

R&S® TS-PAM SIGNAL ANALYZER MODULE

Eight-channel waveform analyzer



Product Brochure
Version 03.00

ROHDE & SCHWARZ

Make ideas real



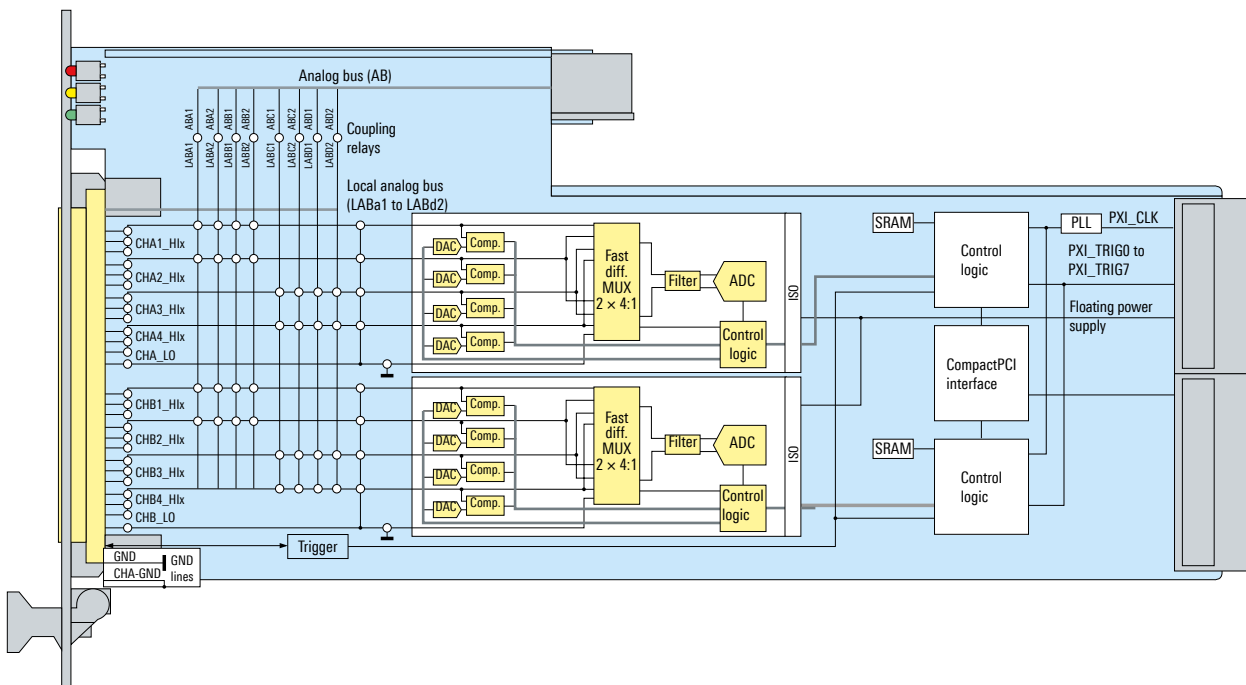
AT A GLANCE

The R&S®TS-PAM signal analyzer module is a PXI module that takes up only one slot in the R&S®TSVP chassis.

Key facts

- ▶ Two fully independent, floating acquisition units with operating voltage up to 120 V DC
- ▶ Acquisition modes with up to eight single-ended or four differential channels
- ▶ High sampling rate of 20 Msample/s for two channels
- ▶ Multichannel signal recording for up to eight channels at 5 Msample/s
- ▶ Synchronous acquisition of eight programmable comparator signals and PXI trigger
- ▶ Wide dynamic range with 14 bit resolution
- ▶ Input ranges from ± 0.2 V to ± 100 V DC (measurement voltage maximum 120 V)
- ▶ 3:1 relay multiplexer per channel
- ▶ 2×1 Msample memory depth
- ▶ Analog and digital trigger signals
- ▶ Analog measurement bus access to eight bus lines
- ▶ Self-test capabilities
- ▶ Soft front panel support for immediate deployment
- ▶ LabWindows/CVI driver support
- ▶ Generic test software library (GTSL) in DLL format

Functional block diagram



PRODUCT INTRODUCTION

The R&S®TS-PAM module contains two fully independent floating acquisition units that can have different ground reference levels. Each unit contains four input channels with a 3:1 relay multiplexer per channel.

