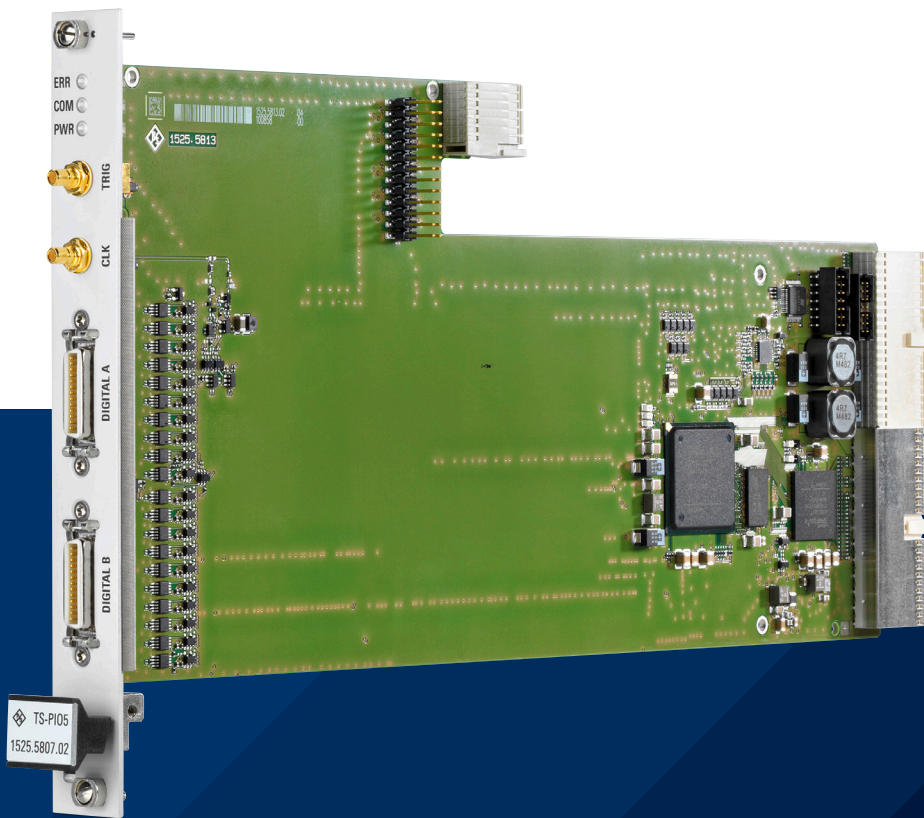


# R&S® TS-PI05 DIGITAL LVDS FUNCTIONAL TEST MODULE

Module with programmable bidirectional  
LVDS channels



Product Brochure  
Version 02.00

**ROHDE & SCHWARZ**

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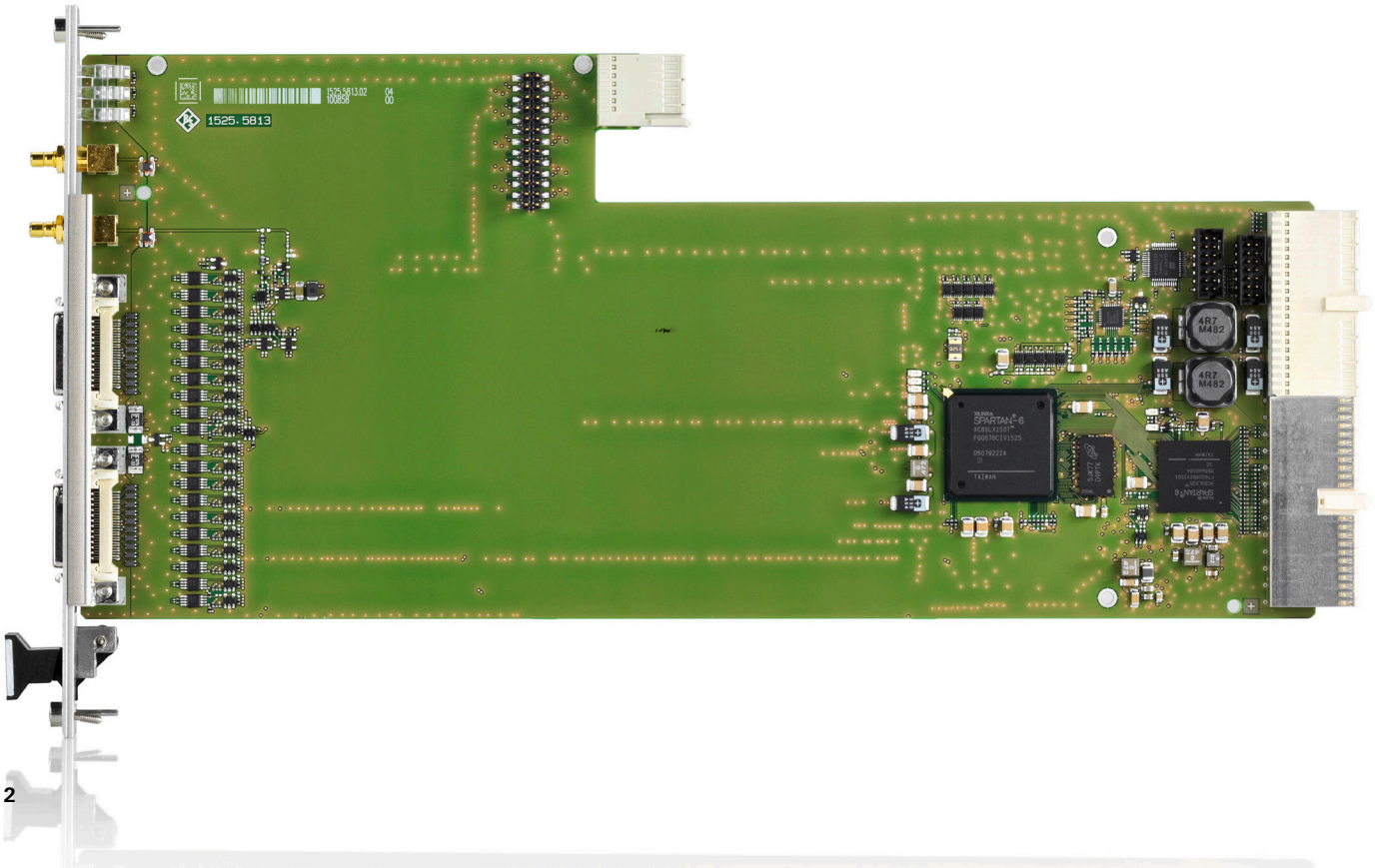


# AT A GLANCE

The R&S®TS-PI05 digital functional test module is a compact PXI device which takes up only one slot in the R&S®TSVP chassis.

## Key facts

- ▶ Two MDR connectors with 10 LVDS channels each (8 × data, 1 × general purpose, 1 × clock), bidirectional LVDM with fixed termination (100 Ω)
- ▶ Two single-ended control lines per connector
- ▶ +5 V/max. 0.30 A power supply available at each digital connector, protected by diode and fuse
- ▶ 10 channels RS-485 (RS-422) compatible I/O channels with interface connector onboard
- ▶ Pattern rate up to 200 Mbit, 5 ns resolution
- ▶ Stimulation of digital realtime data streams with 2 Mpattern memory onboard
- ▶ Acquisition of digital realtime data streams
- ▶ LVDS transceivers with internal ESD protection
- ▶ FPGA based flexibility and simultaneous task operation independent of the operating system
- ▶ Triggering (bidirectional) via PXI trigger bus, resolution based on PXI or external clock,  $\geq 10$  ns
- ▶ Synchronization via
  - TTL external clock input (SMB plug)
  - LVDS clock lines (MDR connector)
  - PXI clock 10 MHz
- ▶ Jitter and signal delay compensation in steps of typ. 2.5 ns, 180° phase shift or delay of numerous clock cycles (combination possible)
- ▶ Self-test software
- ▶ Software front panels for immediate use
- ▶ LabWindows/CVI device driver support
- ▶ Test software library GTSL in DLL format



# PRODUCT INTRODUCTION

The R&S®TS-PIO5 digital functional test module contains very flexibly programmable bidirectional LVDS channels to acquire and stimulate static or dynamic digital patterns. The channels are permanently terminated on board as the LVDM driver tolerates the resulting impedance of 100 Ω in driver mode. Synchronization to digital communications, handshake signals and analog measurement tasks are provided via trigger lines accessible at the front connector or via the PXI trigger lines. The module also generates trigger pulses derived from digital pattern comparisons and performs change detection at the input ports to interact with other slot cards inside the chassis.

