separated according to control/software as well as potential. Because each path is floating, each path can be connected to a different potential and measured there with high accuracy of measurement. Naturally the paths can also be grounded, as with digital oscilloscopes.

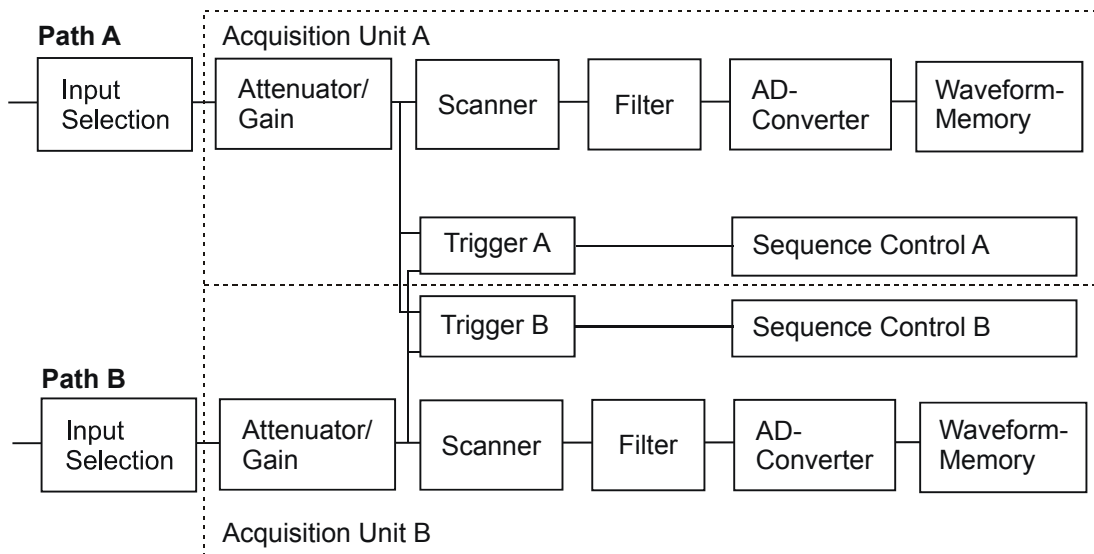


Figure 5-1 Functional blocks of R&S TS-PAM

5.1.1 Acquisition Unit

Each acquisition unit has four channels with individually adjustable gain.

In single-channel mode, two channels or one channel and the floating reference potential can be statically selected. The A/D converter measures the difference signal with maximum sample rate. With two acquisition units, two signals with conversion rates up to 20 MHz can be re-

corded, which corresponds to a sampling period of 50 ns.

In multi-channel mode, two to four signals of a path can be quasi-simultaneously acquired. The channels are scanned and recorded with time offset. At the maximum sampling frequency of 20 MHz, the effective sampling frequency for four acquisition channels is 5 MHz, the interval delta time (offset) is 50 ns. You can select whether the difference between individual channels or the difference of the channels against the floating reference potential is to be measured. With two acquisition units, a total of eight channels can be simultaneously recorded.

Because in most cases, the floating potentials can serve as a reference or even be measured single-ended against GND, all eight channels can be used and there is seldom need to take the difference between two channels. The reference potential of a path is connected to GND or different reference potential of the unit under test. With particularly sensitive units under test, it is possible that the test signal may be distorted if the reference potential of a path is connected directly to the unit under test (cause: The reference potential has a higher capacitance and higher leakage current to GND compared to an input). This can be avoided by using two channels of a unit and measuring fully differential with two high-impedance inputs.

In the standby state after software initialization, each acquisition unit is connected to GND through a relay and a resistor, for reasons of signal technology. During floating operation, this relay is automatically opened when a connection is made to a front connector pin or to the analog bus. During grounded operation, when the GND relay remains closed, care must be taken that the relay and resistor are not overloaded.

5.1.2 Inputs and Measurement Ranges

Each measuring channel can be switched with relays to three input channels, to four lines of the local analog bus LABxy, to the reference potential CHA_LO or CHB_LO or to the analog output for the trigger threshold of the comparator. If the local analog bus line is used as an additional input, $4 \times 8 = 32$ pins on the connector X10 can be measured without having to use a relay in the adapter or an additional plug-in card.

If the local analog bus LAB is connected with the global analog bus AB, up to eight channels can be simultaneously measured and there is access to an almost unlimited number of measuring points (90 channels per plug-in module R&S TS-PMB). Here too, single-ended and differ-

ential measurements are possible.

Each measuring channel has a programmable input divider and measurement amplifier. With nine measurement ranges from 0.2 V to 100 V, small to high voltages can be optimally acquired with 14 bit resolution. In the small measurement ranges, instead of the normal input impedance of 1 M Ω , higher impedances can be measured. Because the floating measuring technique is used, the measuring accuracy of the small ranges is also possible for small signals on high potential.

The maximum permitted rated voltage between arbitrary pins is 125 V.

Measurement range	Resolution	Input impedance
± 100 V	15 mV	1 M Ω
± 50 V	7.5 mV	1 M Ω
± 20 V	3 mV	1 M Ω
± 10 V	1.5 mV	1 M Ω
± 5 V	0.75 mV	1 M Ω or >10 M Ω selectable
± 2 V	0.3 mV	1 M Ω or >10 M Ω selectable
± 1 V	0.15 mV	1 M Ω or >10 M Ω selectable
± 0.5 V	75 μ V	1 M Ω or >10 M Ω selectable
± 0.2 V	30 μ V	1 M Ω or >10 M Ω selectable

