Three new digital modules make the CompactPCI/PXI-based R&S®CompactTSVP test platform even more versatile.

The modular R&S®CompactTSVP open test platform, which is CompactPCI/PXI-based, provides special cost benefits for T&M applications in the development, production, and quality assurance of electronic assemblies and components. Three new digital modules make it even more versatile (FIG 1).

Current trend: reduction of time to market

Ever shorter product development times call for T&M equipment that can quickly and easily be adapted to new requirements. It is therefore advantageous to provide the required T&M equipment in the form of highly compact modules that can be flexibly configured. Large additional investments can thus be avoided.

The modular R&S®CompactTSVP open test platform from Rohde & Schwarz, which is CompactPCI/PXI-based, has been tailored to meet these requirements. It offers special cost advantages for T&M applications in the development, production, and servicing of electronic assemblies or components. By adding the powerful, easy-to-operate, and standardized software components, you will benefit from versatile system solutions that considerably reduce time to market. This holds true not only for manual test stations, but also for fully automatic test stations where space is often limited.

As the test platform implements open industry standards such as CompactPCI/PXI and CAN throughout and features a unique system architecture, you are provided with an efficient portfolio of T&M functionalities as well as hardware and software communications interfaces.
Complex requirements in digital functional tests

To perform digital functional tests on electronic assemblies or components, the test system must simulate the input signals of a DUT as realistically as possible and check whether the DUT responds correctly. The wide diversity in customer applications is matched by the broad-scope requirements placed on stimulation signals in the implementation of digital interfaces. These requirements range from signals with relatively low data rates and levels above 24 V to signals with very high pattern rates in the MHz range and levels below 5 V. The number varies from a few bits for serial buses up to complex signals for parallel buses, where several modules may be used in sync to provide bus emulation. The hardware protocols to be implemented may conform with an industry standard (e.g. RS-232-C, CAN, I²C, SPI), but may also be customer-specific (e.g. Flash programming, processor bus). It is not uncommon for the deterministic

WAGO Kontakttechnik relies on the R&S®TS-PIO2 module

In a project at WAGO Kontakttechnik, in Minden, Germany, the unique capabilities of the R&S®TS-PIO2 module proved their mettle. To achieve optimum test time, ten WAGO assemblies (FIG 2) had to be tested in parallel. The following functionalities had to be implemented:

- Ten constant voltage sources ±24 V / 20 mA
- Five constant current sources 0 V to 20 mA
- Ten voltage measurement channels ±24 V
- Ten current measurement channels 0 V to 20 mA

The R&S®TS-PIO2 modules were required to operate at the highest of precision because the WAGO analog assemblies also had to be calibrated. All these criteria were met with only two R&S®TS-PIO2 modules — and WAGO was able to reduce test time by an extremely impressive factor of 1/30.

FIG 2  DUT of WAGO Kontakttechnik.

FIG 3  R&S®TS-PIO2 analog / digital I/O module.

FIG 4  Operating modes of the R&S®TS-PIO2 module.
simulation and time-synchronous recording of digital signals to also be accompanied by the need for additional protocols at the software level.

**New digital modules expand the wide range of functions**

**When high levels and maximum precision are required: the R&S®TS-PIO2**

A key characteristic of the R&S®TS-PIO2 analog/digital I/O module (FIG 3) is its floating I/O channels. They can prevent the latent danger of hum pickups, as may occur in ground-referenced measurements — especially when longer wiring arrangements are involved.

Featuring 16 precision analog inputs and outputs each, the module enables you to implement even complex measurement tasks. Both the stimulation and the acquisition of signals can be performed statically or dynamically (max. 5 kHz) (FIG 4). Other key criteria include:

- Multichannel voltage sources with levels up to ±27 V and optional current limiting
- Multichannel current sources with currents up to ±100 mA
- Digital output ports with programmable HIGH and LOW levels in the range ±27 V
- Multichannel generation of square-wave signals up to 40 kHz
- Precise, differential voltage measurements
- Multichannel current measurements (shunt resistors on the module)
- Digital input ports with programmable hysteresis in the range ±27 V
- Digital functional test of semiconductor components

For a look at how the R&S®TS-PIO2 module drastically reduces testing time at the WAGO Kontakttechnik company, see the box on page 32.

