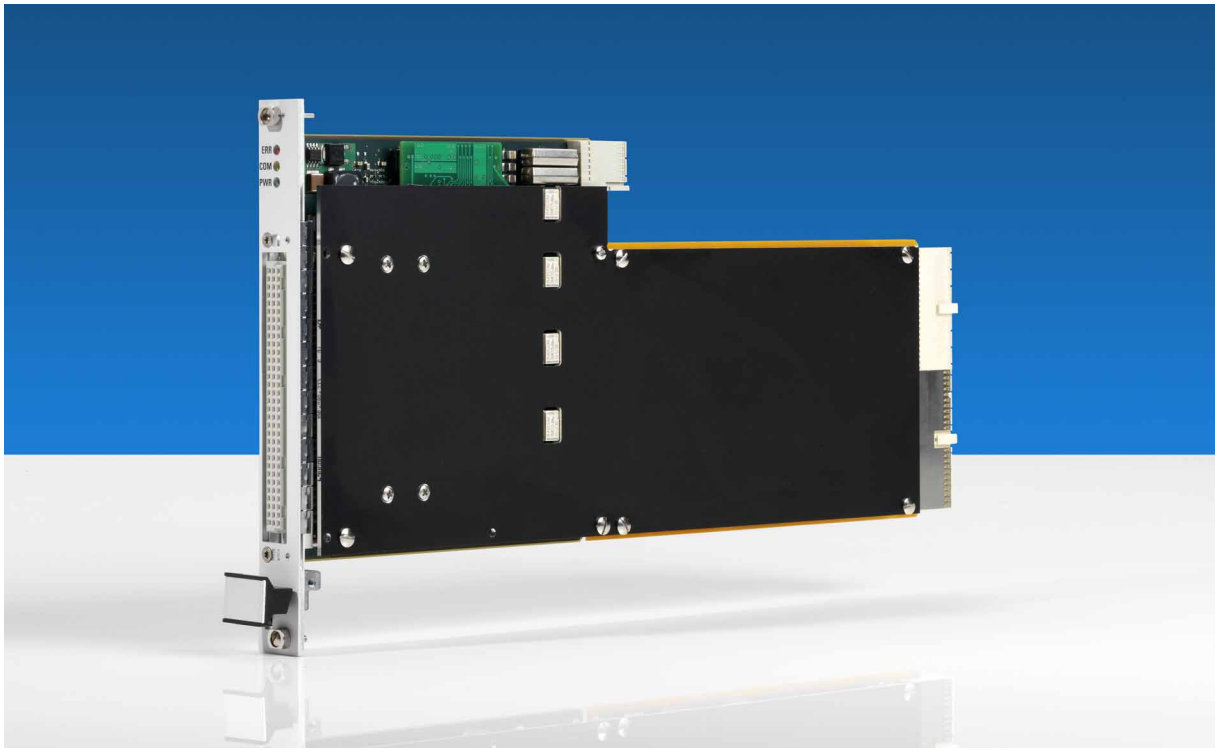
ROHDE&SCHWARZ

USER MANUAL



High-Speed Digital Test Module

R&S®TS-PHDT

User Manual

for ROHDE & SCHWARZ High-Speed Digital Test Module R&S TS-PHDT

3rd Issue / 04.09 / GB 1157.9710.12

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Printed in the Federal Republic of Germany. Errors excepted, subject to technical change without notice.

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.

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Das Rohde & Schwarz Managementsystem ist zertifiziert nach:

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DIN EN 9100:2003
DIN EN ISO 14001:2004

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The Rohde & Schwarz quality management system is certified according to:

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DIN EN ISO 14001:2004

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DIN EN ISO 14001:2004

ROHDE&SCHWARZ

1171.0200.11-03.00

PD 5213.8744.99 · V 01.00 · May 2007

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1171.0200.22-03.00

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1 Usage

1.1 General

The High-Speed Digital Test Module R&S TS-PHDT is used wherever digital circuits are tested by static or dynamic stimulation and the response is recorded.

Deterministic, simultaneous stimulation and recording of digital signals make it possible to simulate operating conditions in a manner approaching reality. A large local memory pool and an independent sequence controller are available on the module to make it possible generating, recording and analysing pattern in real time.

Extensive trigger options via the PXI trigger bus allow for synchronisation with additional R&S TS-PHDT modules or other measurement and stimulus modules. This makes it possible to extend the number of digital channels in an application. Measurements in which analog and digital signals are recorded synchronously are also possible.

Output levels and input thresholds can be programmed in groups of 8 channels (ports). This allows for optimum adaptability to the requirements of different logic families. The effect of interference signals in the test setup can be minimised by adjusting the hysteresis for the input thresholds.

Safety circuits to protect against short circuits, countervoltages, and overvoltages contribute to the robustness of the High-Speed Digital Test Module R&S TS-PHDT.

Due to the extraordinary space-saving design of the I/O safety circuit and signal conditioning unit, the R&S TS-PHDT takes up only one CompactPCI/PXI slot. This makes it possible to set up very high-performance, compact measuring systems.

The High-Speed Digital Test Module R&S TS-PHDT is designed for the R&S CompactTSVP test platform. The module is controlled by the CompactPCI bus.

A Soft Panel is available to operate the module. An IVI-C driver is available to use the module under software control.

The PLX PCI-SDK is used to implement PCI bus access. **"Copyright © 2005 PLX Technology, Inc."**

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1.2 Features of the module R&S TS-PHDT

32 output channels, high and low level for each port (8 channels), separately adjustable.
Output level range -3 V to +10 V
Maximum output current per channel 80 mA Maximum output current per port: 500 mA for output level ≤ 2.9 V 200 mA for output level > 2.9 V
Current limiting for high and low level, separately adjustable for each port
Each channel is individually switchable to “Tri State” at the maximum pattern rate
High-level is formattable within the pattern duration (return-to-zero)
32 input channels, high and low limit for each port, separately adjustable.
Input can be connected with outputs by channel
Maximum pattern rate 40 MHz
Independent memories for - Stimulus data - Reference data - Result data Memory depth 64 M patterns each
Memory for independent pattern sets; selectively executable
Comparison of reference and measurement data in real time; results available immediately (“Pass / Fail”, number of failed patterns, channels)
Trigger options via PXI trigger bus
Self-test capability
Soft Panel for interactive operation
IVI-C driver available
Use in R&S CompactTSVP

Table 1-1 Features R&S TS-PHDT

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1.3 Safety instructions

WARNING!

The R&S CompactTSVP test platform is normally designed for operating voltages up to 125 V.
The High-Speed Digital Test Module R&S TS-PHDT is suitable for voltages from - 3 V to +10 V and must only be used accordingly.

Access to areas that permit higher voltages (R&S analog bus) is only possible for internal purposes during the self-test.

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2 View

Figure 2-1 shows the High-Speed Digital Test Module R&S TS-PHDT.

