

R&S®TS-ISC IN-SYSTEM CALIBRATION KIT

On-site calibration solution for R&S®TSVP



Product Brochure
Version 03.00

ROHDE & SCHWARZ

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AT A GLANCE

The R&S®TS-ISC in-system calibration kit contains the fundamental tools for calibrating the modular instruments available for the R&S®TSVP product family. The most important benefit for systems deployed on the factory floor is that modules that must be calibrated may remain in the instrument chassis slots.

This automatic calibration kit enables users to perform their own factory calibration independently. The R&S®TS-ISC hardware and software package makes it possible to perform the entire range of calibration procedures:

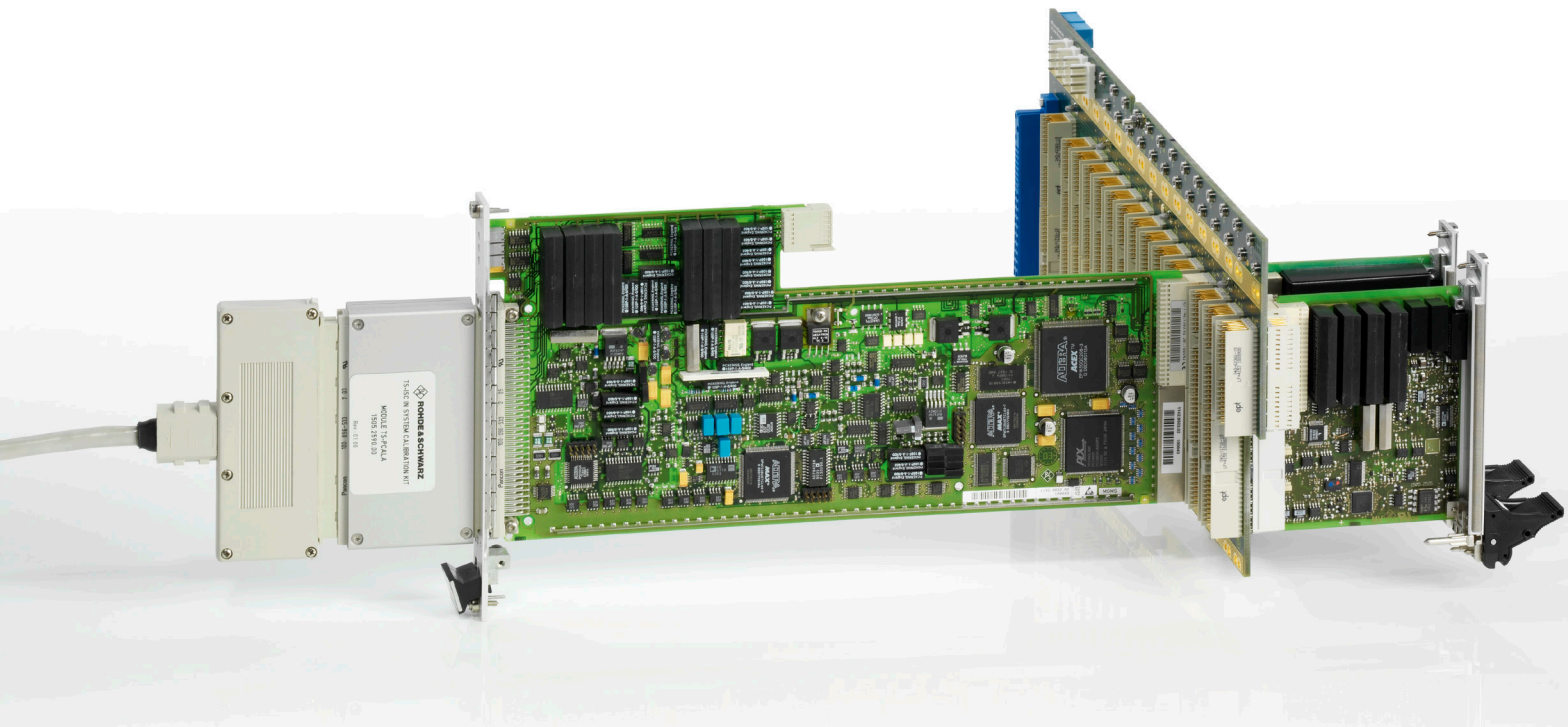
- ▶ Create calibration data on the factory floor
- ▶ Calibrate and adjust the modular instruments of your R&S®TSVP test system
- ▶ Fulfill your in-house periodic calibration schedules independently
- ▶ Full range of calibration sequences
- ▶ Calibration kit includes Rohde&Schwarz test management software G5 factory calibration tool

The calibration process is defined by the instrument manufacturer and is based on the mature software environment deployed at the Rohde&Schwarz factories, i.e. the Rohde&Schwarz test management software G5.