Table 5-1 Measurement ranges

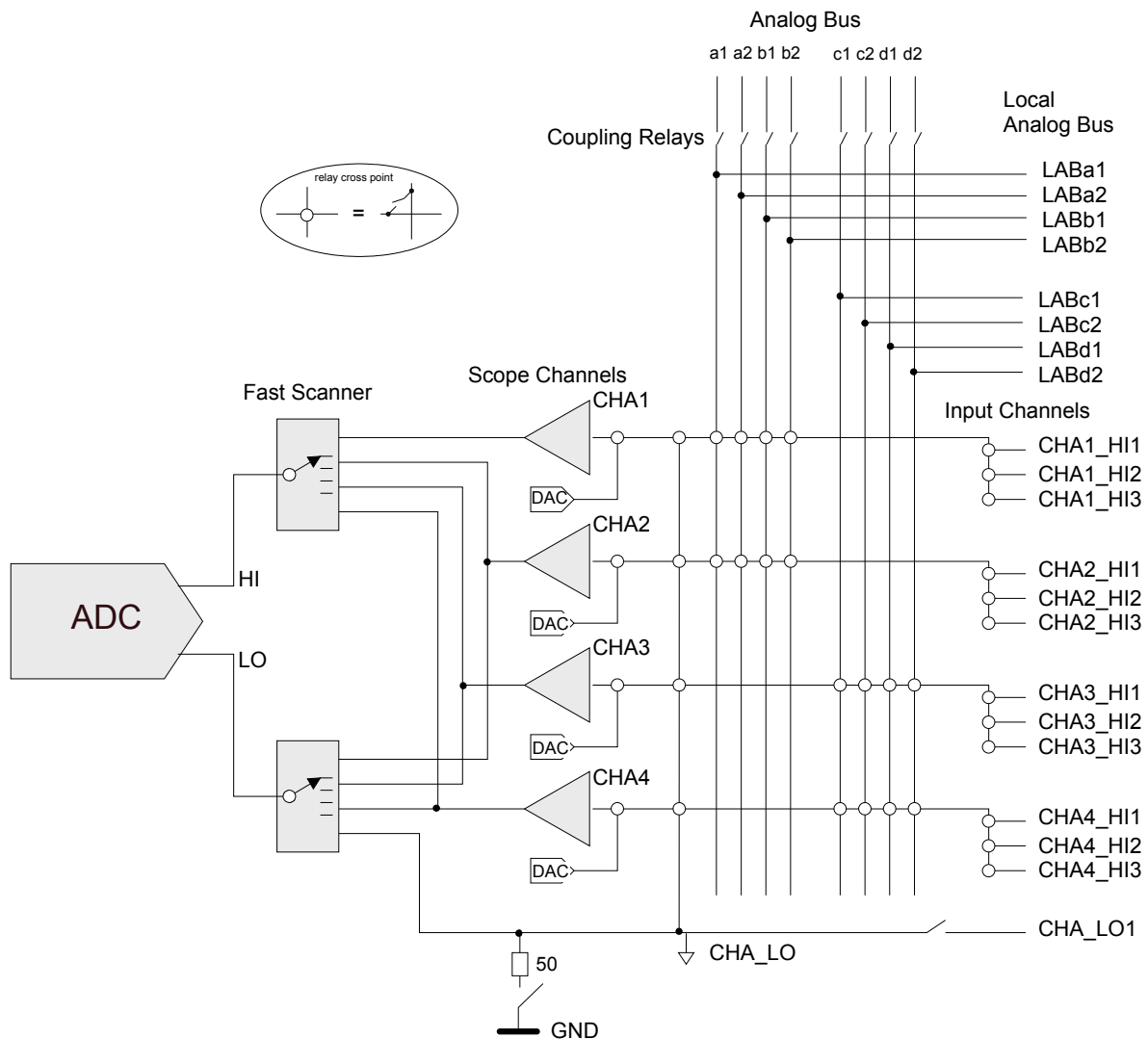


Figure 5-2 Signal inputs and scanner of an acquisition unit (path A)

Signals can be recorded within the input bandwidth. Similarly to digital oscilloscopes, no anti-aliasing filter is provided. For signal conditioning, hardware low pass filters can be connected in series.

The inputs are DC coupled. An AC coupling can be done by connecting an external capacitor in series. The time constant is optimized by the appropriate selection of R and C on the measuring frequency and the desired transient time.

Four programmable analog sources (DAC) per acquisition unit set the trigger threshold of the comparators of each channel and can be connected as a control voltage source for the self-test to the analog bus. The programming is according to the value of the trigger threshold and

the set measurement range.

5.1.3 Timing Control, Scanner

The sampling rate can be varied so that slow or fast signals are optimally acquired and stored in the wave form memory. Because the timing of each acquisition unit can be independently set, slow and fast signals can be simultaneously optimally acquired, which results in a considerably better use of the wave form memory and effectively increases its depth.

Depending on whether the single-channel or multi-channel operating mode is used, the sampling rate can be max. 20 MHz or 5 MHz.

The precise time reference is derived from the 10 MHz PXI clock of the Test System Versatile Platform R&S CompactTSVP.

5.1.4 Synchronization, Trigger

Each acquisition unit can be started through the software, through the test signals, external trigger inputs or PXI trigger inputs (from other modules). For triggering through the test signals, analog comparators with programmable threshold and selectable flanks are used.

Trigger output signals can trigger other modules on the front connector X10 or on the PXI trigger bus. Through the pins XTO1 and XTO2, the trigger time points of both acquisition units or the eight analog trigger signals can be fed out. These signals can also be fed to the eight PXI trigger lines.

The acquisition units can begin the recording synchronously, independently or initiated by the other acquisition unit. The storage in the wave form memory can be done pre- or post-trigger.