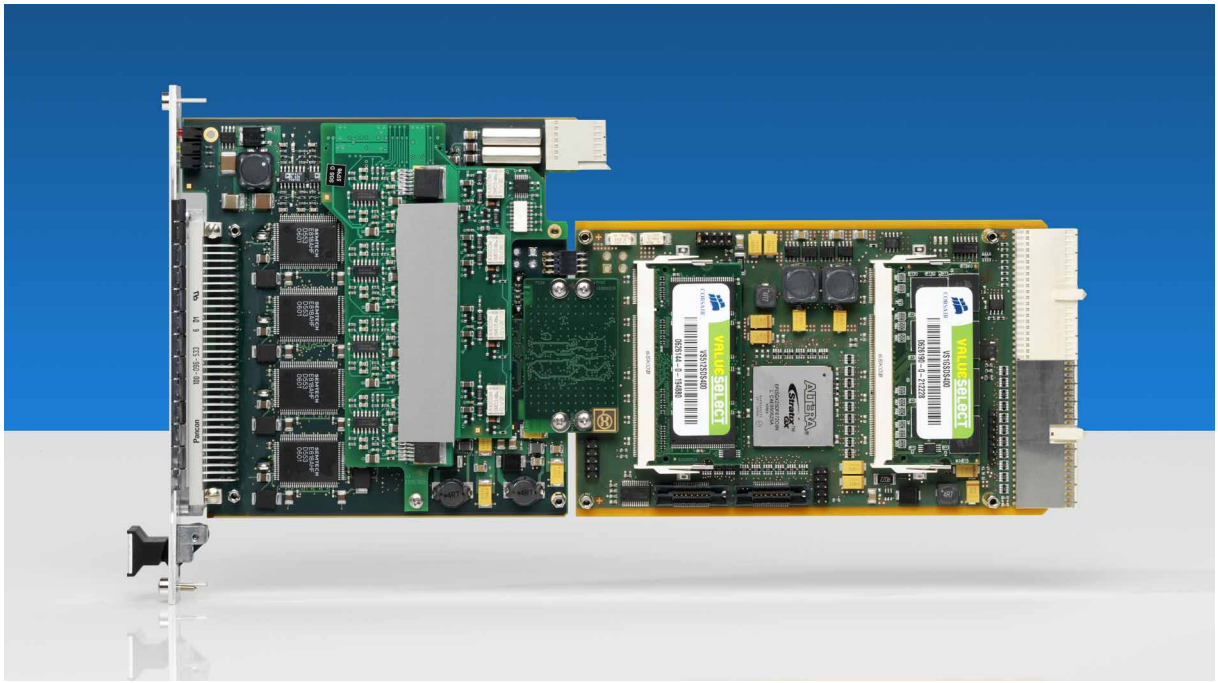

Figure 2-1 View of the High-Speed Digital Test Module R&S TS-PHDT (without cover)

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3 Block Diagram

Figure 3-1 shows the block diagram of the R&S TS-PHDT module.

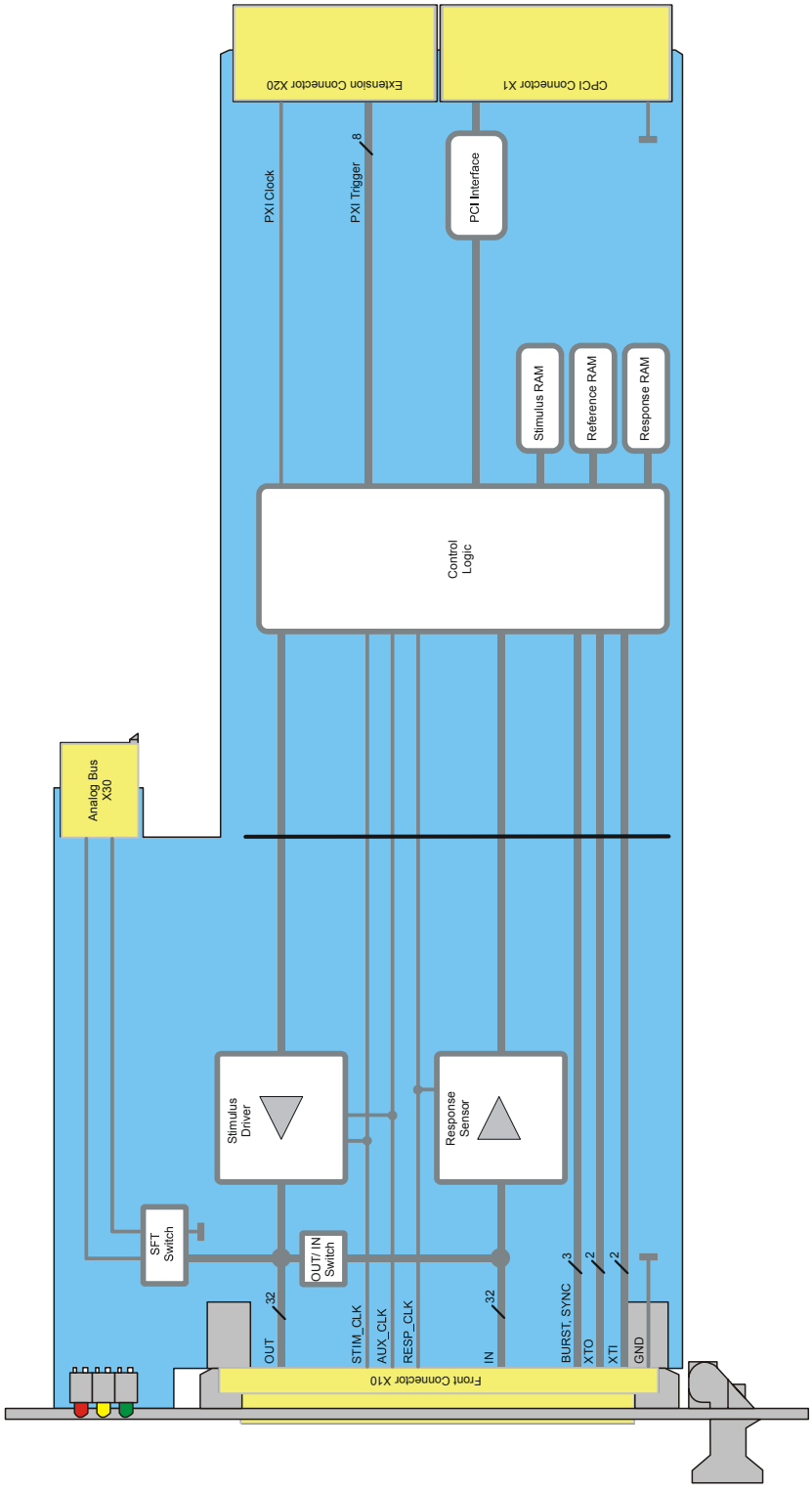

Figure 3-1 Block diagram R&S TS-PHDT

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4 Layout

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

The High-Speed Digital Test Module R&S TS-PHDT is designed as a long plug-in card for front installation in test platforms R&S CompactTSVP.

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. The connectors X20/X1 connect the module with the CompactPCI backplane/PXI control backplane.

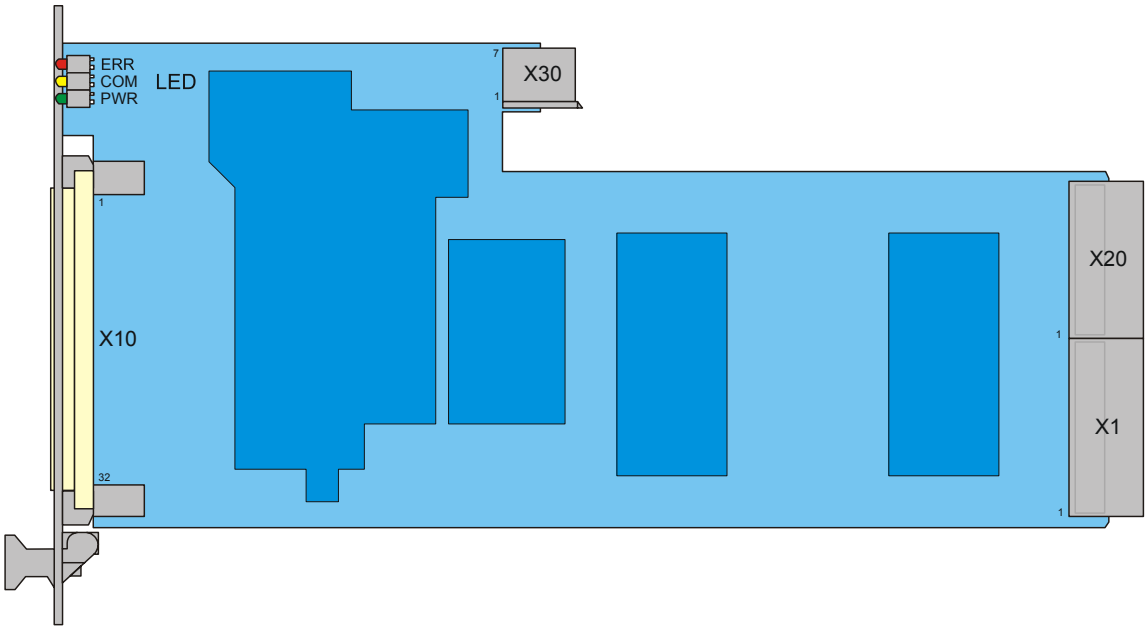

Figure 4-1 Arrangement of the connectors and LEDs on the module R&S TS-PHDT

Name	Use
X1	cPCI bus
X10	Interface to the test object
X20	Extension (PXI, rear I/O)
X30	Analog Bus ConnectorTSVP analog bus access for self-test

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

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

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

LED	Description
ERR (red)	Fault condition: Lights up when a fault is detected on the R&S TS-PHDT 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)
COM (yellow)	Communication: Lights up when data is exchanged across the interface.
PWR (green)	Supply voltage OK: Lights up when all necessary supply voltages are present.