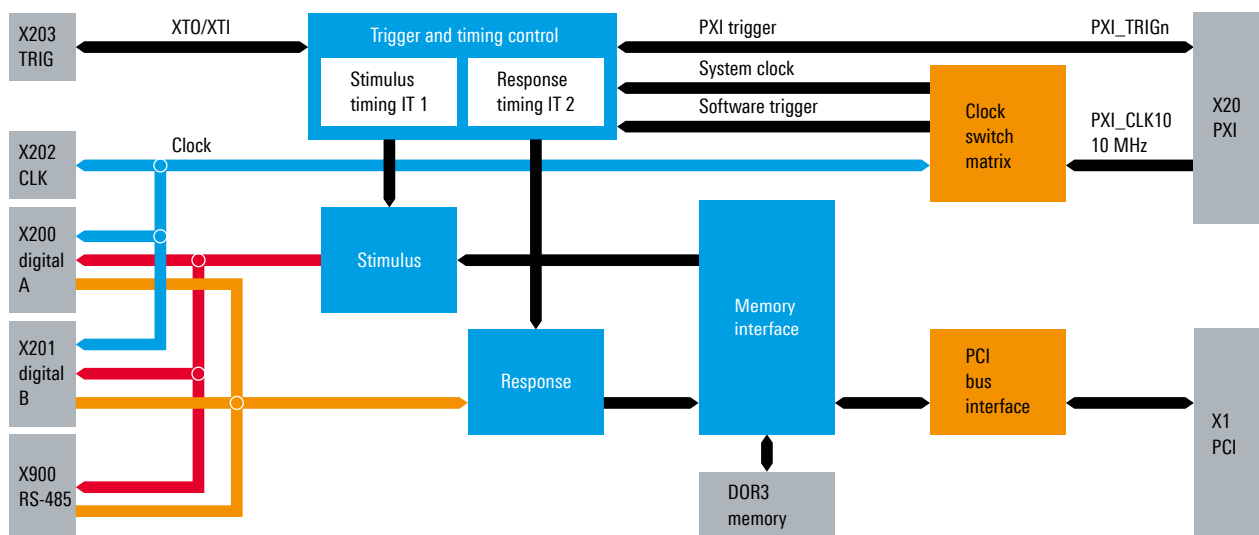
# FLEXIBILITY

The design of the module is very flexible for various application scenarios and high-speed pattern I/O. The programmability of the digital I/O interfaces meets a wide range of requirements regarding data transfer, communications and trigger settings.

If a higher number of digital I/O lines are required, multiple R&S®TS-PIO5 modules can be synchronized within the system or synchronized with other types of measurements via the PXI trigger bus.

To simplify update procedures, the onboard FPGA design can be easily downloaded. The firmware can be upgraded easily with new functionalities or enhancements.

## Functional block diagram



# TYPICAL APPLICATIONS

The R&S®TS-PIO5 digital functional test module is used in all test and measurement scenarios where LVDS based circuits have to be tested using static or dynamic digital patterns. DUT programming in production is a very efficient one-step approach to testing and uploading firmware to the DUTs in the test process.

Realistic simulation of the DUT's environment during testing is most important for many applications.

The R&S®TS-PIO5 therefore offers deterministic generation and simultaneous acquisition of digital patterns at high data rates. This includes tristate control and implementation of bidirectional buses by configuring channel wise connections of input and output lines by software.

Further applications are related to various programming tasks that have to be performed by state-of-the-art board test systems. The R&S®TS-PIO5 handles the most common programming procedures supported by software driver for downloading to flash memories and transferring data streams to onboard memory. Using a converter board LVDS/TTL high data rates can be transported over distance into the test application with the DUT to be programmed.