Due to its wide dynamic range with 14-bit resolution, high sampling rate of up to 20 Msample/s and the deep onboard data buffer, the R&S®TS-PAM handles many sampling voltmeter, counter and oscilloscope applications in the fields of automotive, military and communications electronics.

The programmable measurement range and flexible multichannel acquisition permit a variety of signal configurations to be measured. Comprehensive trigger capabilities and single-ended or differential inputs enable flexible data acquisition particularly in production testing:

- ▶ Multichannel data acquisition
- ▶ Waveform analysis
- ▶ Timing analysis
- ▶ Mixed signal oscilloscope
- ▶ High side current measurements

In high speed sampling mode, the input signal can be acquired with optimal time resolution for waveform and timing analysis.

Additionally, the results of the remaining input signals compared with programmable thresholds can be acquired synchronously to build a mixed signal scope.

The multichannel mode is used if parallel signals have to be recorded and analyzed or timing relationships between signals have to be determined.

Sampling modes and frequencies can be selected independently for each acquisition unit.

The input signal sensitivity is programmable for each input channel so that high-level signals of 100 V and low-level signals of some millivolts can be acquired in parallel. In particular, precision high-side current shunt measurements or low-level signals requiring high noise suppression can benefit from the module's differential input mode. Two single-ended channels can be used to form a differential input channel with high common mode rejection.

The floating measurement technology enables the card to support single-channel measurements on high voltage potentials with nearly 100 times better precision than is possible with standard DSOs or data acquisition cards.

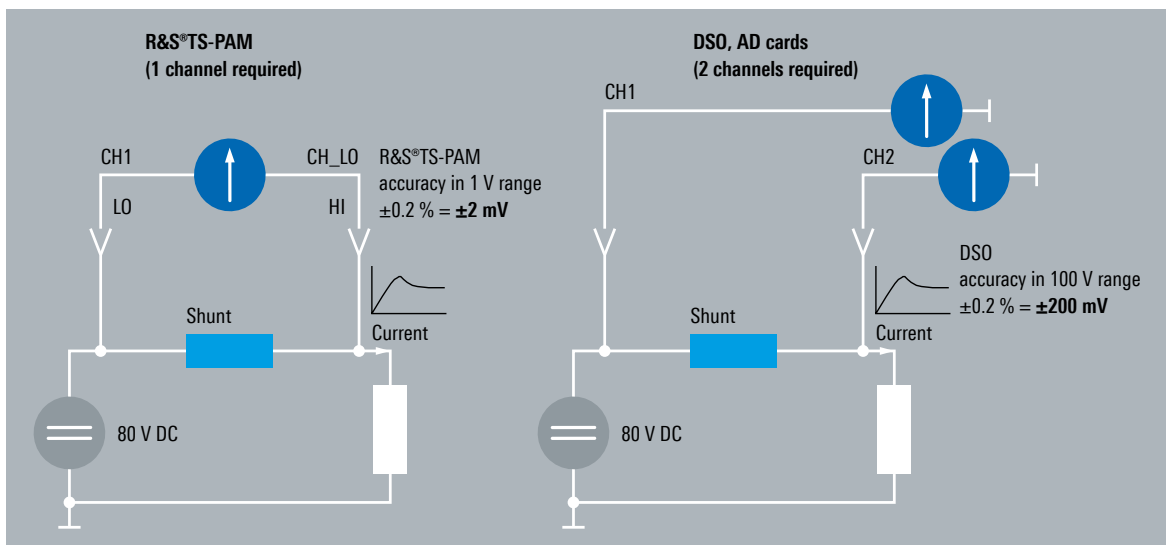
Up to 32 test signals can be directly applied to the front connector of the module. The integrated 3:1 relay multiplexer of each channel and the eight local analog bus inputs reduce adaptation cost and increase the total number of high bandwidth channels.

If more channels are needed, the R&S®TS-PAM functionality can be routed to the Rohde&Schwarz switching cards using the internal analog measurement bus of the chassis.

The R&S®TS-PAM allows continuous data storage to the deep onboard memory with pre- and post-triggering capability.

Trigger signals can be received and generated to synchronize multiple instruments such as signal sources or digital measurement modules in complex application scenarios.

Floating measurement example



Each input channel can be used as a flexible trigger source with programmable level and edge selection.

In addition, eight PXI trigger signals and two dedicated local digital trigger inputs at the front connector of the module can be selected.

The trigger condition and sampling frequency can be selected separately for each acquisition unit, allowing slow and fast signals to be measured in parallel with optimal timing.

Each acquisition unit has four separate programmable comparator references for triggering or mixed signal data acquisition.

