

# R&S® TS-PAM SIGNAL ANALYZER MODULE

Eight-channel waveform analyzer



Product Brochure  
Version 03.00

**ROHDE & SCHWARZ**

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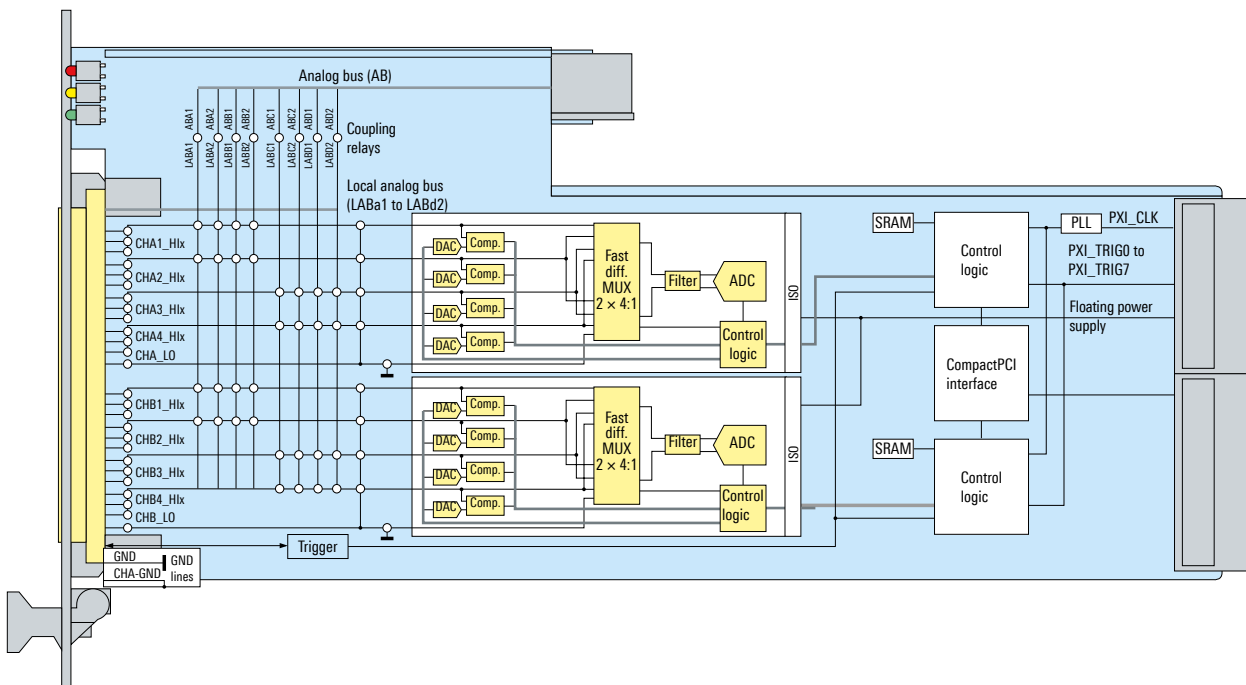
# AT A GLANCE

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  $\pm 0.2$  V to  $\pm 100$  V DC (measurement voltage maximum 120 V)
- ▶ 3:1 relay multiplexer per channel
- ▶  $2 \times 1$  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.

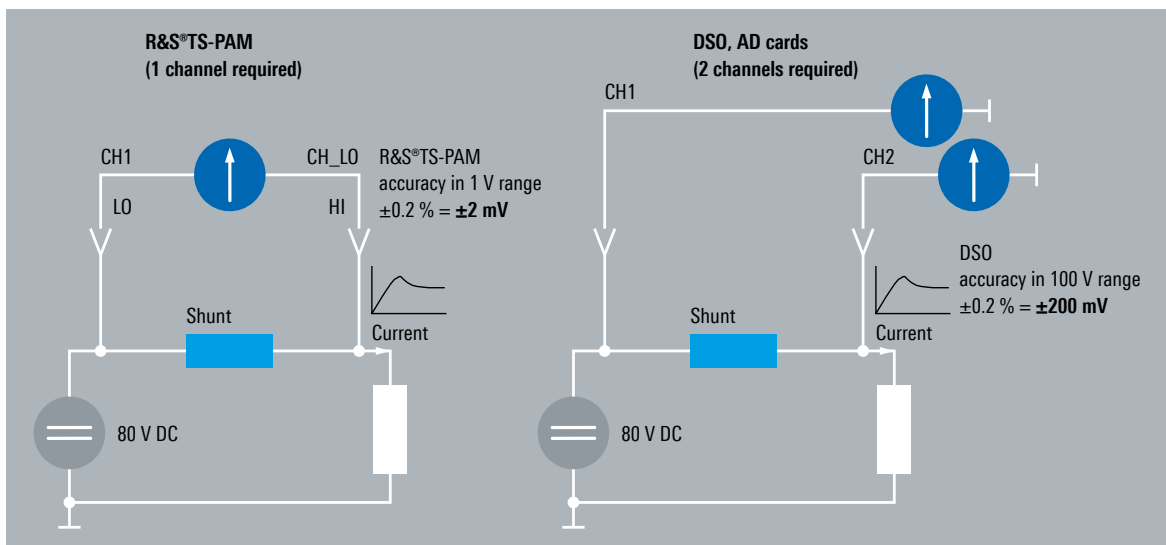
Up to 32 test signals can be directly applied to the front connector of the module. The integrated 3:1 relay multiplexer of each channel and the eight local analog bus inputs reduce adaptation cost and increase the total number of high bandwidth channels.