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

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5 Functional Description

5.1 Overview

5.1.1 General

The High-Speed Digital Test Module R&S TS-PHDT makes 32 outputs (OUT1 to OUT32) and 32 inputs (IN1 to IN32) available. 8 channels are combined together to form ports (PORT0 to PORT3). The output level for voltage and current limiting and the thresholds for inputs are individually configurable for the individual ports

Port (PORTx)	Channels (OUTx, INx)
0	1 ...8
1	9 ...16
2	17 ...24
3	25 ...32

Table 5-1 Assignment of channels to the ports

The timing of the pattern output (stimulus part) and the timing for sampling the inputs with the recording unit (response part) can be separately adjusted. Triggering is separately configurable for both sequence controls. Lines PXI0 to PXI7 on the PXI backplane and contacts XTI1 and XTI2 on the front connector are available as trigger inputs.

The R&S TS-PHDT module contains a large memory for stimulus, reference, and result data. This memory can contain multiple pattern sets at the same time. The pattern sets can then be repeatedly executed for different tests. Cyclic “downloading” of pattern sets is eliminated, thus saving test time.

The input signals are compared with reference data in real time when the pattern sets are executed. Depending on the recording mode selected, either the recorded pattern or the results of the comparison are stored in results memory. The registers on the module holds the number of errors and channels that have failed. Test time can also be saved in this case, since there is often no need to “upload” the extensive data in results memory, as only the error registers are evaluated.

After a pattern set has been executed, outputs OUT1 - OUT32 retain the last pattern to be executed. If you would like the outputs to become

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inactive after execution is complete, a Tri-State pattern must be explicitly appended at the end. It is also possible to set the channels statically after execution is complete.

5.1.2 Simple dynamic digital test

- Stimulus pattern set for 32 output channels
- Reference pattern set for 32 input channels
- The pattern duration for the two pattern sets is identical, i.e. output and recording run synchronously to each other.
- The test object response is recorded with a time delay in reference to the stimulus data. The delay can be adjusted between 0 and the pattern set period.
- Start via software or hardware trigger

The R&S TS-PHDT module contains sufficient memory to hold several pattern sets at the same time. This means there is no need to reload data on the module for each test.

Patterns 1 to n can be generated at a fixed rate. The pattern set period is the time during which a pattern is available at the outputs. Responses of the test object are also recorded at the inputs during this time. The “Response Delay” is the time offset between the beginning of a pattern and recording.

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The pattern rate is the reciprocal of the pattern set period.

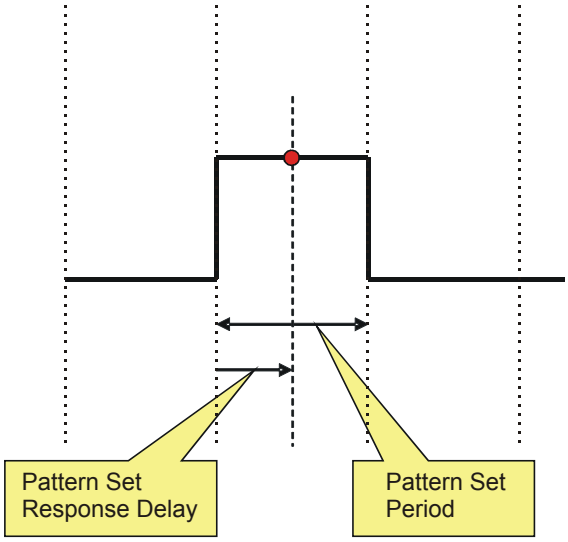

Figure 5-1 “Pattern set period” and “response delay”

The pattern set can be started by a software function or by a hardware trigger. The software can perform additional tasks during execution, i.e. the pattern set is executed under hardware control. The software is able to query whether execution is still in progress, has been interrupted, or may wait for pattern set completion.

After execution is complete, the results are available for additional evaluation (error information or recorded patterns).

5.1.3 Evaluation functions

Evaluation of the recorded pattern must be performed as quickly as possible in the production test. The counter and registers have been implemented in the module for this purpose. They determine the result in real time. The following results are available immediately after the last pattern is executed:

- Number of failed patterns
- Failed channels
- Indices of the failed patterns

Data only need to be uploaded from the module to the PC for a detailed evaluation of errors (which channel was failed in which pattern) or to display all measured values.

5.1.4 Pattern output and pattern recording

- Stimulus pattern set for 32 output channels
- Reference pattern set for 32 input channels
- Pattern set period different for the two pattern sets
- Start via software or hardware trigger

Timing of pattern output and pattern recording can be configured independently of each other. This makes it possible to record data at a higher rate than the stimulation rate. Individual delay times beginning at the trigger event can be adjusted for stimulus and recording.

Application example: Asynchronous serial protocol

- Stimulus pattern set sends serial data at lower rate.
- Recording of the test object response starts after the stimulus pattern set has been sent.
- Recording at a higher rate.

The trigger source for stimulus and recording can be configured independently of each other; for example stimulus via software trigger and recording via hardware trigger.

It is also possible to generate only pattern sets or to record only responses of the test object.

5.1.5 Overwriting stimulus data

Stimulus and reference data that has already been loaded into the R&S TS-PHDT module can be subsequently modified.

Application example: Flash programming

- The stimulus pattern set contains an extensive Flash sequence.
- A serial number must be programmed for each test object.
- Only a small part of the sequence needs to be replaced to do this. The entire sequence does not need to be transferred again.

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5.1.6 Stimulus formatting

Stimulus signals can be formatted channel-specifically (return-to-zero or RTZ). A logical “High” appears only during a time window within a pattern:

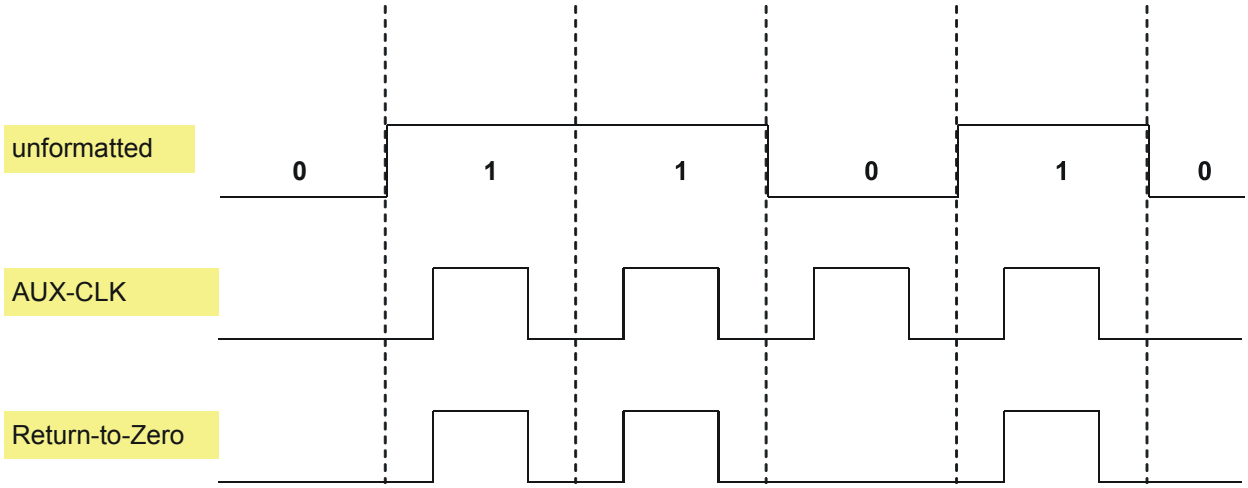

Figure 5-2 Return-to-zero formatting

5.1.7 Stop-on-fail

The Stop-on-fail operating mode is used to cancel running pattern sets prematurely in the event of an error. Stop-on-fail saves testing time if you are only interested in a "Pass / Fail" outcome and not the complete record of test object responses.