The R&S®TS-ISC in-system calibration kit consists of the following components:

- ▶ R&S®TS-PCAL2 calibration module
- ▶ Calibration adapters
 - R&S®TS-PCALA
 - R&S®TS-PCALB
 - R&S®TS-PCALC
- ▶ R&S®TS-PKL cable for connecting the adapters to the external multimeter

Calibration setup for an R&S®TS-PSAM module, showing the interior of the R&S®TSVP. An R&S®TS-PMB module in front of the R&S®TS-PCAL2 module is used to route the reference signals (see also drawing on page 5).



BENEFITS AND KEY FEATURES

Efficient operation through measurements on the factory floor

- ▶ Create calibration data without changing your test system configuration
- ▶ Modular instrumentation cards can remain in the chassis, no need to extract the modules for calibration

High availability and reliable measurements

- ▶ R&S®TS-ISC hardware and software kit provides full range of calibration procedures
- ▶ Highly accurate digital multimeter (8 ½ digits) is remotely controlled by the calibration software
- ▶ Calibration test results can be saved and transferred to protocols
- ▶ Automatic creation of calibration data files
- ▶ Regular in-system calibration can lead to major improvements of the long-term stability of the R&S®TSVP test and measurement modules

Fulfill your in-house periodic calibration schedules independently

- ▶ Adjust the modular instruments of your R&S®TSVP test system if needed
- ▶ Store your calibration data for documentation as well as for references and certificates
- ▶ In-system calibration significantly reduces the overall lifecycle costs of test systems based on R&S®TSVP platform technology



In production, the user can rely on the modular test and measurement instruments to deliver test results that cover a wide range of measurement values while remaining within specified tolerances.

To ensure that the R&S®TSVP modules fulfill such expectations, the modular instruments should be recalibrated within the specified calibration interval.

FACTORY CALIBRATION SOFTWARE TOOL

Full range of calibration sequences

The calibration software performs an individual test sequence for each module. The test management software guides the user through the calibration setup, indicating how to interconnect the test adapters and prepare the cabling to the DMM.

The software also guides the user when changes to the test setup have to be made. The test setup includes three dedicated adapters for the different modules. However, calibration tasks should preferably be handled by skilled technicians.

Using the in-system calibration software on existing platforms requires generic test software library (GTSL) version 02.80 or higher.

The calibration process is defined by the Rohde & Schwarz test management software G5. During calibration, the adaption window provides information about all necessary instrument interconnections. The results are displayed in the measurement window.

The screenshot displays the TM G5 Desktop software interface. The main window is titled 'TM G5 Desktop' and features a menu bar (File, Edit, Execute, Test Report, Extras, Tools, Settings, Help) and a toolbar. The interface is divided into several panes:

- Meta Data:** Contains 'Device Data' (Designation: Analog Source, Type: TS-PSAM, Equipment No.: 1142.9503.02, Material No.: 200000, Serial No.: 09.22, MI: 09.22) and 'Options' (SFT_BOARD, Test Environment, Add. Test Mark: 2, Scanner Port: 1, Temperature: 23°C +/- 5°C, Test System: Name UCS_Dell, Mode Factory, Test Adapter).
- Test Sequences:** A tree view showing 'Predefined Test Sequences' (including '(Master) Calibration', '(T06) Adjustment Sequence', and '(T12) Additional Tests') and 'User Test Sequences'.
- ADAPTION / Id.:00000 / TM Version V03.14.04 / TP Version V04.04:** A central window displaying instructions: 'Connect TS-PCALA to TS-PSAM in frame 1, slot 3', 'Connect DMM to TS-PCALA', and 'Disconnect all other connectors'. It also shows a 'New Configuration:' section: 'TS-PCALA is connected to TS-PSAM in frame 1, slot 3', 'DMM is connected to TS-PCALA'.
- Execute Context Menu:** A context menu is open over the Adaption window, listing actions like 'Execute (Renaming)', 'Execute (Complete)', 'Test Info', 'Test Report...', 'New', 'Load...', 'Save', 'Save As...', 'Save Copy As...', 'Add To User Test Sequence', 'Copy', 'Paste', 'Delete', 'Rename', 'Expand (highest Level)', 'Collapse (lowest Level)', 'Expand All', and 'Collapse All'.
- Measurement Window (PEB V 06.09.02):** Displays 'Calculated AC current correction data' with a table of results.