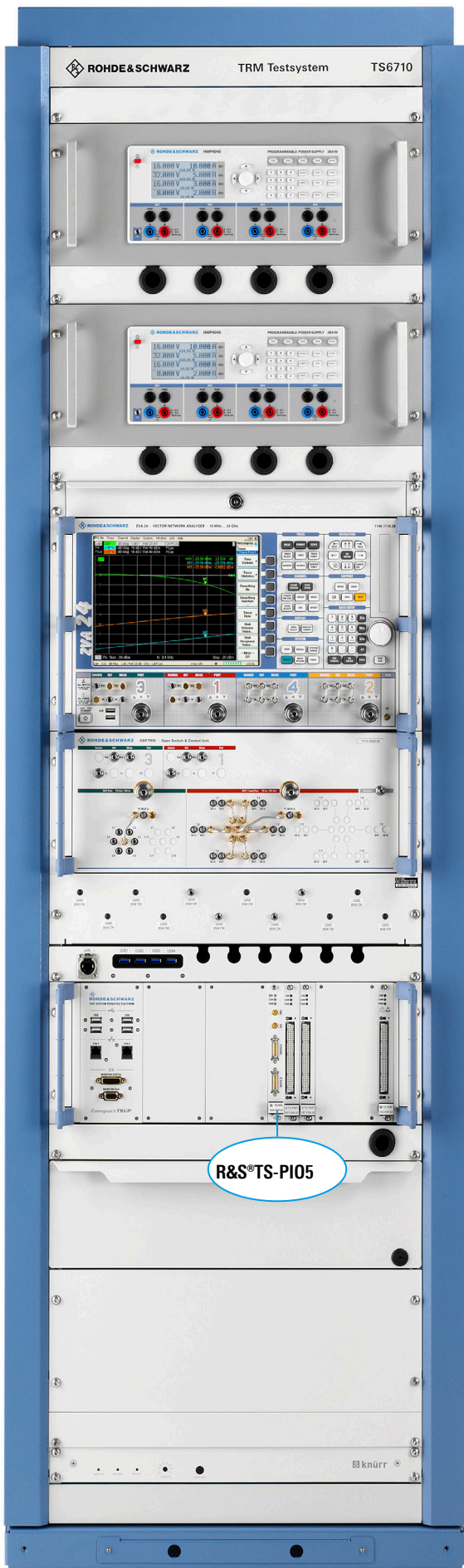
A sophisticated set of trigger setups provides flexible synchronization to DUT signals or synchronizes to multiple R&S®TS-PIO5 modules, Rohde&Schwarz measurement modules or commercially available PXI modules via the standardized PXI trigger bus.

Typical applications include:

- ▶ Digital functional test
- ▶ Download to flash memories, serial and parallel
- ▶ Deterministic stimulation and acquisition of digital data streams
- ▶ Digital I/O control (LVDS)
- ▶ Simulation of LVDM bus lines

R&S®TS7610 test system including R&S®TS-PIO5

R&S®TS-PIO5 digital functional test module



# SOFTWARE SUPPORT

A LabWindows/CVI driver for standardized device operation is available for the R&S®TS-PIO5. Function panels and online help are common features for the LabWindows/CVI driver.