5.2 Memory layout

The R&S TS-PHDT module provides memory for 64 M patterns. Memory is divided into 6 memory banks, each with 64 M x 32 bits. Each of the 32 bits is assigned to one of the 32 input or output channels. The meaning of the individual bits is as follows:

- Stimulus memory (banks 1 and 2):

  Activation of the output channels (High, Low, Tri-State).

- Reference memory (banks 3 and 4):

  Coding of the expected measurement value (High, Low, Forbidden-Zone, don't care).

- Results memory (banks 5 and 6):

  Coding of the measured value (High, Low, Forbidden-Zone) or error information (Pass, Fail).

Memory layout is designed so that all data is already available on the PC in such a manner that it can be transferred directly to memory without calculating or recopying.

Transfer of data therefore always takes place in two equally long 32-bit data arrays in which the contents of the memory banks are transferred. The user must prepare the arrays, fill them with data, and then transfer them to the module-internal memory of the R&S TS-PHDT:

```
ViInt32    id;
ViUInt32 * pStim     = calloc(1024, sizeof(ViUInt32));
ViUInt32 * pTriState = calloc(1024, sizeof(ViUInt32));

// all channels LOW
pStim[0]     = 0x00000000;
pTriState[0] = 0x00000000;

// OUT1 HIGH
pStim[1]     = 0x00000001;
pTriState[1] = 0x00000000;

// all channels HIGH
pStim[2]     = 0xFFFFFFFF;
pTriState[2] = 0x00000000;

// ... etc.

// all channels Tri-State
pStim[1023]     = 0x00000000;
pTriState[1023] = 0xFFFFFFFF;
```

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```
// Download data to stimulus memory
rsphdt_LoadData(vi, RSPHDT_VAL_DATA_STIM,  pStim,
pTriState, 1024, &id );