- ▶ Rise and fall time of slopes
- ▶ Pulse width
- ▶ Event counting (slopes, maxima, minima)
- ▶ Time measurement between events
- ▶ Waveform comparison
- ▶ Calculation of reference and limit curves
- ▶ Loading and storing in files
- ▶ Display of curves with reference and markers
- ▶ Separate R&S®TS-LAA audio library available to support the functions
- ▶ RMS calculation
- ▶ Single-/multitone frequency response
- ▶ Distortion
- ▶ Filters (lowpass, highpass, bandpass, bandstop, ITU-R weighted/unweighted)

SOFTWARE SUPPORT

A LabWindows/CVI driver conforming to the IVI standard is available for the module's analyzer functions. All other hardware functional groups are operated via specific driver extensions.

Functional panels and online help are available as common features for the LabWindows/CVI driver, which is available as a DLL file and ready to be used in various programming environments.

A free-of-charge signal analysis library allows digital signal processing and waveform analysis after data acquisition:

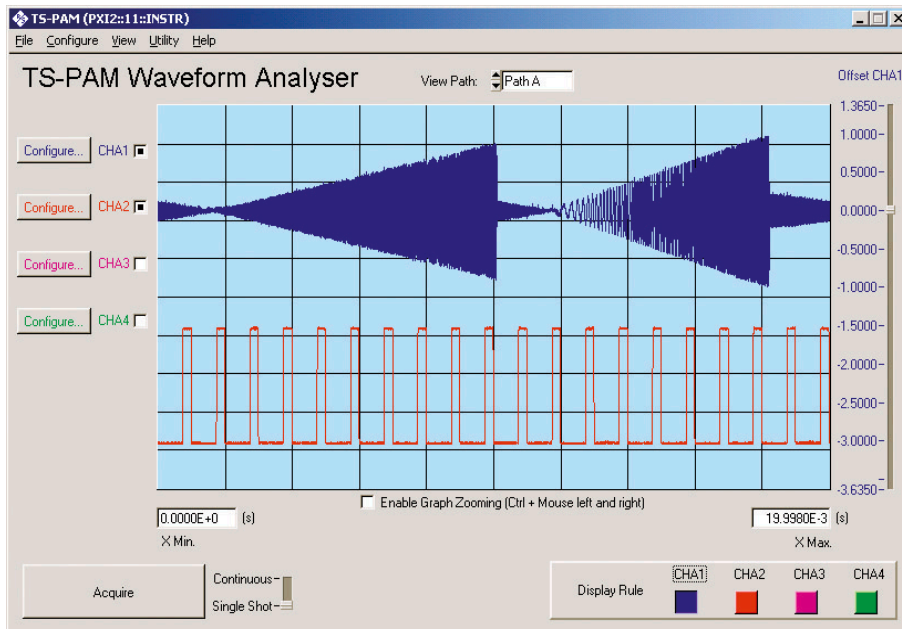
- ▶ Average and RMS voltage
- ▶ Maximum and minimum values (absolute and relative), peak, peak-to-peak
- ▶ Frequency, period duration

SECURITY THROUGH SELF-TEST AND DIAGNOSTIC FEATURES

The built-in self-test capability of the module ranges from fast diagnostics to the complete, automated evaluation of input levels, trigger lines and all switching paths.

Using the onboard reference voltage sources, the module self-test can perform a static check of each input channel. A comprehensive dynamic module test is possible via the analog bus in conjunction with the R&S®TS-PSAM module.

Diagnostic LEDs on the module front panel speed up system integration and allow proper operation to be determined at a glance.



Software front panel

SPECIFICATIONS

Application in the R&S®TSVP platform

| | | |
|-----------------------|--|-----------------------------------|
| PXI module | | 1 slot required |
| Interface | | |
| Control bus | | PXI |
| DUT connector (front) | | DIN41612, 96 pins |
| Rear I/O connector | | CompactPCI connector J2, 110 pins |

Module features

| | | |
|-------------------------------|------------------------------|-----------------------------|
| Number of acquisition units | independent, floating | 2 |
| Number of channels | | |
| Single-channel mode | per unit | 1 |
| Multichannel mode | per unit | 4 |
| Number of inputs | | |
| Relay multiplexer | per channel | 3:1 |
| Analog measurement bus access | per channel | 4 bus lines |
| Input configurations | | |
| | | single-ended, differential |
| Timing | | |
| Sample rate | single-channel mode | 20 sample/s to 20 Msample/s |
| | multichannel mode | 5 sample/s to 5 Msample/s |
| Reference clock accuracy | PXI clock of chassis, 10 MHz | ±(1.5 ppm + 1 ppm/year) |
| Memory size | per unit | 1 Msample |