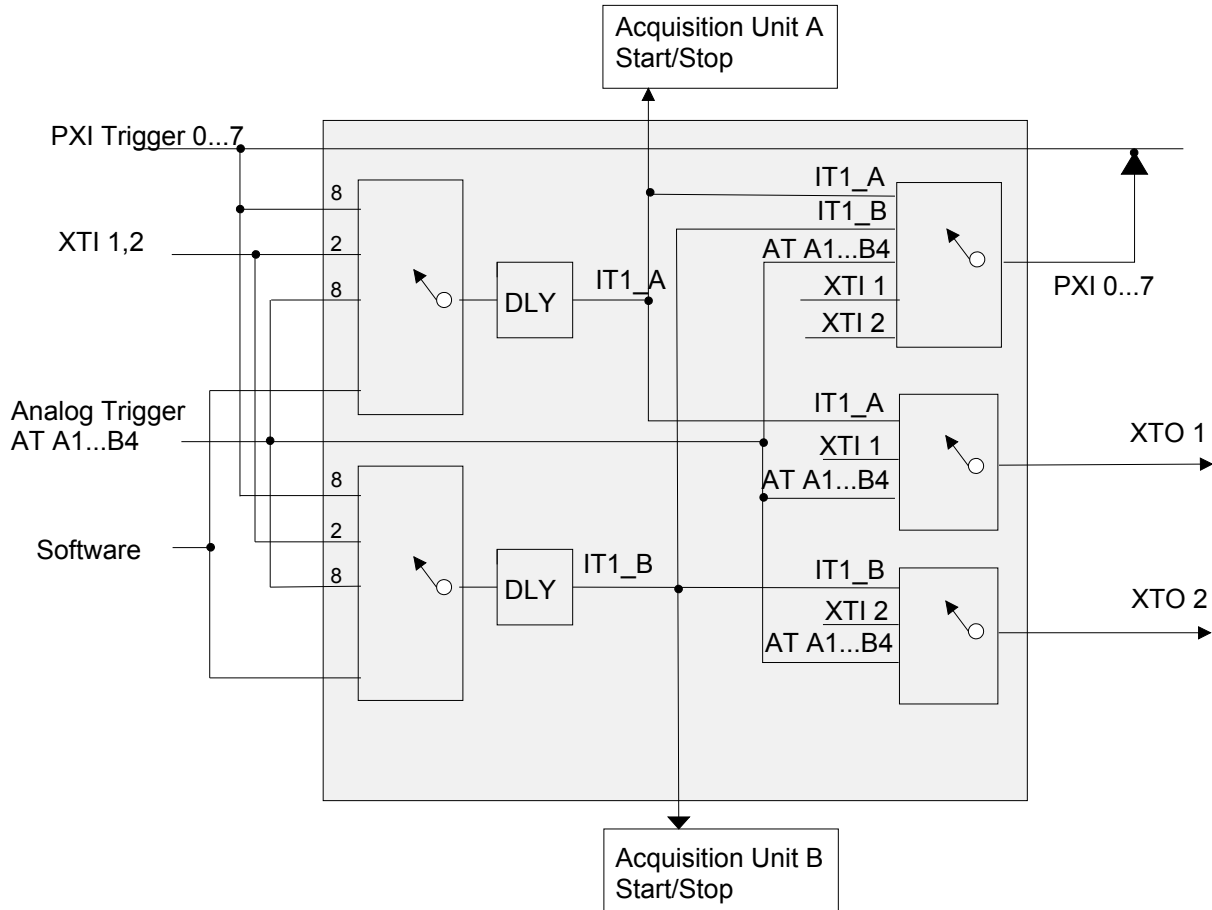


Figure 5-3 Trigger unit

5.1.5 Memory

The wave form memory contains 1 MSamples (of 32 Bit width) per acquisition unit. This means that in the single-channel mode, two channels (each acquisition unit) can record a maximum of 1 MSamples each. In the multi-channel mode, eight channels up to a depth of 256 ksamples each can be measured. In addition to the analog values, the trigger information from the PXI-Bus and the analog comparators is also recorded.

5.1.6 Signal processing, Filter

The measuring channels are broadband and have, like digital oscilloscopes, no specific anti-aliasing filters. For noise suppression, a 100 kHz or 400 Hz filter can be connected in the path. It has to be observed that the filters are arranged behind the measuring scanner. The filters only function correctly if the filter cut-off frequency is distinctly higher than the scan frequency. Otherwise, a distortion of the measurement value can occur up to an identical test signal of all channels.

An additional filtering can be obtained with the digital filter (low pass filter with cut-off frequency $0.2 \times$ sampling frequency).

Additional special filter features can be implemented with software by processing of the waveform arrays with commercially available programs.

5.1.7 Analog Bus Access

Each input channel has direct access to four local analog bus lines and through coupling relays to the global analog bus. Thus, a total of eight channels can be simultaneously connected to the analog bus. Instead of an input channel, the floating reference potential CHA_LO or CHB_LO can be switched to the analog bus. In this way, the measuring channels can measure signals from other switch modules, and signals to the connector X10 can also be connected to other measuring modules.

When there is signal feed through the analog bus and other cards, it must be noted that the best signal quality is obtained only for short signal paths. Signals to the connector X10 can therefore be best measured.

5.1.8 Measuring Functions

The acquisition units can record analog signals and at the same time digital trigger signals within a given time. An analysis of the wave forms can be done with the Signal Analysis Library (see Software Analysis Library in Section 7.3).

5.1.9 Particulars of Floating Measurements

To make optimum use of the possibilities of floating measurement of R&S TS-PAM, it is important to look at the grounding. The unit under test **or** the measuring instrument must be grounded in order to obtain reproducible, stable measuring results. Only with very slow measuring techniques (battery operated hand multimeters) the hum can be equalized by decelerating averaging. For fast and accurate measurements, one must give some thought to the grounding. It is important here to only provide a single grounding point. See examples Figure 5-4 to Figure 5-8 .

a) Simple Single-ended Grounding

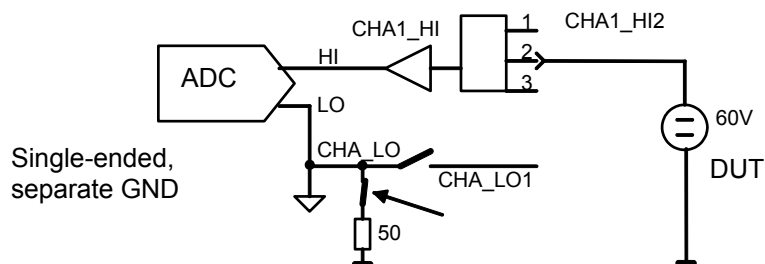


Figure 5-4 Grounding procedure “Simple Single-ended Grounding”

In the simplest case (Figure 5-4) with low accuracy requirements, grounding is done “somewhere”, i.e. the unit under test is grounded in the fixture, the measuring unit is internally connected to GND.

Advantage: Only the test signals are considered; the grounding is connected in some way. The connection becomes very simple. If the signals are fed through the analog bus, you save one bus line for the GND.

Disadvantage: Low accuracy, particularly for signals in the magnitude of 100 mV and lower.

When there is a small difference in the grounding potentials, transient currents flow which distort the measurement. The LO input of the measuring unit is not arbitrarily low resistant but connected to ground through approx. 50 Ω ; faults up to 50 mV can be caused by derivative currents. This type of connection has the hidden danger that one may inadvertently place a grounded voltage on CHA_LO. Thus, there may be a higher current which destroys the relay con-

tacts. Therefore, there is here a PTC resistor with a approx. $50\ \Omega$ resistance built in, which limits this current. However, it must be ensured that neither the max. current of the GND relay (500 mA) nor the switching power of 15 W are exceeded.

Measurement a) is used for digital oscilloscopes and non-differential A/D converter cards. There is no option to separate the acquisition unit from GND for these devices.

b) Single-ended, Grounding on the Unit under Test

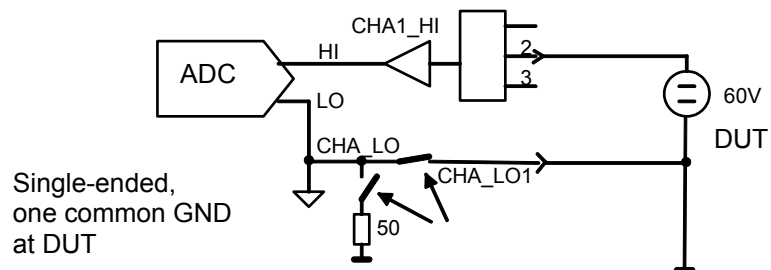


Figure 5-5 Grounding procedure “Single-ended, Grounding on Unit under Test”

With this wiring (Figure 5-5), the floating character of the acquisition unit of R&S TS-PAM is used to ground only on the low-resistance ground point of the unit under test (grounding only on one point).

Advantage: Accurate measurements even at low voltages, no ground loops or potential differences, because there is only a single ground point.