// Data arrays are no longer required now
free(pStim);
free(pTriState);
```

The transfer to reference memory is a similar process.

5.2.1 Stimulus memory

The coding of stimulus memory is as follows:

Bank 2 (Tri-State)	Bank 1 (Stim)	Function
0	0	Drive Low
0	1	Drive High
1	0	(reserved)
1	1	Drive Tri-State

Table 5-2 Coding of stimulus memory

If only High/Low will be stimulated, Bank 2 does not need to be transferred to the R&S TS-PHDT. In this case memory is automatically filled with zeros.

5.2.2 Reference memory

High/Low information, similar to stimulus memory.

Bank 4 (Control)	Bank 3 (Level)	Function
0	0	Expect Low
0	1	Expect High
1	0	don’t care
1	1	Expect Forbidden Zone (FBZ)

Table 5-3 Reference memory coding

If only High/Low is expected, Bank 4 does not need to be transferred to the R&S TS-PHDT. In this case memory is automatically filled with ze-

ros.

The value “don't care” means that any level (including the Forbidden Zone) may be measured without an error being reported.

5.2.3 Results memory

Results memory is filled with data while a pattern set is being executed. The recording mode decides which of the two possible data formats should be used:

Measurement values (RSPHDT_VAL_COLLECT_DATA):

- Data is stored according to the format for stimulus/reference memory.

Error information (RSPHDT_VAL_COLLECT_RESULTS):

- Pass/Fail information and FBZ are saved.
- Optimised coding, which mixes Pass/Fail and current values.

The two formats each have strengths and weaknesses that are described in the following sections.

5.2.3.1 Measurement values

Bank 6 (FBZ)	Bank 5 (Level)	Function
0	0	Low measured
0	1	High measured
1	0	(reserved)
1	1	“Forbidden Zone” measured

Table 5-4 Coding of measurement values in results memory

This memory format is ideally suited for recording unknown data from a test object and using it either directly as stimulus data (simulation of the test object) or as reference data (learning procedure).

The disadvantage is that information about failed patterns can only be obtained through a comparison with reference memory.

5.2.3.2 Error information

Bank 6 (FBZ)	Bank 5 (Fail)	Function
0	0	The expected value (Low or High) has been measured. For “don't care”: Low or High has been measured.
0	1	An unexpected value (Low or High) has been measured.
1	0	Forbidden Zone was expected and measured. For “don't care”: Forbidden Zone was measured.
1	1	Forbidden Zone was measured, but not expected

Table 5-5 Coding of results memory for Pass/Fail and FBZ information

The advantage of the Pass/Fail storage is, that searching for failed patterns is simple and fast. Only the “Fail” bits need to be considered, which means that Bank 6 does not need to be uploaded and evaluated.

The disadvantage of the Pass/Fail save is that the currently measured value can only be reconstructed by a logical link with reference memory. If reference memory contains “don't care”, the current value (High or Low) cannot be reconstructed at all, since “don't care” always results in the “Fail” bit being set to zero. The FBZ bit can still be used to determine whether Forbidden Zone or a valid level was measured, but not whether the level was High or Low.

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5.3 Upload / Download data

The R&S TS-PHDT module is capable of holding multiple pattern sets in memory simultaneously. Because of this feature, various digital tests can be performed one after the other without having to reload data to the module each time.

A pattern set for the R&S TS-PHDT module means either stimulus data or reference and results data. Stimulus data (Banks 1 and 2) may therefore have a different length than reference data (Banks 3 and 4). Stimulus and reference data are loaded into R&S TS-PHDT memory before execution. Results data (Banks 5 and 6) match reference data in terms of their length and position in memory. They are not available until after the pattern set has been executed. Then they can be loaded onto the PC for evaluation.

It is also possible for special applications to execute only one stimulus pattern set or to record only responses of the test object. In the latter cases, reference data must also be physically present in R&S TS-PHDT memory. They do not need to be explicitly provided, however, if no comparison is required. In this case “don't care” is automatically assigned to them.

When downloading a pattern set, the data type (stimulus or reference data), number of patterns, and the pointers to the two data arrays corresponding to the format of the two memory banks involved are transferred. The device driver transfers the data to the module and returns an “ID”, i.e. a unique identification number. The data record can be referenced later with this “ID”.

Stimulus and reference data are transferred using function “`rsphdt_LoadData`” to the R&S TS-PHDT module (download). The data must be provided in two 32-bit arrays. The data format corresponds exactly to the format in the memory banks. This makes it possible to transfer the data to the module with optimum speed. It is also necessary to be able to modify data that is already loaded into the module. The function “`rsphdt_UpdateData`” is available for this purpose. It is able to overwrite portions of the data on the module. It also has two 32-bit arrays as parameters in addition to the “ID” of the data record, the “Start index" and the “Number of patterns". The “ID” serves to identify the data record and is assigned by the function “`rsphdt_LoadData`”.

Pattern sets that are no longer required can be removed from memory with the function “`rsphdt_DiscardData`”.

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NOTE:

Deleting data records in some cases causes gaps in memory on the R&S TS-PHDT module that will be refilled by pattern sets of the same size or smaller. In unfavourable cases it may happen that the gaps cannot be filled in and therefore the full extent of memory can no longer be used. Deleting all data records or calling the function "`rsphdt_reset`" makes all of memory available again.

Two 32-bit arrays must be provided in the user program for the results data. The content of the results memory banks is transferred to these two arrays by means of the function "`rsphdt_FetchData`" (upload).

The data quantity can either include the complete pattern set or an excerpt of it. It may be useful, uploading Pass / Fail data starting with the first failing pattern. An excerpt is defined by the parameters "Start index" and "Number of patterns".

5.4 Configuration of stimulus channels

The voltage level and current limiting for the outputs can be adjusted with function "`rsphdt_ConfigureStimPort`". The settings are always made specifically for one port. Separate current limiting can be adjusted for high and low level.

NOTE:

The output resistance of the driver and the resistors in the output safety circuits (about 39 Ω) results in a drop in voltage when a current is flowing. This may have to be taken into consideration when adjusting the level.

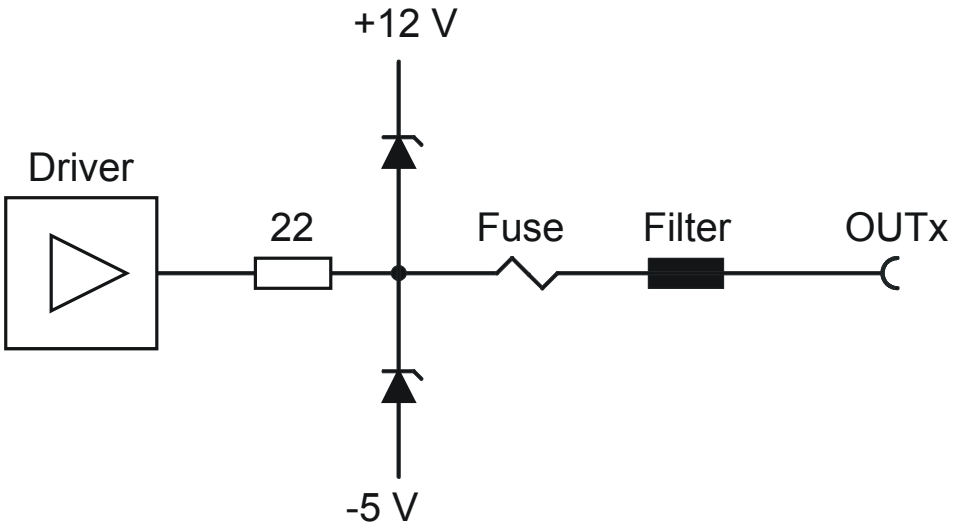

Figure 5-3 Output safety circuit

5.5 Configuration of the measurement channels

The measurement channel inputs have a safety circuit before the comparators that is structured as follows.

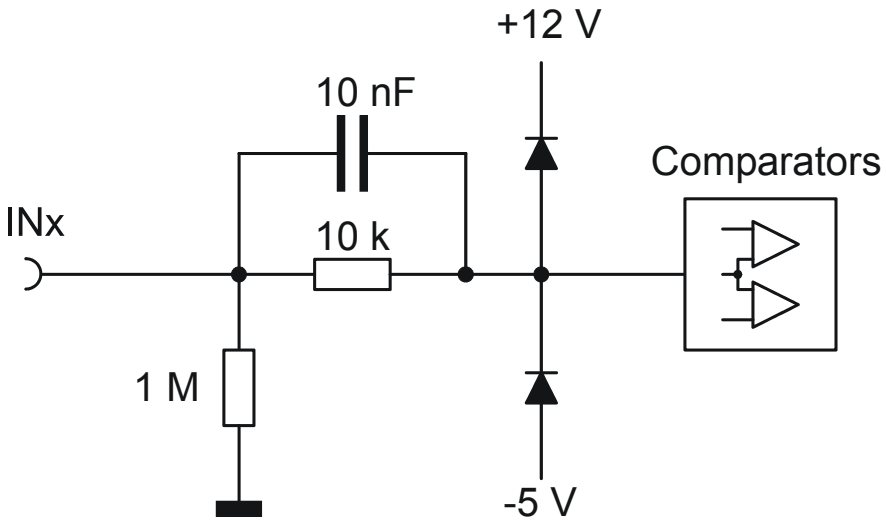

Figure 5-4 Input safety circuit

Each input is directed to two comparators with adjustable thresholds. This makes it possible to implement a hysteresis for evaluating signals. The thresholds can be set using driver function "`rsphdt_ConfigureRespPort`". This makes it possible to set individual values for each port.

The result of the signal evaluation of a channel is "1" if the input level is greater than the High-threshold.

The result of the signal evaluation of a channel is "0" if the input level is less than the Low-threshold.