Range/mA	calculated gain	calculated offset	nominal	actual
0.10	+1.00000	+0.00000	PASS	PASS
0.20	+1.00000	+0.00000	PASS	PASS
0.50	+1.00000	+0.00000	PASS	PASS
1.00	+1.00000	+0.00000	PASS	PASS
2.00	+1.00000	+0.00000	PASS	PASS
5.00	+1.00000	+0.00000	PASS	PASS
10.00	+1.00000	+0.00000	PASS	PASS
20.00	+1.00000	+0.00000	PASS	PASS
50.00	+1.00000	+0.00000	PASS	PASS
100.00	+1.00000	+0.00000	PASS	PASS
200.00	+1.00000	+0.00000	PASS	PASS
500.00	+1.00000	+0.00000	PASS	PASS
1000.00	+1.00000	+0.00000	PASS	PASS

The bottom status bar shows 'Ready' and 'Computer memory load' at 63%.

DEPLOYMENT OVERVIEW

The in-system calibration kit contains the fundamental tools for calibrating modular instruments available for the R&S®TSVP product family. The R&S®TS-PCAL2 calibration module is used to provide traceable calibration signals. A highly accurate multimeter is required to achieve a corresponding measuring accuracy within the calibration.

The module provides the following functionalities:

- ▶ Floating 5 V reference source
- ▶ Three reference resistors for resistance measurements
- ▶ Ground-referenced current source, adjustable up to 1 A for current measurements
- ▶ Floating signal generator for dynamic measurements of
 - DC: –40 V to 40 V
 - AC sinusoidal:
 - 2 V to 80 V (V_{pp}) in frequency range 20 Hz to 50 kHz
 - 0.2 V to 2 V (V_{pp}) in frequency range 50 kHz to 1 MHz

- ▶ An onboard relay multiplexer connects the components to the analog bus lines on an R&S®TS-PMB module installed in front of the R&S®TS-PCAL2 module

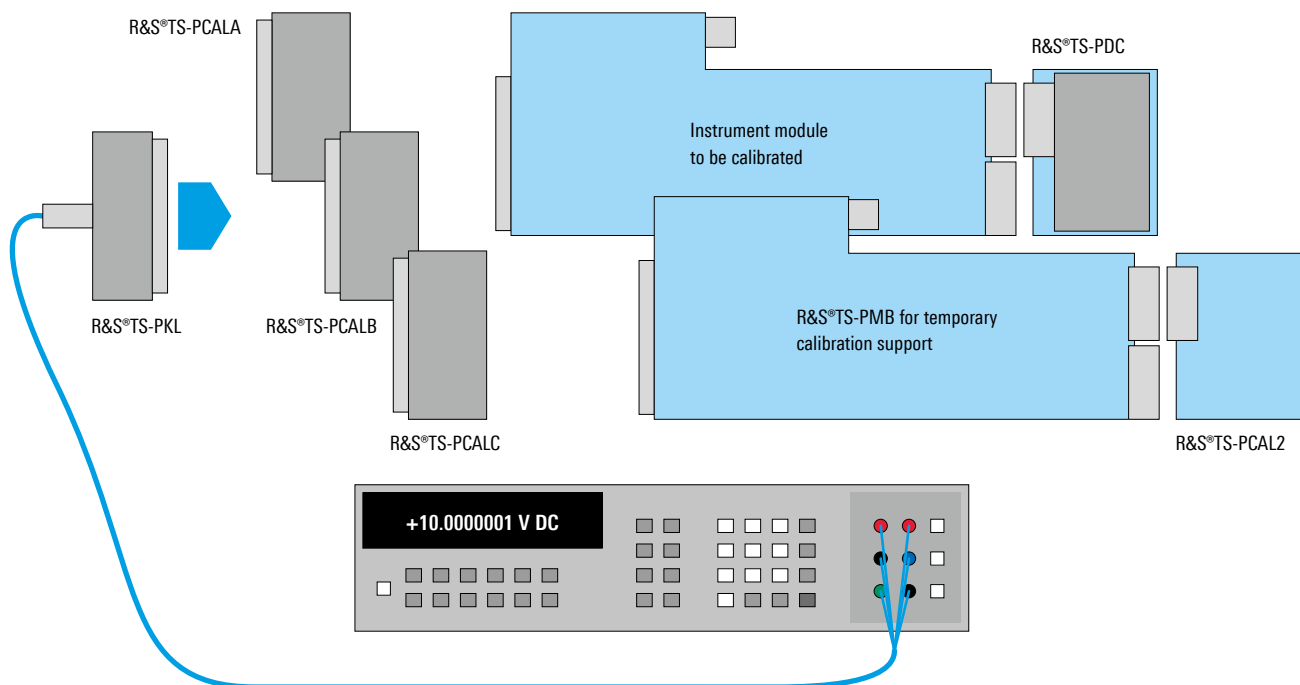
Furthermore, the kit includes calibration adapters to connect the different DUTs to the external multimeter by using the dedicated cabling. The following adapter components are used (see table):