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:

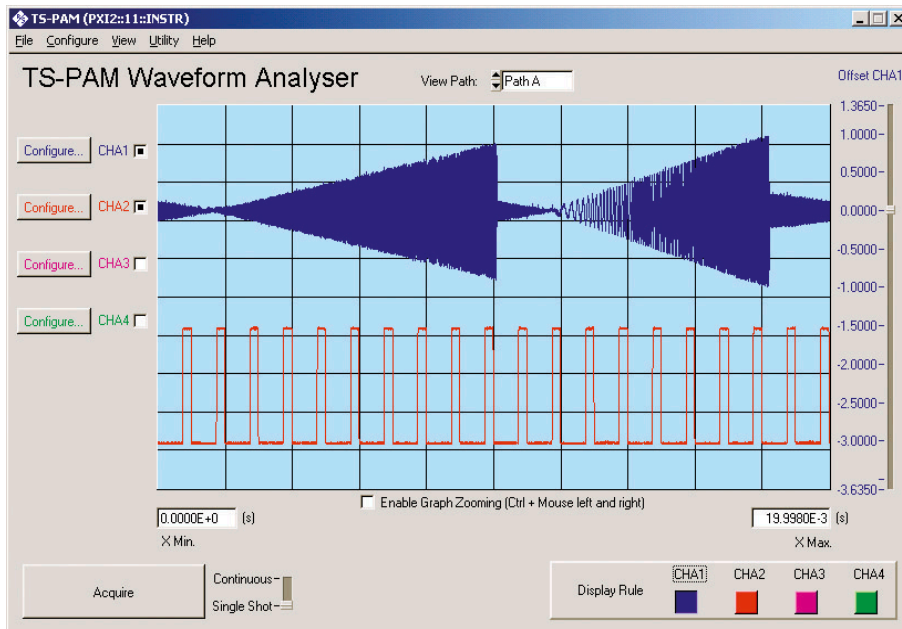
- ▶ Average and RMS voltage
- ▶ Maximum and minimum values (absolute and relative), peak, peak-to-peak
- ▶ Frequency, period duration

## 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 $\mu$ V	> 10 M $\Omega$ , 1 M $\Omega$ selectable
0.5 V	-0.5 V to +0.5 V	75 $\mu$ V	> 10 M $\Omega$ , 1 M $\Omega$ selectable
1 V	-1 V to +1 V	150 $\mu$ V	> 10 M $\Omega$ , 1 M $\Omega$ selectable
2 V	-2 V to +2 V	300 $\mu$ V	> 10 M $\Omega$ , 1 M $\Omega$ selectable
5 V	-5 V to +5 V	750 $\mu$ V	> 10 M $\Omega$ , 1 M $\Omega$ selectable
10 V	-10 V to +10 V	1.5 mV	1 M $\Omega$
20 V	-20 V to +20 V	3 mV	1 M $\Omega$
50 V	-50 V to +50 V	7.5 mV	1 M $\Omega$
100 V	-100 V to +100 V	15 mV	1 M $\Omega$

## 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 <sup>1),2)</sup> with digital filter		Offset error <sup>1),2)</sup> without digital filter	
		BW $\leq$ 100 kHz	Full BW	BW $\leq$ 100 kHz	Full BW
		0.2 V	0.1 %	400 $\mu$ V	600 $\mu$ V <sup>3)</sup>
0.5 V	0.1 %	500 $\mu$ V	1 mV <sup>3)</sup>	750 $\mu$ V	2 mV <sup>3)</sup>
1 V	0.1 %	1 mV	1.5 mV <sup>3)</sup>	1.5 mV	3 mV <sup>3)</sup>
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

<sup>1)</sup> Ground-referenced measurement.

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

<sup>3)</sup> 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
$\Delta T$ :	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](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

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