If the input level is between the thresholds, "Forbidden Zone" is returned as the result.

5.6 Time settings for data output

Two functions are available to configure the timing of the stimulus channels during pattern execution. Function "rsphdt_ConfigureStimTiming" adjusts the trigger delay and pattern set period. The trigger delay is the wait time between the trigger event and the output of the first pattern. The pattern set period is the time during which a pattern is present. If formatting for the stimulus signal (RTZ/return-to-zero mode) is deactivated, this time also defines the duration of a High and Low level. The selected pattern set period corresponds to the set period of the clock signals STIM_CLK and AUX_CLK on the front-side connector.

Function "rsphdt_ConfigureReturnToZeroMode" can be used to define the time response of the channels when RTZ mode is activated. The first parameter determines the delay of the active signal edge in reference to the beginning of the pattern. The second parameter determines the length of the RTZ signal. It must be remembered that the total of the delay and length must be less than or equal to the pattern set period. These settings have an effect on the clock signal AUX_CLK on the front connector (see also Figure 5-2: „Return-to-zero formatting").

RTZ mode can be activated for each channel individually using the function "rsphdt_EnableReturnToZeroMode".

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5.7 Time settings for data recording

Three time parameters can be set with function "`rsphdt_ConfigureRespTiming`" to record input signals. As was the case for pattern output, trigger delay, and pattern set period are available as parameters. In addition, the delay between the beginning of the pattern and the sampling point can also be configured (Response Delay). This setting also affects the clock signal `RESP_CLK` on the front connector.

Figure 5-5 shows an example of the effects of time settings on clock signals and thus on data output and recording. In this figure, the polarity of the clock signals is set to "active high". See also Section 5.16: Configuration of clock signals.

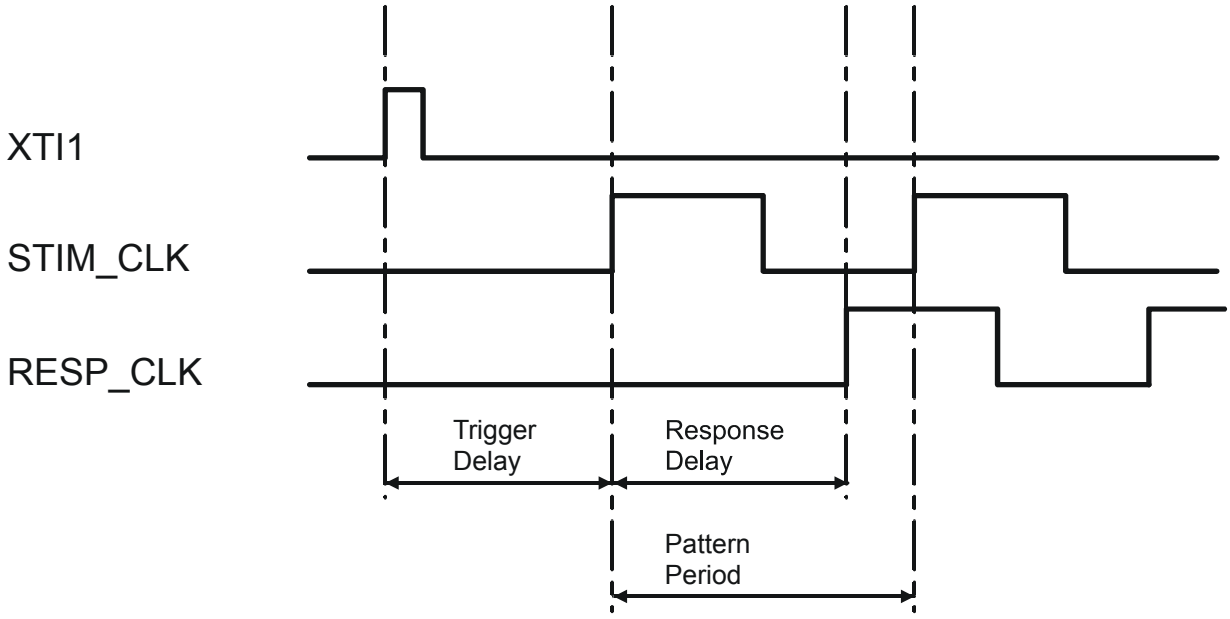

Figure 5-5 Time settings

The rising edge of the signal on trigger input XTI starts starts execution. After "Trigger Delay", the rising edge of signal `STIM_CLK` causes the first pattern to be generated. The next rising edge causes the second pattern to be generated, etc. After the programmed "Trigger Delay" and "Response Delay" signal `RESP_CLK` starts. The rising edge marks the point when sampling of the input channels begins. In this example, the trigger delay for data output and recording are set to the same value.

5.8 Mode for data recording

Function "`rsphdt_ConfigureCollectionMode`" defines the format for data in results memory. The user can select between saving the pattern that is read in (`RSPHDT_VAL_COLLECT_DATA`) and storing error information (`RSPHDT_VAL_COLLECT_RESULTS`). The formats are described in Section 5.2.3: Results memory.

5.9 Cancel if error is detected

Function "`rsphdt_ConfigureStopOnFail`" can be used to configure sequence controls so that execution of the pattern set ends as soon as an error is detected by the comparison of measurement and reference data ("Stop-on-Fail"). If this happens, the pattern output as well as recording are interrupted.

NOTE:

Depending on the system, it may be possible that execution does not end until one or two more patterns after an error is detected.

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5.10 Triggering and sequence control

A separate sequence control is available for the stimulus and recording unit.

Various trigger sources are available to start controllers:

Name	Note
“Immediate”	Sequence control starts immediately after arming (when function “rsphdt_InitiateExecution” or “rsphdt_InitiateExecutionEx” is called)
“External”	See XTI1
“XTI1, XTI2”	TTL inputs on the front side connector; positive signal edge triggers sequence control
PXI0 … PXI7	Positive signal edges on the PXI trigger lines start sequence control

Table 5-6 Trigger sources

Function “rsphdt_ConfigureTriggerSource” determines the trigger source.

Driver function “rsphdt_InitiateExecution” and “rsphdt_InitiateExecutionEx” enable the previously configured trigger source. Then the addressed sequence controls are in “Waiting” state. If trigger source “Immediate” is selected, the corresponding controller immediately switches to “Running” state. Otherwise the change of the state does not take place until after the trigger event occurs. In this state the number of patterns in stimulus memory are generated and the number of patterns in reference memory are recorded.

If only patterns will be generated, the value RSPHDT_INVALID_DATA_ID must be passed to the “Initiate” function as an ID for reference data. If only recording should take place, the value above must be passed as an ID for the stimulus data.

After the set number of patterns have been processed, the corresponding sequence control reverts to the “Stopped” state.

The “Stopped” state is also reached is an error is detected when comparing reference and measurement data with the “Stop-on-Fail” option turned on. When this happens, both sequence controls stop.

The current state of both sequence controls can be queried with function “rsphdt_FetchExecutionState”. Function “rsphdt_WaitUntilExecutionComplete” waits in the test program for the end of execution.

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The "BURST" signal on the front connector is active if at least one of the two process controls is in the "Running" state.

NOTE:

If sequence control is in the "Waiting" or "Running" state, some functions cannot be performed. In that case, those functions return an error message. If necessary, sequence control can be switched to its reset state with the "`rsphdt_AbortExecution`" function.

5.11 Result evaluation

After a pattern set is executed, some status information must be available immediately, i.e. without transferring and analysing large quantities of data. This information is collected in real time during execution and is available in the R&S TS-PHDT module.

Since stimulation and recording can take place independently of each other, some of these status information items may be available separately.

5.11.1 Number of patterns executed / current pattern index

Function "`rsphdt_FetchExecutedPatternCount`" returns the number of patterns that were generated and recorded.

This information is important if a pattern set has been interrupted (for example because of a user request or due to "Stop-on-Fail").

The function can also be called during execution, in which case it returns the index of the pattern currently present.

5.11.2 Number of failed patterns

After a pattern set is executed, function "`rsphdt_FetchFailedPatternCount`" returns the number of patterns in which at least one channel returned a "Fail" result.

The function can also be called during execution.

If execution was started with function "`rsphdt_InitiateExecutionEx`", the parameter "Reset Flag" determines whether the counter will be reset for start. Function "`rsphdt_InitiateExecution`" always sets the number of failed patterns to zero before execution starts.

5.11.3 Failed channels

Function "`rsphdt_FetchFailedChannels`" returns a 32-bit word, where the according channel bit is set to 1 if at least one pattern of this channel failed.

The number of failed channels corresponds to the number of bits set to 1 in that result.

The function can also be called during execution.

If execution was started with function

"rsphdt_InitiateExecutionEx", the parameter "Reset Flag" determines whether the register will be reset for start. Function "rsphdt_InitiateExecution" always sets the register of the failed channels to zero before execution starts.