- ▶ R&S®TS-PCALA calibration adapter
- ▶ R&S®TS-PCALB calibration adapter
- ▶ R&S®TS-PCALC calibration adapter
- ▶ R&S®TS-PKL cable for connecting the adapters to the external multimeter

Modules	R&S®TS-PCALA	R&S®TS-PCALB	R&S®TS-PCALC
R&S®TS-PSAM	•		•
R&S®TS-PFG	•		
R&S®TS-PAM			•
R&S®TS-PSU	•		
R&S®TS-PSU12	•		
R&S®TS-PIO2		•	
R&S®TS-PICT	•		

Note: To calibrate the R&S®TS-PSM3/PSM4/PSM5 high-power switching modules, additional equipment is required, including an appropriate power supply, calibration resistors and special cable sets. These components are not included in the R&S®TS-ISC kit. For details, refer to the "R&S®TS-ISC TSVP In-System Calibration User Manual."

Application: R&S®TS-ISC in-system calibration kit, cabling and test adapters for R&S®TSVP



SPECIFICATIONS

Specifications

General information

The software monitors temperature and time and requests the execution of the R&S®TS-PCAL2 autocorrection feature after 24 hours or a temperature drift > ±5°C.

The specified uncertainties apply during a valid autocorrection period and in an ambient temperature range from +18°C to +28°C. Additional error due to temperature coefficient: $\pm(0.1 \times \text{specified uncertainty})/^\circ\text{C}$ for a valid autocorrection period and in ambient temperature ranges from +5°C to +18°C and +28°C to +40°C.

Specifications apply if no R&S®TS-PCAL2 module is installed next to an R&S®TS-PDC module.

Specifications for the measurement unit apply under the following conditions: Measuring time 400 ms; the average value of at least 40 sample is within the specified uncertainty.

R&S®TS-PCAL2 calibration module

AC/DC source, DC mode

Output level, range 40 V		-40 V to +40 V
Resolution		typ. 5.37 mV
Uncertainty ¹⁾		0.3% + 70 mV
Output level, range 4 V		-4 V to +4 V
Resolution		typ. 0.537 mV
Uncertainty ¹⁾		0.3% + 7 mV

AC/DC source, AC mode

Output level, range 40 V		1 V to 28 V
Resolution		typ. 1.6 mV
Uncertainty ¹⁾	20 Hz to 1 kHz	0.9% + 40 mV
	1 kHz to 10 kHz	1.2% + 40 mV
	10 kHz to 50 kHz	3.2% + 40 mV
Output level, range 4 V		0.1 V to 2.8 V
Resolution		typ. 0.16 mV
Uncertainty ¹⁾	20 Hz to 1 kHz	0.9% + 4 mV
	1 kHz to 10 kHz	1.2% + 4 mV
	10 kHz to 50 kHz	1.2% + 4 mV
Output level, range 4 V		0.1 V to 0.7 V
Resolution		typ. 0.16 mV
Uncertainty ¹⁾	50 kHz to 100 kHz	1.2% + 4 mV
	100 kHz to 1 MHz	4.0% + 4 mV

Grounded current source

Maximum current	steady state	≤ 250 mA
Calibrated values		stored in flash memory
Uncertainty of calibrated values	100 mA	±2.5 mA
	200 mA	±2.8 mA
	500 mA	±3.7 mA
	1 A	±5.2 mA

Measurement unit, source

Voltage injection		
Output level		0 V to 10 V
Resolution		typ. 1.2 mV
Uncertainty ¹⁾		0.03% + 10 mV
Current injection		
Output level		0.1 mA to 10 mA
Resolution		typ. 1.2 µA
Uncertainty ¹⁾		0.04% + 10 µA

¹⁾ Accuracy = ±(% of measured value + absolute value).