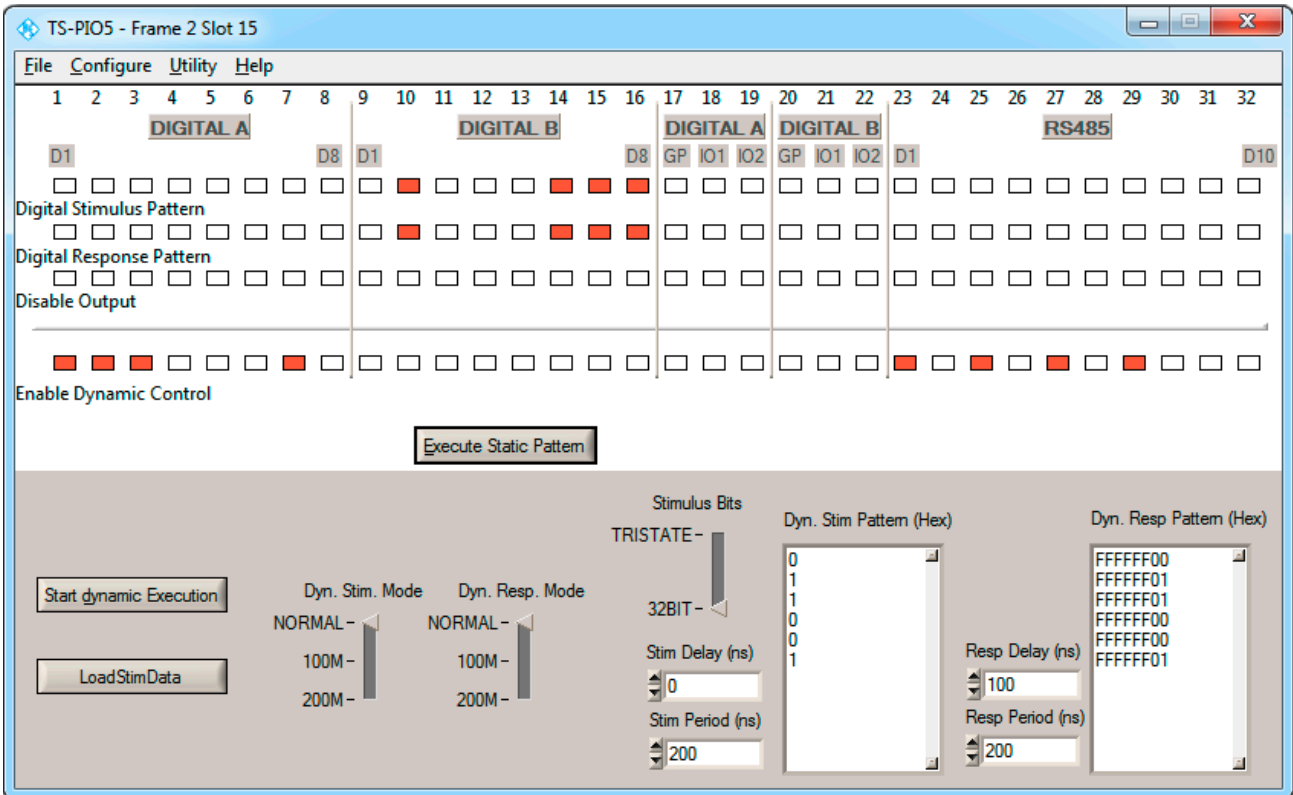
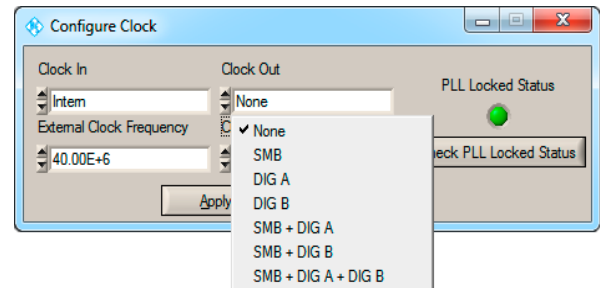
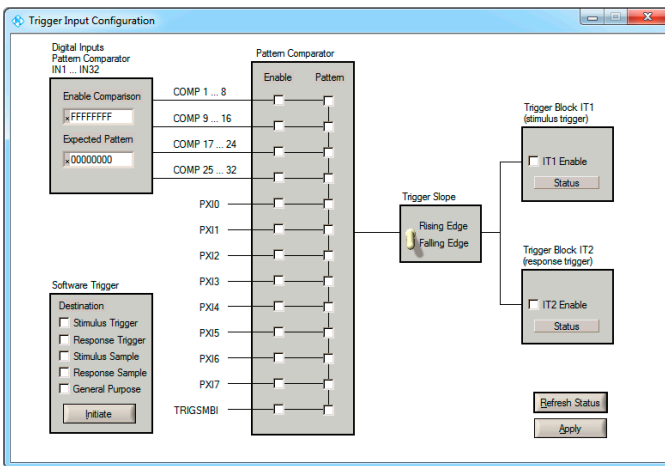
The definition and evaluation of complex digital test scenarios are supported by the Rohde&Schwarz generic test software library (GTSL) including the DIO manager.

With a set of software front panels users learn the module's various functions. Users evaluate test setups by simply using test panels rather than by means of programming.

Waveform data can be loaded into and retrieved from the module's onboard memory using the driver functions provided by the DIO manager library, which is part of the Rohde&Schwarz GTSL software package. The driver functionality also includes the synchronization of multiple modules and pattern sets.

# SELF-TEST AND DIAGNOSTICS FOR RELIABLE OPERATION

The built-in self-test capability of the module and the related self-test application ranges from fast diagnostics to the complete, automated evaluation of output channels and trigger lines. Diagnostic LEDs on the module front panel speed-up system integration and indicate proper operation at a glance.