Disadvantage: The CHA_LO must be specifically connected with relays and wired in the fixture. When there is signal feed through the analog bus, an additional bus line is necessary.

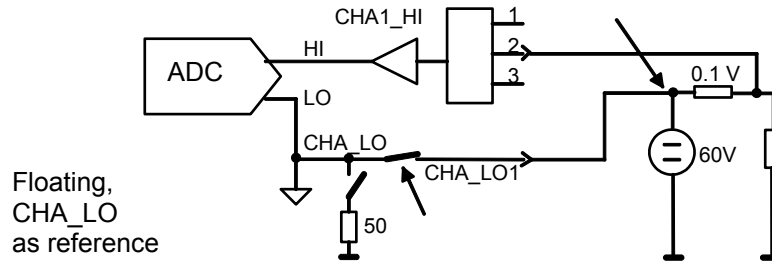
c) Floating with Potential as Reference


Figure 5-6 Grounding procedure “Floating with Potential as Reference”

With this wiring, (Figure 5-6) the measuring unit can be operated on a deviating, higher potential (instead of being grounded).

Advantage: Despite a voltage of 60 V e.g. , the smallest ranges and not the 100-V range can be used to measure the current. The common mode suppression is nearly ideal using the floating measuring technique.

Disadvantage: The „cold“ connection CHA_LO is not exactly equal to the „hot“ signal connection (CHA1_HI2). The LO connection has a greater capacity (to the order of 1 nF) to ground and exhibits greater leak currents between LO and GND. In most cases this capacity can change the signal on the unit under test. Therefore LO must be applied to a low resistant point of the unit under test. In the example of the current measurement by the voltage drop at a resistor, this is the side facing the source.

Digital oscilloscopes and non-differential A/D converter cards must use two channels for this. Otherwise, they can only measure in the inaccurate large measurement ranges (60 V). Even differential A/D converter cards must use the large measurement ranges and lose accuracy.

d) Differential measurement with two Channels

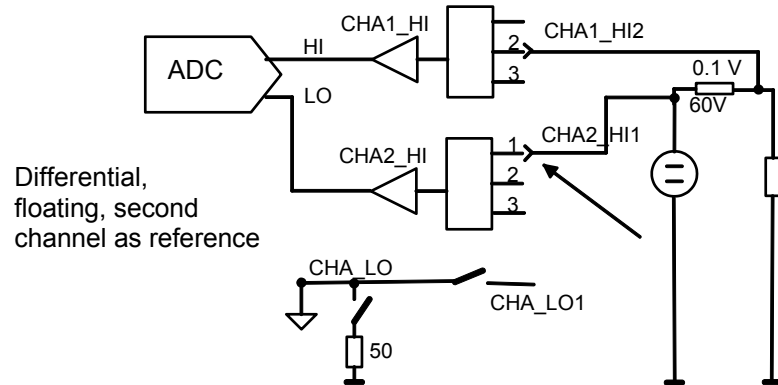


Figure 5-7 Grounding procedure “Differential Measurement with two Channels”

Similarly to c), with this wiring (Figure 5-7), measurement can be done on a different potential. However, a high-resistance separate channel with low capacitance is used as reference.

For reproducible measurements the input ranges with $1\text{ M}\Omega$ input resistance must be used. This resistance must be selected specifically in the small measuring ranges.

Reason: Since the acquisition unit is operated here without direct reference potential, leak currents of the operational amplifier cannot otherwise flow to the reference potential CHA_LO.

Advantage: The high-resistance input from CHA2_HI1 distorts the signal on the unit under test very little. Measurement can be done in the more accurate small measurement ranges.

Disadvantage: An additional channel is necessary.

e) **Differential Measurement at High Reference Potential**

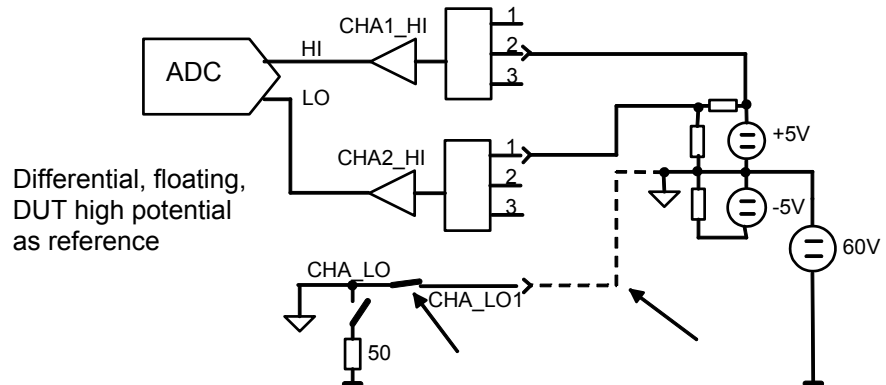


Figure 5-8 Grounding procedure “Differential Measurement at High Reference Potential”

The wiring as in Figure 5-8 is optimally suited when a unit under test has a larger portion of the circuit at a higher reference potential than the other grounded circuit. The reference potential of the acquisition unit is connected to the reference potential of unit under test (60 V in the example, broken line).

Advantage: All measurements can be carried out in the small, more accurate measurement ranges. Single-ended measurements against the reference potential or differential measurements between various signals of the high potential can be carried out. Fewer analog bus lines are necessary.

Disadvantage: It must be noted which signals belong to the high reference potential and a line for this provided. There is danger of a short circuit between GND and high reference potential.

It must be ensured that one does not inadvertently close the GND relay and thus cause a short circuit.

5.1.10 Information for Operation with Dangerous Voltages

The following voltages are considered “dangerous live” under EN 61010-1.

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



CAUTION!

When operating the Analyzer Module R&S TS-PAM above these voltage limits, the instructions under EN 61010-1 must be followed.

The Analyzer Module R&S TS-PAM and the Test System Versatile Platform R&S CompactTSVP are designed for a maximum voltage of 125 V between floating measuring components, analog buses and GND. It must be ensured that this limit is not exceeded at any time, even at summation of the voltages, even through alternating signals.

Figure 5-9 shows some typical permissible voltage configurations between analog buses and ground.

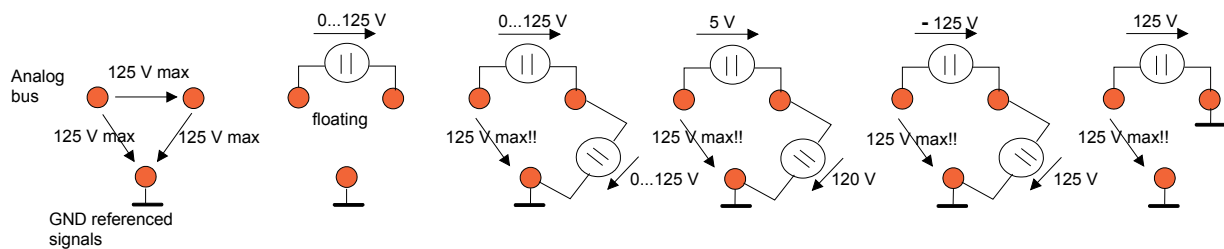


Figure 5-9 Permitted voltages on analog bus lines

For reasons of fire safety, it is recommended in EN 61010-1 that for DC-sources, the current or the rating be limited to 150 VA.