Input characteristics

| | | |
|---|------------------------------------|---|
| Input bandwidth | | 4 MHz |
| Lowpass filter analog | | off, 400 Hz, 100 kHz |
| Lowpass filter digital | software Butterworth IIR 8th order | cut-off frequency: 0.2 × sampling frequency |
| Crosstalk | < 10 V range at 1 MHz | typ. -70 dB |
| | ≥ 10 V range at 1 MHz | typ. -50 dB |
| Coupling | | DC |
| Isolation (unit-to-unit, unit-to-earth) | | 120 V DC |
| Overvoltage protection | | ±200 V DC |

Synchronization

| | | |
|---------------------------|----------|-----------------------|
| Trigger inputs | per unit | 4 × analog trigger |
| | | 1 × TTL |
| | | 8 × PXI trigger lines |
| Analog trigger resolution | | 12 bit |
| Trigger outputs | per unit | 1 × TTL |
| | | 8 × PXI trigger lines |

Analog measurement bus access and relay multiplexer

| | | |
|---|----|------------------|
| Switching voltage | DC | 120 V |
| | AC | max. 50 V (RMS) |
| Switching current | | max. 1 A |
| Switching power | DC | max. 10 W |
| | AC | max. 10 VA (RMS) |
| Isolation (unit-to-unit, unit-to-earth) | | 120 V DC |

| Range characteristics | | | |
|-----------------------|---------------------|-------------|---|
| Range | Voltage level range | Resolution | Input impedance |
| 0.2 V | -0.2 V to +0.2 V | 30 μ V | > 10 M Ω , 1 M Ω selectable |
| 0.5 V | -0.5 V to +0.5 V | 75 μ V | > 10 M Ω , 1 M Ω selectable |
| 1 V | -1 V to +1 V | 150 μ V | > 10 M Ω , 1 M Ω selectable |
| 2 V | -2 V to +2 V | 300 μ V | > 10 M Ω , 1 M Ω selectable |
| 5 V | -5 V to +5 V | 750 μ V | > 10 M Ω , 1 M Ω selectable |
| 10 V | -10 V to +10 V | 1.5 mV | 1 M Ω |
| 20 V | -20 V to +20 V | 3 mV | 1 M Ω |
| 50 V | -50 V to +50 V | 7.5 mV | 1 M Ω |
| 100 V | -100 V to +100 V | 15 mV | 1 M Ω |

DC measurement accuracy

Conditions

| | |
|--|--------------------------------------|
| Temperature range | +23 °C \pm 5 °C |
| Additional error specified by the temperature coefficient in the range | +5 °C to +18 °C and +28 °C to +40 °C |
| Warm-up time | 30 min |

Single-ended (SE)

| Range | Gain error | Offset error ^{1),2)} with digital filter | | Offset error ^{1),2)} without digital filter | |
|-------|------------|---|----------------------|--|---------------------------|
| | | BW \leq 100 kHz | Full BW | BW \leq 100 kHz | Full BW |
| | | 0.2 V | 0.1 % | 400 μ V | 600 μ V ³⁾ |
| 0.5 V | 0.1 % | 500 μ V | 1 mV ³⁾ | 750 μ V | 2 mV ³⁾ |
| 1 V | 0.1 % | 1 mV | 1.5 mV ³⁾ | 1.5 mV | 3 mV ³⁾ |
| 2 V | 0.1 % | 2 mV | 2 mV | 2.6 mV | 4 mV |
| 5 V | 0.1 % | 5 mV | 5 mV | 6.5 mV | 10 mV |
| 10 V | 0.1 % | 10 mV | 10 mV | 13 mV | 20 mV |
| 20 V | 0.1 % | 20 mV | 20 mV | 26 mV | 40 mV |
| 50 V | 0.1 % | 50 mV | 50 mV | 65 mV | 100 mV |
| 100 V | 0.1 % | 100 mV | 100 mV | 130 mV | 200 mV |

V_{DC} : absolute value of reading
 E_{Gain} : gain error
 E_{Offset} : offset error
 $E_{SE} = E_{Gain} \times V_{DC} + E_{Offset}$: total error
 $ACC_{SE} = \pm(E_{SE})$: accuracy for a single-ended DC measurement

¹⁾ Ground-referenced measurement.