5.11.4 Number of failed channels

Function "rsphdt_FetchFailedChannelCount" returns the number of channels that had a "Fail" in at least one pattern.

The function can also be called during execution.

If execution was started with function "rsphdt_InitiateExecutionEx", the parameter "Reset Flag" determines whether the counter will be reset for start. Function "rsphdt_InitiateExecution" always sets the number of failed channels to zero before execution starts.

5.11.5 Failed patterns

During execution of a pattern set, the indices of failed patterns are recorded by blocks. This makes it possible to have access to errors that occurred regardless of the recording type (measured values or error information). The result data does not need to be transferred to the PC and browsed.

This error memory can be read with function "rsphdt_FetchFailedPatternGroup". Each time the function is called, a block is indicated by returning the starting index and block length, provided blocks are still in storage.

When a pattern set is started, error memory is automatically deleted regardless of the "Initiate" function that was used. Thus the errors of the last execution are always received.

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5.12 Generating trigger signals

The High-Speed Digital Test Module R&S TS-PHDT is capable of generating trigger signals on the following lines:

Name	Note
XTO1, XTO2	TTL outputs on the front connector
PXI0 ... PXI7	PXI trigger lines on the backplane

Table 5-7 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 event is possible:

Name	Note
"General Purpose Trigger"	Function `rsphdt_InitiateTrigger` generates a pulse of approximately 200 ns length on the configured trigger lines. .

Table 5-8 Events for generating a trigger pulse

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

All settings are made with the aid of function "`rsphdt_ConfigureTriggerOutput`".

5.13 Bidirectional channels

Each input can be connected individually with the corresponding output by means of an analog switch. This makes it possible to read back the outputs or to read in a test object response when the outputs are switched to Tri-State. The circuit is set up by means of function "`rsphdt_ConnectInOut`".

5.14 Generating a static pattern

Output of a pattern is possible even if memory on the module has not previously been written with function "`rsphdt_SetDigitalOuputState`". Timing and trigger settings have no effect on execution of this function. The transferred pattern appears immediately at the output. Transferring a bit mask makes it possible to address individual channels selectively. This function cannot be performed if sequence control for stimulus has status "Waiting" or "Running".

5.15 Querying the inputs

The state of the inputs (IN1 to IN32) on the module can be queried with drive function "`rsphdt_GetDigitalInputState`". The coding of the status in both return values corresponds to the coding in results memory in "Measurement values" recording mode.

forbidden zone bit	logic level bit	Function
0	0	Low measured
0	1	High measured
1	0	(reserved)
1	1	"Forbidden Zone" measured

Table 5-9 Coding of return values

This function can not be performed if the sequence control for the recording unit has status "Waiting" or "Running".

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5.16 Configuration of clock signals

The following clock signals are available on the front connector:

Signal name	Meaning of polarity “active high”
STIM_CLK	A new pattern is generated with the rising edge of this signal. If stimulus formatting is turned off, the pattern appears immediately on the outputs.
AUX_CLK	If stimulus formatting is activated for an output, this clock determines the time for which a High level is generated.
RESP_CLK	The inputs are sampled with the rising edge of this signal.

Table 5-10 Clock signals on the X 10

The time response of the clock outputs is configured by time settings for stimulation and data recording.

The polarity of the clock signals can be set individually with function “`rsphdt_ConfigureClockPolarity`”.

NOTE:

Propagation delay times and rise times in the output driver cause delays in signal change on the outputs compared to clock signal edges.

5.17 Synchronising multiple modules

Multiple R&S TS-PHDT modules can be synchronised with each other to increase the number of output and input channels.

- All modules are synchronised to a PXI trigger signal.
- The trigger signal either can be generated externally or by one of the R&S TS-PHDT modules.

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6 Commissioning

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

- Shut down and turn off the R&SCompactTSVP
- Select a suitable front side connection slot.

  See also in user manual “R&S CompactTSVP TS-PCA3” the chapter entitled “Permitted module configurations”

  Connection slots 5 to 15 are permitted with the following exceptions:

  – The module could not be used in the Backplane version 3.x.
  – When using the R&S TS-PSC3 controller only the connection slots 9 to 15 are permitted.
- Loosen the screws and remove the appropriate front plate section on the TSVP housing.

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-PHDT module must be guided into the right hole, while the lower catch pin is guided into the left hole of the R&S CompactTSVP housing.

CAUTION!

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

- When the R&S TS-PHDT 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-PHDT module.

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NOTE:

The High-Speed Digital Test Module R&S TS-PHDT is detected automatically by the R&S CompactTSVP.

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7 Software

7.1 Driver software

An IVI-C driver is available for the functions of the High-Speed Digital Test Module R&S TS-PHDT. 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
rsphdt.dll	<GTSL directory>\Bin	Driver
rsphdt.hlp	<GTSL directory>\Bin	Help file
rsphdt.fp	<GTSL directory>\Bin	LabWindows CVI Function Panel File, Function Panels for CVI Development Environment
rsphdt.sub	<GTSL directory>\Bin	LabWindows CVI attribute file. This file is required by several “Function Panels”.
rsphdt.lib	<GTSL directory>\Bin	Import library
rsphdt.h	<GTSL directory>\Include	Header file for driver

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

NOTE:

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

7.2 Soft Panel

A Soft Panel is available for the module. The Soft Panel is based on the IVI driver and allows for interactive operation of the module.

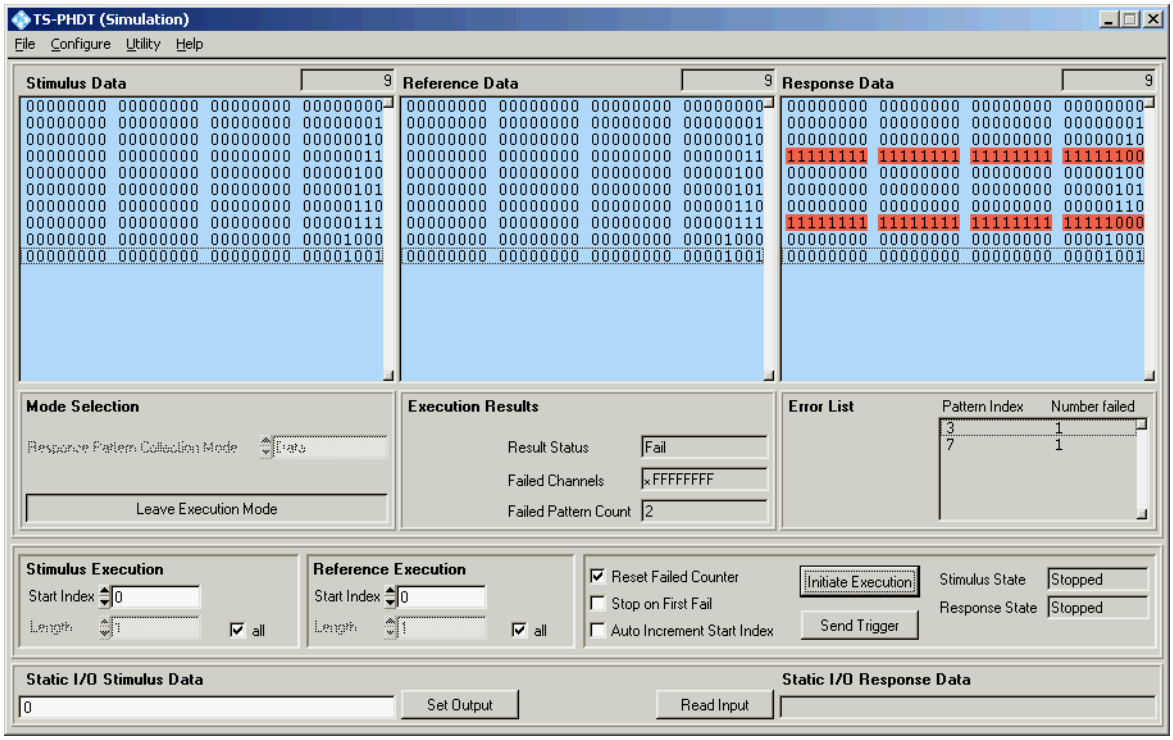

Figure 7-1 Soft Panel R&S TS-PHDT

NOTE:

The operation of the Soft Panel is described in Chapter 13 of the ”R&S GTSL Software Description”.

The input fields for the pattern allow for binary and hexadecimal format. With hexadecimal entries, a lower- or uppercase ‚h’ can be appended to distinguish them from binary format if necessary. Spaces are permitted between characters. For stimulus data, the letter “z”(“Z”) is also permitted to identify the Tri-State status. For reference data, the character “x” (“X”) means “don’t care” and the character “u” (“U”) means that “Forbidden Zone” is expected as the result.

Input	Note	Output pattern (binary)
1000	Binary	00000000 00000000 00000000 00001000
1000h	Hexadecimal	00000000 00000000 00010000 00000000
zzzz	Binary	00000000 00000000 00000000 0000ZZZZ
zzzzh	Hexadecimal	00000000 00000000 ZZZZZZZZ ZZZZZZZZ
55555555	Hexadecimal	01010101 01010101 01010101 01010101
FFFFFFFF	Hexadecimal	11111111 11111111 11111111 11111111
1111 1111	Binary	00000000 00000000 00000000 11111111

Table 7-2 Input formats for pattern

A “U” with result data means that the measured level was within the forbidden zone.

7.3 Sample program R&S TS-PHDT