5.1.11 Power Supply

The digital portion of the Analyzer Module R&S TS-PAM is supplied with power of +5 V and +3.3 V of the CompactPCI Bus. The two floating measuring portions are each supplied with a set of floating voltages, +5 V, +3.3 V, +15 V, -15 V from the rear I/O module R&S TS-PDC (DC/DC converter). The associated capacity is taken from the 5-V-CompactPCI supply.

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)

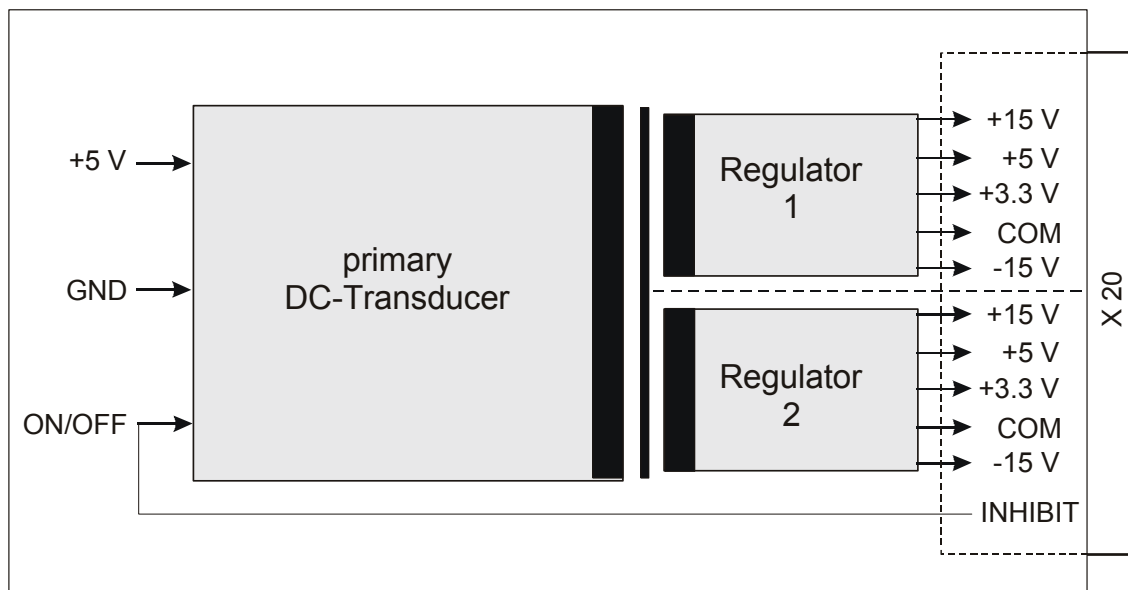


Figure 5-10 Block schematic diagram of Rear I/O Module R&S TS-PDC



6 Commissioning

6.1 Installation of the Plug-in Module

- Power down and switch off the R&S CompactTSVP.
- Select a suitable front slot (slots 5-15 possible).
- Remove the corresponding front panel portion from the TSVP chassis by loosening the two screws.


WARNING!

Check the backplane connectors for bent pins! Any bent pins must be straightened!

Failure to do this may permanently damage the backplane!

- Apply moderate pressure to insert the plug-in module (use locating pin to attach).


WARNING!

To insert the plug-in module, use both hands to guide carefully into the backplane connectors.

- The module is correctly located when a distinct “stop” can be felt.
- Tighten the two retaining screws on the front panel of the module.


WARNING!

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

6.2 Installation of the Module R&S TS-PDC

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

- The R&S TS-PAM module must have been installed beforehand.
- Select the corresponding rear I/O slot for the R&S TS-PAM module.
- Remove the corresponding rear panel portion from the R&S CompactTSVP chassis by loosening the two screws.



WARNING!

**Check the backplane connectors for bent pins! Any bent pins must be straightened!
Failure to do this may permanently damage the backplane!**

- Push in the plug-in module using moderate pressure.



WARNING!

To insert the plug-in module, use both hands to guide carefully into the backplane connectors.

- 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.
- The module is correctly located when a distinct “stop” can be felt.
- Tighten the two retaining screws on the front panel of the module.

7 Software

7.1 Driver Software

For the functions of the signal recording of the Analyzer Module R&S TS-PAM, a LabWindows IVI SCOPE driver is available. All other functions of the hardware are served by specific extensions of the driver. The driver is a component of the ROHDE & SCHWARZ GTSL software. All functions of the driver are fully documented in the online help and in the LabWindows/CVI Function Panels.

During driver installation, the following software modules are installed:

Module	Path	Comment
rspam.dll	<GTSL directory>\Bin	Driver
rspam.hlp	<GTSL directory>\Bin	Help file
rspam.fp	<GTSL directory>\Bin	LabWindows CVI Function Panel file, function panels for CVI development interface
rspam.sub	<GTSL directory>\Bin	LabWindows CVI attribute file. This file is required by some „function panels“.
rspam.lib	<GTSL directory>\Bin	Import Library
rspam.h	<GTSL directory>\Include	Header file for the driver

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



NOTE:

To use the driver, the IVI and VISA libraries from National Instruments are necessary.

7.2 Soft Panel

For the Analyzer Module R&S TS-PAM, there is a Soft Panel available (Figure 7-1). The Soft Panel is based on the LabWindows CVI driver. The Software Panel enables interactive operation of the module. The measured values are displayed graphically.