# SPECIFICATIONS

## Specifications

### Application in R&S®TSVP platform

PXI module 1 slot required

### Interfaces

|                       |   |
|-----------------------|---|
| Control bus           | PXI   |
| DUT connector (front) | 2 × Mini D Ribbon (MDR) 26 contact connectors,<br>2 × SMB plug connectors |
| Rear I/O connector    | CompactPCI connector, 110 pins  |
| Side connector        | RS-485<br>Semtec terminal strips (2.54 mm)                                |

### Module features

#### Front connectors

|             |                                    |   |
|-------------|------------------------------------|---|
| DIGITAL A/B | 2 × Mini D Ribbon (MDR) connectors | 2 × 8 LVDM data I/O channels,<br>2 × 1 LVDM general purpose I/O channels,<br>2 × 1 LVDM clock I/O channel,<br>2 × 2 LVTTTL digital I/O channels |
| CLK, TRIG   | 2 × SMB connectors                 | 1 clock I/O channel, 1 trigger I/O channel  |

#### LVDS channels (data input mode)

|                            |                       |   |
|----------------------------|-----------------------|---|
| DIGITAL A/B                |                       | 2 × MDR connectors                          |
| Input modes                | half-duplex operation | LVDM with termination 100 Ω                 |
| Difference input voltage   |                       | max. ±600 mV                                |
| Difference input threshold |                       | min. ±100 mV                                |
| Input resistance           |                       | 100 Ω                                       |
| Real-time acquisition      | sample rate (SDR)     | 0.01 bit/s to 100 Mbit/s (10 ns resolution) |
|                            | sample rate (DDR)     | 200 Mbit/s (only for data channels)         |

#### LVDS channels (data output mode)

|                      |   |   |
|----------------------|---|---|
| DIGITAL A/B          |   | 2 × MDR connectors                                      |
| Output modes         | half-duplex operation                     | LVDM with termination 100 Ω                             |
| Output voltage       | VOD , into 50 Ω load (double termination) | min. 247 mV, max. 454 mV                                |
| Output current       | IOS                                       | max. 10 mA  |
| Tristate control     |   | programmable per channel and up to 50 Mbit/s per sample |
| Realtime stimulation | sample rate (SDR)                         | 0.01 bit/s to 100 Mbit/s (10 ns resolution)             |
|                      | sample rate (DDR)                         | 200 Mbit/s (only for data channels)                     |

#### TTL channels (input/output mode)

|   |  |   |
|---|--|---|
| DIGITAL A/B                             |  | 2 × MDR connectors  |
| Input/output mode                       | voltage                                | 3.3 V logic; 10 kΩ pullup onboard   |
| Realtime stimulation/acquisition        | sample rate                            | 0.01 bit/s to 50 Mbit/s (10 ns resolution)  |
| Connector                               | onboard connector                      | pin connector (terminal strips 2.54 mm)   |
| Input/output mode                       |  | RS-485/RS-422 signal level, 10 bidirectional channels,<br>no RS-485 serial protocol |
| Realtime stimulation/acquisition        | sample rate                            | 0.01 bit/s to 20 Mbit/s with 10 ns resolution                                       |
| Realtime stimulation/acquisition memory | data buffer depth/width (programmable) | 2 Mpattern at 32 bit (18 × LVDS, 4 × TTL, 10 × RS-485)                              |

#### External clock

|             |                      |  |
|-------------|----------------------|--|
| DIGITAL A/B | input/output voltage | according to LVDS channels, 2 × MDR connectors |
|             | frequency range      | 20 MHz to 50 MHz                               |
| CLK         | input/output voltage | 3.3 V TTL logic (SMB plug)                     |
|             | frequency range      | 20 MHz to 50 MHz                               |

#### Trigger

|      |                      |                            |
|------|----------------------|----------------------------|
| TRIG | input/output voltage | 3.3 V TTL logic (SMB plug) |
| PXI  | input/output voltage | 8 × PXI, 5 V TTL logic     |

#### Synchronization

|                              |                       |   |
|------------------------------|-----------------------|---|
| Trigger units                | applications          | 2 × full independent hardware trigger logic:<br>▶ programmable trigger generator<br>▶ generation of real-time stimulation clock<br>▶ generation of real-time acquisition clock<br>▶ frequency measurement |
| Trigger unit characteristics | reference pattern     | 10 bit, 3 states: high, low, don't care   |
|                              | slope                 | positive/negative   |
|                              | trigger delay setting | 0 s to 100 s (10 ns resolution)   |
|                              | output signals        | ▶ trigger received signal (pulse)<br>▶ trigger active signal (start of trigger until burst end)<br>▶ sample pulse (pulse for each sample)   |