Specifications

R&S®TS-PCAL2 calibration module

Measurement unit, voltage

Input level, range 50 V		-50 V to +50 V
Resolution		typ. 9 μ V
Uncertainty ¹⁾	10 ms \leq sample interval \leq 1 s	0.023% + 12.5 mV
	1 ms \leq sample interval < 10 ms	0.023% + 15 mV
	200 μ s \leq sample interval < 1 ms	0.023% + 20 mV
Input level, range 5 V		-5 V to +5 V
Resolution		typ. 745 nV
Uncertainty ¹⁾	10 ms \leq sample interval \leq 1 s	0.023% + 0.5 mV
	1 ms \leq sample interval < 10 ms	0.023% + 1 mV
	200 μ s \leq sample interval < 1 ms	0.023% + 1.25 mV
Input level, range 0.5 V		-0.5 V to +0.5 V
Resolution		typ. 74.5 nV
Uncertainty ¹⁾	10 ms \leq sample interval \leq 1 s	0.025% + 0.7 mV
	1 ms \leq sample interval < 10 ms	0.043% + 0.75 mV
	200 μ s \leq sample interval < 1 ms	0.043% + 0.8 mV

Measurement unit, current via MU_HI

Input level		0 A to 1 A
Resolution		typ. 166 nA
Uncertainty ¹⁾		0.25% + 0.5 mA

Measurement unit, current via MU_LO

Input level		0 A to 200 μ A
Resolution		typ. 30 pA
Uncertainty ¹⁾		0.015% + 200 nA

Reference voltage

Calibrated value stored in flash memory

Output level		typ. 5.0 V
Uncertainty of calibrated value		\pm 0.5 mV

Reference resistors

Calibrated values		stored in flash memory
Uncertainty of calibrated values	10 k Ω	\pm 2 Ω
	100 k Ω	\pm 20 Ω
	1 M Ω	\pm 200 Ω

¹⁾ Accuracy = \pm (% of measured value + absolute value).

Specifications

General data

Interface	controlled by R&S®TS-PMB module	SPI
Power consumption		1.2 A at 5 V
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 EN 60068-2-78
Altitude	operating	up to 2000 m
Mechanical resistance		
Vibration	sinusoidal	in line with EN 60068-2-6, 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 EN 60068-2-64, 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: ▶ EN 61326-1 (industrial environment) ▶ EN 61326-2-1 ▶ EN 55011 Group 1, Class A
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EC	applied harmonized standard: 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 hazardous substances in electrical and electronic equipment 2011/65/EU	compliant; applied harmonized standard: EN IEC 63000
Dimensions (W × H × D)	calibration module	140 mm × 130 mm × 20 mm (5.51 in × 5.11 in × 0.79 in)
	calibration adapter	100 mm × 70 mm × 20 mm (3.94 in × 2.76 in × 0.79 in)
Length	calibration cable	650 mm (25.59 in)
Weight	calibration module	0.2 kg (0.44 lb)
	calibration adapter	0.5 kg (1.1 lb)
Recommended calibration interval		12 months

ORDERING INFORMATION

Designation	Type	Order No.
Calibration kit		
In-system calibration kit, including R&S®TS-PCAL2 calibration module/R&S®TS-PKISC cabling set	R&S®TS-ISC	1505.2502.02
Rear-I/O module for in-system calibration	R&S®TS-PCAL2	1505.2519.02
Cabling set for in-system calibration, including:		
▶ R&S®TS-PCALA calibration adapter		
▶ R&S®TS-PCALB calibration adapter	R&S®TS-PKISC	1505.2560.02
▶ R&S®TS-PCALC calibration adapter		
▶ R&S®TS-PKL cable for connecting the adapters to the external multimeter		
Option (required for operation)		
Switching matrix module	R&S®TS-PMB	1143.0039.02
Required extras		
External multimeter:		
▶ Calibration interval: 1 year		
▶ DCV standard uncertainty: 2 ppm	Keysight 3458A	
▶ Resistance standard uncertainty: 3 ppm		
Option for external multimeter, required for calibration of R&S®TS-PIO2 modules	Keysight 3458A-002	
GPIO-USB2.0 interface IEC 625, mandatory to control the external multimeter	R&S®TS-PIEC2	1501.9690.02
Calibration resistor 10 mΩ, 0.03%, 2 A (e.g. burster 1240-0,01), required for calibration of R&S®TS-PSM3/PSM4/PSM5 power switching modules		
High-load calibration resistor 1 mΩ, 0.02%, 30 A (e.g. burster 1282-0,001), required for calibration of R&S®TS-PSM3/PSM4/PSM5 power switching modules		
Power supply with at least 30 A output current, GPIB interface, SCPI instruction set (e.g. Keysight 5765A), for R&S®TS-PSM3		
Power supply with at least 16 A output current, GPIB interface, SCPI instruction set (e.g. Keysight 5765A), for R&S®TS-PSM4		
Power supply with at least 50 A output current, GPIB interface, SCPI instruction set (e.g. Keysight 5765A), for R&S®TS-PSM5		

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- ▶ 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.

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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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