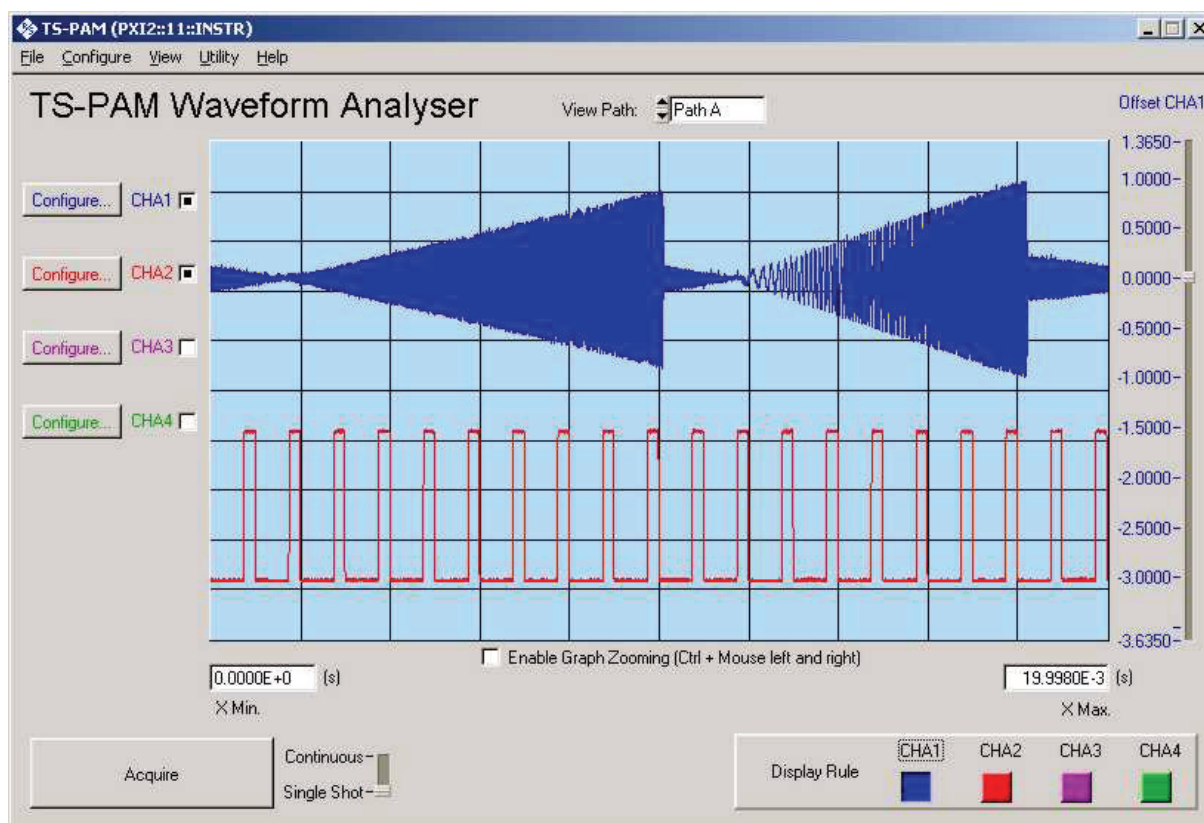


Figure 7-1 Soft Panel R&S TS-PAM

The switching of the signal path of R&S TS-PAM can be done through the Soft Panel (Figure 7-2).

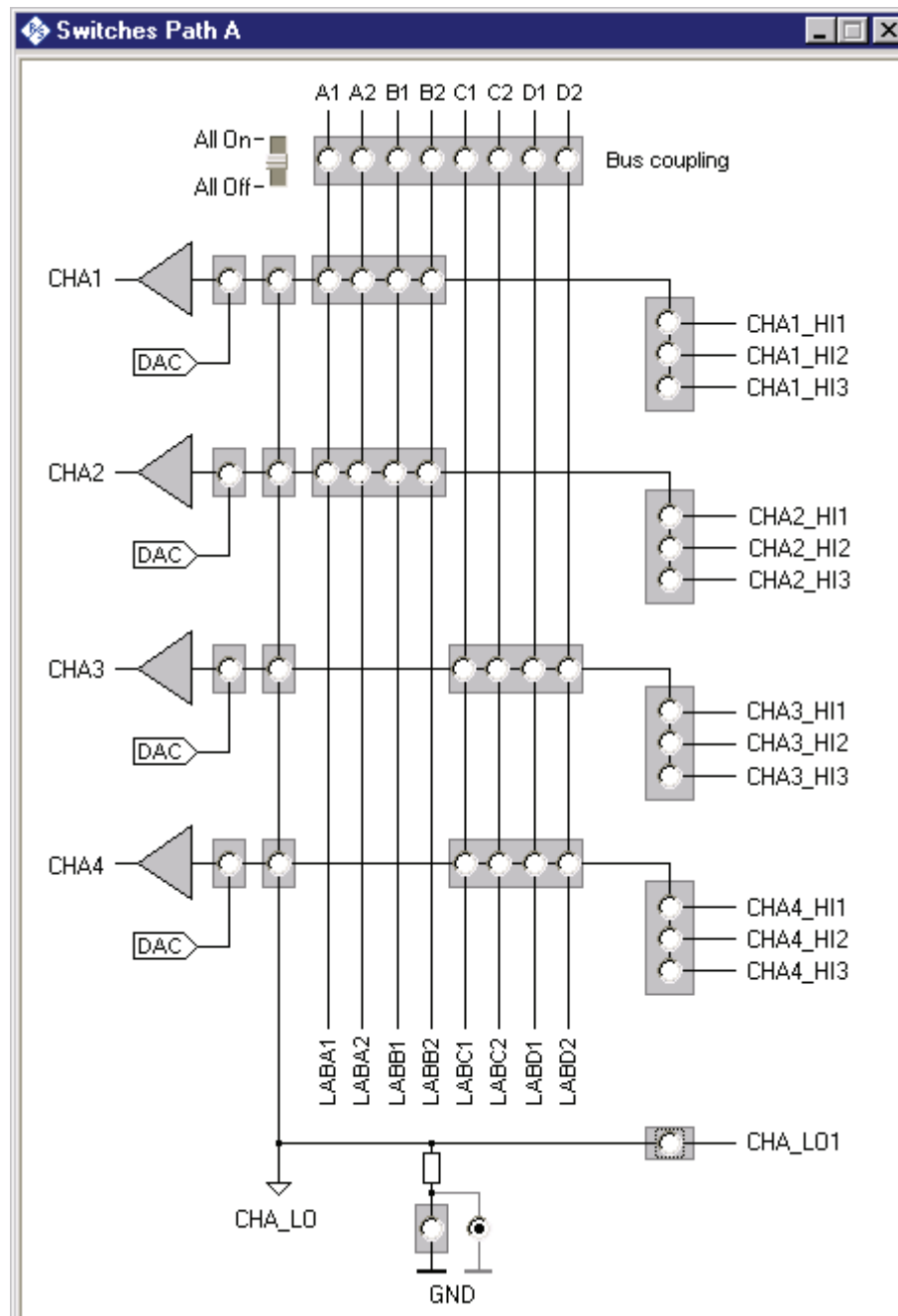


Figure 7-2 Soft Panel R&S TS-PAM switching

7.3 Signal Analysis Library

The Signal Analysis Library offers functions for the analysis of the signals recorded by the Analyzer Module R&S TS-PAM . The following signal parameters can be determined:

- Frequency, period
- Average value, RMS
- Rise and fall times
- Pulse width
- Maximum and minimum values (absolute and relative maxima/minima)
- Event counting (slopes, minima, maxima)
- Time measurement between two events