```
/*
  This sample shows a simple digital functional test.

  Sample pattern:
  Stimulus channel OUT1 generates a clock signal
  Stimulus channel OUT2 generates a enable signal
  Response channel IN1 expects the inverted clock signal
  Response channel IN2 expects the direct clock signal if enable=high

  Pattern #    0     1     2     3     4     5     6     7

 Stimulus

                 _____       _____       _____       _____
  out1       _____|     |_____|     |_____|     |_____|
                                 _____________________________
  out2       ___________________|

  Response

             _____       _____       _____       _____
  in1             |_____|     |_____|     |_____|     |_____
                                 _____       _____       _____
  in2       XXXXXXXXXXXXXXXXXX       |_____|     |_____|

  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 "rsphdt.h"

#define PATTERN_COUNT       8

/* Pattern #                                    0  1  2  3  4  5  6  7 */
static ViUInt32 s_StimLvl[PATTERN_COUNT] = { 0, 1, 0, 3, 2, 3, 2, 3 };

static ViUInt32 s_RefLvl[PATTERN_COUNT]  = { 1, 0, 1, 2, 1, 2, 1, 2 };
static ViUInt32 s_RefCtrl[PATTERN_COUNT] = { 2, 2, 2, 0, 0, 0, 0, 0 };

static ViUInt32 s_RespLvl[PATTERN_COUNT];
static ViUInt32 s_RespCtrl[PATTERN_COUNT];

int main (int argc, char *argv[])
{
  ViInt32   idStim, idRef, exeResult;
  ViSession vi;
  ViStatus  status;
```

```
  /*
    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 = rsphdt_InitWithOptions("PXI1::11::0::INSTR",
                                  VI_TRUE,
                                  VI_TRUE,
                                  "Simulate=0,RangeCheck=1",
                                  & vi);
  /*
    stimulus data download
    only high / low pattern -> VI_NULL for tri-state information
  */
  status = rsphdt_LoadData(vi, RSPHDT_VAL_DATA_STIM, PATTERN_COUNT,
                           s_StimLvl, VI_NULL, & idStim);


  /*
    reference data download
  */
  status = rsphdt_LoadData(vi, RSPHDT_VAL_DATA_REF, PATTERN_COUNT,
                           s_RefLvl, s_RefCtrl, & idRef);

  /* set collection mode to data */
  status = rsphdt_ConfigureCollectionMode(vi, RSPHDT_VAL_COLLECT_DATA)
;

  /*
    configure stimulus ports

    voltage high            : 5.0 V
    voltage low             : 0.0 V
    current limit high level: 0.1 A
    current limit low level : 0.1 A
  */
  status = rsphdt_ConfigureStimPort(vi, RSPHDT_MASK_PORT_ALL,
                                    5.0, 0.0,
 0.1, 0.1);

 /*
    configure response ports

    voltage high threshold  : 2.4 V
    voltage low threshold   : 0.8 V
  */
  status = rsphdt_ConfigureRespPort(vi, RSPHDT_MASK_PORT_ALL, 2.4, 0.8
);
```

```
/*
  configure stimulus timing

  trigger delay  : 0.0 s
  pattern period : 1.0e-6 s
*/
status = rsphdt_ConfigureStimTiming(vi, 0.0, 1.0e-6);

/*
  configure response timing

  trigger delay  : 0.0  s
  pattern period : 1.0e-6 s
  response delay : 0.5e-6 s
*/
status = rsphdt_ConfigureRespTiming(vi, 0.0, 1.0e-6, 0.5e-6);

/*
  trigger source "immidiate" is default after reset
  start execution of stimulus and response part
*/
status = rsphdt_InitiateExecution(vi, idStim, idRef);

/*
  wait until execution has finished

  timeout :   10 ms
*/
status = rsphdt_WaitUntilExecutionComplete(vi, RSPHDT_VAL_BOTH, 10);

/* get the execution result */
status = rsphdt_FetchExecutionResult(vi, & exeResult);


if (exeResult != RSPHDT_VAL_RESULT_PASS)
{
  /* test failed */
  ViInt32  failedPatternCount, readRespPatternCnt;
  ViUInt32 failedChannels;

  /* fetch some execution results */
  status = rsphdt_FetchFailedPatternCount(vi, & failedPatternCount);
  status = rsphdt_FetchFailedChannels(vi, & failedChannels);

  /* fetch all the measured pattern */
  status = rsphdt_FetchData(vi, idRef, RSPHDT_VAL_DATA_RESP,
                            0, PATTERN_COUNT, s_RespLvl, s_RespCtrl,
                            & readRespPatternCnt);
}
```

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

 return 0;
}
```

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8 Self-Test

The High-Speed Digital Test Module R&S TS-PHDT 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 one second. 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

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8.2 Power on test

The power on test runs in parallel to the LED test. The following observations may be made about the different display states of the LEDs:

LED	Description
PWR LED (green) on	All power supply voltages are present
PWR LED (green) off	At least one power supply voltage is missing
ERR LED (red) off	If the green LED is turned on at the same time, no detectable error is present
ERR LED (red) on	Hardware error is present

Table 8-2 Observations about the power on test

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8.3 TSVP self-test

As part of the TSVP self test, an extensive test of the R&S TS-PHDT 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.

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.

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9 Interface description

9.1 Connector X1

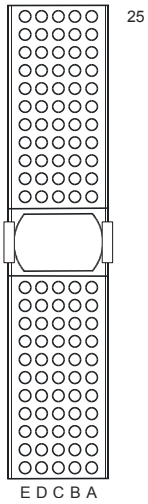

Figure 9-1 Connector X1 (view: plug side)

Pin	Z	E	D	C	B	A
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					
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

9.2 Connector X20

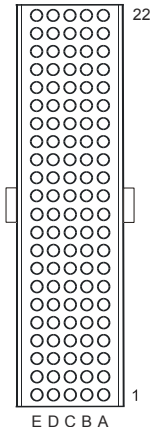

Figure 9-2 Connector X20 (view: plug side)

Pin	E	D	C	B	A
22	GA0	GA1	GA2	GA3	GA4
21					
20		GND		AUX1	AUX2
19	AUX1	AUX2		GND	
18	PXI_TRIG6		PXI_TRIG5	PXI_TRIG4	PXI_TRIG3
17	PXI_CLK10			GND	PXI_TRIG2
16	PXI_TRIG7	GND		PXI_TRIG0	PXI_TRIG1
15				GND	
14					
13					
12					
11					
10					
9					
8					
7					
6					
5					
4					
3				GND	
2					
1				GND	

Table 9-2 Pin assignment for connector X20

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9.3 Connector X10

Plug type DIN 41612, 96 pin, female

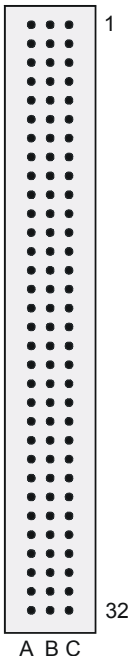

Figure 9-3 Connector X10 (view: front panel)

	A	B	C
1			
2			
3			
4			GND
5	OUT1	OUT2	OUT3
6	IN1	IN2	IN3
7	OUT4	OUT5	OUT6
8	IN4	IN5	IN6
9	OUT7	OUT8	
10	IN7	IN8	GND
11	OUT9	OUT10	OUT11
12	IN9	IN10	IN11
13	OUT12	OUT13	OUT14

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

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	A	B	C
14	IN12	IN13	IN14
15	OUT15	OUT16	
16	IN15	IN16	GND
17	OUT17	OUT18	OUT19
18	IN17	IN18	IN19
19	OUT20	OUT21	OUT22
20	IN20	IN21	IN21
21	OUT23	OUT24	
22	IN23	IN24	GND
23	OUT25	OUT26	OUT27
24	IN25	IN26	IN27
25	OUT28	OUT29	OUT30
26	IN28	IN29	IN30
27	OUT31	OUT32	
28	IN31	IN32	GND
29	XTO1	XTO2	XTI2
30	XTI1	BURST	AUX_CLK
31	SYNCIN	STIM_CLK	GND
32	SYNCOUT	RESP_CLK	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.

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9.4 Connector X30

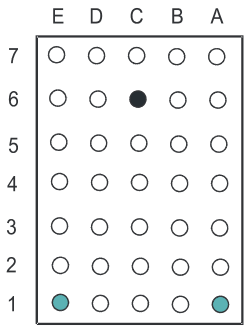

Figure 9-4 Connector X30 (view: plug side)

Pin	E	D	C	B	A
7					
6			GND		
5					
4					
3					
2					
1	ABD2				ABD1

Table 9-4 Pin assignment for connector X30

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10 Specifications

NOTE:

Technical data for the High-Speed Digital Test Module R&S TS-PHDT 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.

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