## Specifications

|                                 |   |   |
|---------------------------------|---|---|
| Synchronization inputs          | channels  | 1 × TTL trigger (TRIG),<br>8 × PXI trigger bus,<br>1 × pattern comparator   |
| Synchronization outputs         | channels  | 1 × TTL trigger (TRIG),<br>8 × PXI trigger bus  |
|                                 | signals   | ▶ output trigger unit 1 (IT1)<br>▶ output trigger unit 2 (IT2)<br>▶ TTL signal (TRIG)   |
| <b>General data</b>             |   |   |
| Power consumption               |   | 5 V: typ. 1 A, 3.3 V: typ. 1 A  |
| <b>Environmental conditions</b> |   |   |
| Temperature                     | operating temperature range   | +5°C to +40°C   |
|                                 | storage temperature range   | -10°C to +60°C  |
| Damp heat                       |   | +40°C, 80% rel. humidity, steady state,<br>in line with EN 60068-2-78   |
| Altitude                        | operating   | up to 2000 m  |
| <b>Mechanical resistance</b>    |   |   |
| Vibration                       | sinusoidal  | in line with EN 60068-2-6,<br>frequency range: 5 Hz to 55 Hz,<br>displacement: 0.3 mm (peak-to-peak) (1.8 g at 55 Hz),<br>frequency range: 55 Hz to 150 Hz,<br>acceleration: 0.5 g constant |
|                                 | random  | in line with EN 60068-2-64,<br>8 Hz to 500 Hz, acceleration 1.2 g (RMS); 5 min/axis   |
| Shock                           |   | shock test in line with MIL-STD-810G,<br>method 516.6, procedure I:<br>shock response spectrum ramp 6 dB/octave up to 45 Hz,<br>45 Hz to 2000 Hz: max. 40 g                                 |
| <b>Product conformity</b>       |   |   |
| Electromagnetic compatibility   | EU: in line with EMC Directive 2014/30/EC   | applied harmonized standards:<br>▶ EN 61326-1 (industrial environment)<br>▶ EN 61326-2-1<br>▶ EN 55011 Group 1, Class A   |
| Electrical safety               | EU: in line with<br>Low Voltage Directive 2014/35/EC  | applied harmonized standard:<br>EN 61010-1  |
|                                 | USA   | applied standard: UL 61010  |
|                                 | Canada  | applied standard: CSA-C22.2 No. 61010-1   |
| RoHS                            | EU: in line with the restriction of the use of<br>hazardous substances in electrical and electronic<br>equipment 2011/65/EU | compliant;<br>applied harmonized standard: EN IEC 63000   |
| Dimensions                      | W × H × D   | 316 mm × 174 mm × 20 mm (12.4 in × 6.8 in × 0.8 in)   |
| Weight                          |   | 0.21 kg (0.47 lb)   |

# ORDERING INFORMATION

| Designation   | Type        | Order No.    |
|---|-------------|--------------|
| LVDS digital functional test module                         | R&S®TS-PIO5 | 1525.5807.02 |
| Cable for Mini D Ribbon 26 contact connectors, SMU-Z6 cable | R&S®TVR290  | 1415.0201.02 |

| Service options   | Type                |   |
|---|---------------------|---|
| Extended warranty, one/two/three/four year(s)                           | R&S®WE1/WE2/WE3/WE4 | Please contact your local Rohde & Schwarz sales office. |
| Extended warranty with calibration coverage, one/two/three/four year(s) | R&S®CW1/CW2/CW3/CW4 |   |

### Extended warranty with a term of one to four years (WE1 to WE4)

Repairs carried out during the contract term are free of charge<sup>1)</sup>. Necessary calibration and adjustments carried out during repairs are also covered.

### Extended warranty with calibration (CW1 to CW4)

Enhance your extended warranty by adding calibration coverage at a package price. This package ensures that your Rohde & Schwarz product is regularly calibrated, inspected and maintained during the term of the contract. It includes all repairs 5 and calibration at the recommended intervals as well as any calibration carried out during repairs or option upgrades.

<sup>1)</sup> Excluding defects caused by incorrect operation or handling and force majeure. Wear-and-tear parts are not included.

## Service that adds value

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

## Rohde & Schwarz

The Rohde&Schwarz technology group is among the trail-blazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks&cybersecurity. Founded more than 85 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

[www.rohde-schwarz.com](http://www.rohde-schwarz.com)

## Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

## Rohde & Schwarz training

[www.training.rohde-schwarz.com](http://www.training.rohde-schwarz.com)

## Rohde & Schwarz customer support

[www.rohde-schwarz.com/support](http://www.rohde-schwarz.com/support)