In addition, the Signal Analysis Library offers the following functions:

- Wave form comparison
- Calculation of reference wave forms
- Loading and saving of the wave forms as files
- Display of signal waves with reference curves and markers

Module	Path	Comment
siganl.dll	<GTSL directory>\Bin	Driver
siganl.hlp	<GTSL directory>\Bin	Help file
siganl.fp	<GTSL directory>\Bin	LabWindows CVI Function Panel file, function panels for CVI development interface
siganl.lib	<GTSL directory>\Bin	Import Library
siganl.h	<GTSL directory>\Include	Header file for the driver

Table 7-2 Installation of the signal analysis library

The analysis of audio signals is possible with the Audio Analysis Library R&S TS-LAA. This library offers the following functions:

- RMS calculation
- Single/Multitone frequency response
- Distortion factor
- Filter (low-pass, high-pass, band-pass, band-stop, CCIR weighted/unweighted)

- Windowing of the signal

7.4 Programming example R&S TS-PAM

The following sample program shows the recording of a signal which contacts the connections CHA1_HI1 and CHA_LO1 on the front side connector.

```
/*

This sample shows the acquisition of analog wave forms
using the TS-PAM module.

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 <userint.h>

#include "rspam.h"

int main (int argc, char *argv[])
{

    ViSession vi;
    ViStatus status;

    ViReal64 * pWaveform = VI_NULL; /* pointer to wave form array */
    ViInt32 actualPoints; /* number of samples returned from */
    ViReal64 initialX; /* time of the first sample, relative
                        to the trigger event */
    ViReal64 xIncrement; /* time between two samples */

    /*
    Open a session to the device driver. The resource descriptor
    depends on the slot number of the TS-PAM module and must be
    adapted to the target system.
    */
    status = rspam_InitWithOptions ( "PXI1::13::0::INSTR",
                                    VI_TRUE,
                                    VI_TRUE,
                                    "Simulate=0,RangeCheck=1",
                                    &vi);

    /*
    Configure the acquisition time base for path A:
    Take a minimum of 20000 samples in 1 ms
    - Sample frequency is 20 MHz
    - Trigger delay = 0, i.e. no pre- or post-triggering
    */
    status = rspam_ConfigureAcquisitionRecordPath (vi, RSPAM_VAL_PATH_A,
                                                    1.0e-3, 20000, 0.0);

    /*
    Configure channel CHA1 for a signal between -5 V and + 5 V.
    The vertical range is 10 V (peak-to-peak), the offset is 0 V.
    */
    status = rspam_ConfigureChannel (vi, "CHA1", 10.0, 0.0,
                                    RSPAM_VAL_DC, 1.0, VI_TRUE);

    /*
```



```
    Configure channel CHA1 for 1 MOhm impedance, no lowpass filter
*/
status = rspam_ConfigureChanCharacteristics (vi, "CHA1", 1.0e6, 20.0e6);

/*
    Configure the trigger:
    - Edge trigger
    - Trigger level 2.5 V, positive slope
*/
status = rspam_ConfigureTriggerPath (vi, RSPAM_VAL_PATH_A,
                                     RSPAM_VAL_EDGE_TRIGGER );

status = rspam_ConfigureTriggerSourcePath (vi, RSPAM_VAL_PATH_A,
                                           "CHA1", 2.5,
                                           RSPAM_VAL_POSITIVE);

/*
    Configure the path for floating acquisition
*/
status = rspam_ConfigureGroundPath (vi, RSPAM_VAL_PATH_A, VI_FALSE);

/*
    Connect the instrument to the front connector
    and wait until all relays have been closed
*/
status = rspam_Connect (vi, "CHA1_HI", "CHA1_HI1");
status = rspam_Connect (vi, "CHA_LO", "CHA_LO1");
status = rspam_WaitForDebounce ( vi, 1000 );

/*
    Get the actual number of points for the acquisition and allocate
    memory for it. Note that this value may be greater than the minimum
    number of samples requested above.
*/
status = rspam_ActualRecordLengthPath (vi, RSPAM_VAL_PATH_A,
                                       &actualPoints);
pWaveform = calloc (actualPoints, sizeof(ViReal64));

/*
    Start the acquisition
    - Timeout is 1000 ms
*/
status = rspam_ReadWaveform (vi, "CHA1", actualPoints, 1000,
                             pWaveform, &actualPoints, &initialX,
                             &xIncrement);

/*
    Display the wave form
*/
status = WaveformGraphPopup ("Waveform", pWaveform, actualPoints,
                             VAL_DOUBLE, 1.0, 0.0, initialX,
                             xIncrement);

/*
    Close the driver session
*/
status = rspam_close ( vi );

/*
```



```
    free memory
*/
free ( pWaveform );

return 0;
}
```



8 Self-test

The Analyzer Module R&S TS-PAM has integrated self-test capability. The following tests are possible:

- LED Test
- Power-on test
- Self-test by the driver

8.1 LED Test

When the device is switched on, all three LEDs are lit for about one second. This indicates that the 5 V supply voltage is present and all LEDs are working, also that the power-on test was successful. The following statements can be made about the different LED statuses in this power-on phase:

LED	Description
One LED does not light up	Hardware problem on the module LED faulty
No LED's light up	No +5V supply

Table 8-1 Statements about the LED Test



NOTE:

If diagnostics suggest a problem with the supply voltage, the LEDs for the associated rear I/O module, R&S TS-PDC, must be inspected visually. If a supply voltage failure is confirmed, the R&S TS-PDC module must be replaced.

8.2 Power-on test

The power-on test runs at the same time as the LED test. In this test, the result of the FPGA loading process is calculated. The following statements can be made about the different statuses of the red and green LEDs:

LED	Description
Green LED on	all supply voltages present
green LED off	at least one supply voltage from R&S TS-PAM module or the R&S TS-PDC module is not present
red LED off	no errors were detected
red LED on	The FPGA/μP was not successfully loaded

Table 8-2 Statements about the power-on test



NOTE:

If diagnostics suggest a problem with the supply voltage, the LEDs for the associated rear I/O module, R&S TS-PDC, must be inspected visually. If a supply voltage failure is confirmed, the R&S TS-PDC module must be replaced.

8.3 Self-test by the driver

The driver which is supplied has a more extensive self-test. It is started through the standard self-test function and delivers a “PASS” or “FAIL” result.

In the TSVP self-test, a test report is generated.



NOTE:

Information on starting the self-test and on the sequence of the necessary steps can be found in the R&S GTSL software description or the R&S GTSL online help.