²⁾ Additional error in multichannel mode: $\pm 0.1\%$ of range.

³⁾ Additional error for sample rate > 1 MHz: $\pm 0.1\%$ of range.

DC measurement accuracy

Temperature coefficient (TC) in °C

| Range | TC gain error | TC offset error |
|-------|---------------|-----------------|
| 0.2 V | 0.016% | 80 µV |
| 0.5 V | 0.011% | 83 µV |
| 1 V | 0.01% | 150 µV |
| 2 V | 0.01% | 260 µV |
| 5 V | 0.01% | 650 µV |
| 10 V | 0.01% | 130 µV |
| 20 V | 0.01% | 2.6 mV |
| 50 V | 0.01% | 6.5 mV |
| 100 V | 0.01% | 13 mV |

| | |
|--|---|
| E_{TC_Gain} : | TC gain error |
| E_{TC_Offset} : | TC offset error |
| ΔT : | temperature beyond the range (e.g. $T = +38^\circ\text{C} \rightarrow \Delta T = +10^\circ\text{C}$) |
| $TC = E_{TC_Gain} \times V_{DC} + E_{TC_Offset}$: | temperature coefficient in °C |
| $E_{TC} = TC \times \Delta T$: | additional error because of temperature coefficient |
| $ACC_{SE_TC} = \pm(E_{SE} + E_{TC})$: | accuracy with additional error because of temperature coefficient |

Differential

For differential measurements, the range must be set to the same value for both channels involved.

| Range | Common mode error (ECM) |
|-------|-------------------------|
| 0.2 V | 0.1% |
| 0.5 V | 0.1% |
| 1 V | 0.2% |
| 2 V | 0.2% |
| 5 V | 0.2% |
| 10 V | 0.4% |
| 20 V | 0.4% |
| 50 V | 0.4% |
| 100 V | 0.4% |

| | |
|---|--|
| V_1 : | ground-referenced voltage of first channel |
| V_2 : | ground-referenced voltage of second channel |
| E_{SE} : | error of a corresponding single-ended DC measurement |
| $ACC_{Diff} = \pm(1.4 \times E_{SE} + E_{CM} \times (V_{DC1} + V_{DC2})/2)$: | accuracy for a differential measurement |

| General data | | |
|----------------------------------|---|--|
| Power consumption | | typ. +5 V: 5 A, +3.3 V: 0.5 A (incl. R&S®TS-PDC) |
| Environmental conditions | | |
| 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, in line with EN60068-2-78 |
| Altitude | operating | up to 2000 m |
| Mechanical resistance | | |
| Vibration | sinusoidal | in line with EN60068-2-6, frequency range: 5 Hz to 55 Hz, displacement: 0.3 mm (peak-to-peak) (1.8 g at 55 Hz), frequency range: 55 Hz to 150 Hz, acceleration: 0.5 g constant |
| | random | in line with EN60068-2-64, 8 Hz to 500 Hz, acceleration 1.2 g (RMS); 5 min/axis |
| Shock | | shock test in line with MIL-STD-810G, method 516.6, procedure I: shock response spectrum ramp 6 dB/octave up to 45 Hz, 45 Hz to 2000 Hz: max. 40 g |
| Product conformity | | |
| Electromagnetic compatibility | EU: in line with EMC Directive 2014/30/EC | applied harmonized standards: ▶ EN61326-1 (industrial environment) ▶ EN61326-2-1 ▶ EN55011 Group 1, Class A |
| Electrical safety | EU: in line with Low Voltage Directive 2014/35/EC | applied harmonized standard: EN61010-1 |
| | USA | applied standard: UL61010 |
| | Canada | applied standard: CSA-C22.2 No. 61010-1 |
| RoHS | EU: in line with the restriction of the use of hazardous substances in electrical and electronic equipment 2011/65/EU | compliant; applied harmonized standard: EN IEC63000 |
| Dimensions | W × H × D | 20 mm × 174 mm × 316 mm (0.79 × 6.85 in × 12.44 in) |
| Weight | incl. R&S®TS-PDC (140 g/0.3 lb) | 631 g (1.39 lb) |
| Recommended calibration interval | | 12 months |

ORDERING INFORMATION

| Designation | Type | Order No. |
|---|------------|--------------|
| Signal analyzer module (incl. R&S®TS-PDC) | R&S®TS-PAM | 1157.9410.02 |

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

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 trailblazers 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

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

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