9 Interface Description

9.1 Interface Description R&S TS-PAM

9.1.1 Connector X1

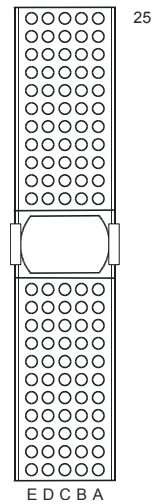


Figure 9-1 Connector X1 (view: plug side)

Pin	F	E	D	C	B	A	X1 C O N N E C T O R
25	GND	5V	3.3V	ENUM#	REQ64#	5V	
24	GND	ACK64#	AD[0]	V(I/O)	5V	AD[1]	
23	GND	AD[2]	5V	AD[3]	AD[4]	3.3V	
22	GND	AD[5]	AD[6]	3.3V	GND	AD[7]	
21	GND	C/BE[0]#	M66EN	AD[8]	AD[9]	3.3V	
20	GND	AD[10]	AD[11]	V(I/O)	GND	AD[12]	
19	GND	AD[13]	GND	AD[14]	AD[15]	3.3V	
18	GND	C/BE[1]#	PAR	3.3V	GND	SERR#	
17	GND	PERR#	GND	IPMB_SDA	IPMB_SCL	3.3V	
16	GND	LOCK#	STOP#	V(I/O)	GND	DEVSEL#	
15	GND	TRDY#	BD_SEL#	IRDY#	FRAME#	3.3V	
12..14 Key Area							C O N N E C T O R
11	GND	C/BE[2]#	GND	AD[16]	AD[17]	AD[18]	
10	GND	AD[19]	AD[20]	3.3V	GND	AD[21]	
9	GND	AD[22]	GND	AD[23]	IDSEL	C/BE[3]#	
8	GND	AD[24]	AD[25]	V(I/O)	GND	AD[26]	
7	GND	AD[27]	GND	AD[28]	AD[29]	AD[30]	
6	GND	AD[31]	CLK	3.3V	GND	REQ#	
5	GND	GNT#	GND	RST#	BSRSV	BSRSV	
4	GND	INTS	INTP	V(I/O)	HEALTHY#	IPMB_PWR	
3	GND	INTD#	5V	INTC#	INTB#	INTA#	
2	GND	TDI	TDO	TMS	5V	TCK	
1	GND	5V	+12V	TRST#	-12V	5V	

Table 9-1 Pin assignment for connector X1

9.1.2 Connector X20

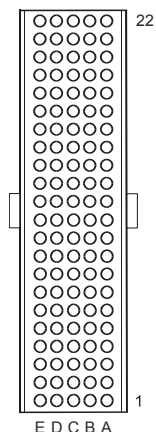


Figure 9-2 Connector X20 (view: plug side)

NC = not connected, NP = not populated

Pin	F	E	D	C	B	A	X20 C O N N E C T O R
22	GND	GA0	GA1	GA2	GA3	GA4	
21	GND				GND		
20	GND		GND				
19	GND				GND		
18	GND	PXI TRIG6	GND (CAN-En)	PXI TRIG5	PXI TRIG4	PXI TRIG3	
17	GND	PXI CLK10			GND	PXI TRIG2	
16	GND	PXI TRIG7	GND		PXI TRIG0	PXI TRIG1	
15	GND				GND		
14	NC						
13	NC						
12	NP	COM 1	+3.3V 1	+5V 1	-15V 1	+15V 1	
11	NP						
10	NC	COM 2	+3.3V 2	+5V 2	-15V 2	+15V 2	
9	NC						
8	NC						
7	NC						
6	NC						
5	NC						
4	GND						
3	GND	RSA0	RRST#		GND	RSD0	
2	GND		RSDI	RSA1		RCLK	
1	GND				GND	RCS#	

Table 9-2 Pin assignment for connector X20

9.1.3 Connector X10

Plug type DIN 41612, 96 pin, female

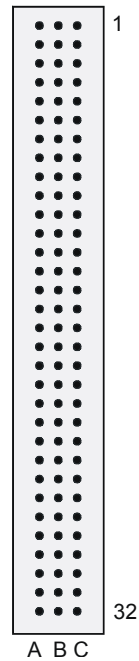


Figure 9-3 Connector X10 (view: front panel)

	A	B	C
1	LABA1	GND	LABA2
2	LABB1	GND	LABB2
3	LABC1	GND	LABC2
4	LABD1	GND	LABD2
5			
6	CHA1_HI1	CHA1_HI2	CHA1_HI3
7	CHA_LO1	CHA_LO1	CHA_LO1
8	CHA2_HI1	CHA2_HI2	CHA2_HI3
9	CHA_LO1	CHA_LO1	CHA_LO1
10			
11	CHA3_HI1	CHA3_HI2	CHA3_HI3
12	CHA_LO1	CHA_LO1	CHA_LO1
13	CHA4_HI1	CHA4_HI2	CHA4_HI3

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

	A	B	C
14	CHA_LO1	CHA_LO1	CHA_LO1
15			
16	CHB1_HI1	CHB1_HI2	CHB1_HI3
17	CHB_LO1	CHB_LO1	CHB_LO1
18	CHB2_HI1	CHB2_HI2	CHB2_HI3
19	CHB_LO1	CHB_LO1	CHB_LO1
20			
21	CHB3_HI1	CHB3_HI2	CHB3_HI3
22	CHB_LO1	CHB_LO1	CHB_LO1
23	CHB4_HI1	CHB4_HI2	CHB4_HI3
24	CHB_LO1	CHB_LO1	CHB_LO1
25			
26			
27			
28	GND	GND	GND
29	XTO1	GND	XTO2
30	XTI1	GND	XTI2
31	GND	GND	GND
32	GND	GND	CHA_GND

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

Comment:

The signal CHA_GND is connected with the front panel of the component and through two 10 nF condensers with GND. The front panel itself has no direct connection to GND. During the connection of a unit under test, the unit under test's GND should be connected to GND. Do not connect GND and CHA_GND to prevent hum loops.

9.1.4 Connector X30

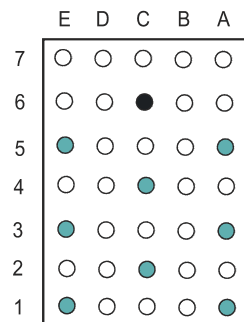


Figure 9-4 Connector X30 (view: plug side)

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

9.2.1 Connector X20 (Extension Connector)

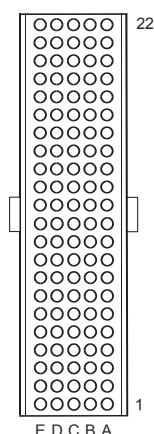


Figure 9-5 Connector X20 (view: plug side R&S TS-PDC)

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

**NOTE:**

The technical data of the Analyzer Module R&S TS-PAM and the Rear I/O Module R&S TS-PDC are shown in the corresponding data sheets.

In the event of any discrepancies between data in this user manual and technical data in the data sheet, the data sheet takes precedence.