**When industry standards and realtime capabilities are required: the R&S®TS-PDFT**

A large challenge for many test systems is the implementation of deterministic timing for digital signals. If it is also necessary to provide industry-standard-compliant serial bus systems, high system costs are usually involved.

By using just one R&S®TS-PDFT digital functional test module (FIG 5), you can meet these highly diverse requirements and thus achieve a cost-efficient solution. Owing to an autonomous hardware control mechanism on the module, digital signals can be simultaneously stimulated and detected. Data widths and frequency (max. 20 MHz) can be set separately.

A local processor, which is also present on the module, allows efficient communication with the DUT. Interferences in application timing caused by the operating system of the system controller are therefore avoided right from the start. But the module offers even more interesting features:

- Digital output ports with programmable HIGH level in the range –3 V to +10 V and TRI state control (both features for each 8-bit port)
- Digital input ports with programmable hysteresis in the range 0 V to +9.5 V (for each 8-bit port)
- Multichannel generation of frequency signals or pulse width modulation with up to 50 kHz
- Frequency measurement or event counting of programmable input patterns with up to 12.5 MHz
- Communication with the DUTs via a — serial interface in accordance with CAN 2.0 B (ISO11519-2 and ISO11898); generation of cyclical CAN messages — serial, asynchronous interface (RS-232-C, K bus, TTL) — serial, synchronous interface (SPI, PC)

**If speed and memory depth are the main criteria: the R&S®TS-PHDT**

Since the number of electronic assemblies containing intelligent, digital components is steadily growing, there is an increasing demand for simulating digital
data streams under realistic conditions. While digital in-circuit tests used to be state of the art, digital functional tests are now predominant. But these tests are possible only if the hardware used can provide the clock rates, memory depths, and analysis capability needed.

The data volume to be handled is often a special challenge: A large portion of the test time is consumed alone by the two steps of transferring recorded test data to the system controller and analyzing it.

The R&S®TS-PHDT high-speed digital test module (FIG 6) is the optimum solution to this problem. Its architecture was developed in close cooperation with the department developing inspection, measuring, and test equipment at a notable semiconductor manufacturer working in the automotive and communications electronics sector.

Owing to the local storage capacity of a remarkable 1.5 Gbyte (3 × 64 Msamples) for stimulus, nominal, and actual data, you can locally store all data required for testing a DUT. The data to be stimulated is transferred to the module in a single step during the initialization phase of the test system. To perform individual tests, you can also execute selected parts of the overall sequence.

The timing for stimulation and acquisition can be set separately in extremely small increments. The maximum pattern rate that can be implemented is 40 MHz. A signal referred to as a strobe signal, which is generated within one clock cycle, allows you to transfer data to the DUT.

Parallel to stimulation, the integrated analysis hardware compares nominal data with recorded actual data in real-time and documents the deviations that are detected. Pass/fail information, number of errors, failed channels, and additional information on erroneous steps are available in the error memory immediately after completion of a test. For further analysis, only the test data indicating errors needs to be transferred to the system controller. The resulting test performance is much higher than obtained with conventional hardware.

Comparing to the R&S®TS-PDFT digital functional test module, the LOW levels of the outputs can additionally be programmed for each 8-bit port. Plus, one TRI state control for each output channel is possible, and even highly complex applications can be implemented.

Other key criteria are:
- Digital output ports with programmable HIGH and LOW level in the range –3 V to +10 V (for each 8-bit port) and TRI state control (for each channel)
- Digital input ports with programmable “forbidden zone” in the range 0 V to +9.5 V (for each 8-bit port)
- Digital functional test of electronic assemblies and components
- Programming of non-volatile DUT memories (microcontrollers, flash components)
- Simulation of digital control or processor buses

When “analog” and “switching” functions are required in addition to “digital”

In addition to the base units, numerous other Rohde & Schwarz modules (FIG 7) are available for implementing functional and in-circuit tests:
- R&S®TS-PSC4 system controller
- R&S®TS-PSC0 PCI interface kit
- R&S®TS-PSAM digital multimeter
- R&S®TS-PCT ICT extension module
- R&S®TS-PFG function generator module
- R&S®TS-PAM signal analyzer module
- R&S®TS-PSU power supply / load module
- R&S®TS-PMB switch matrix module B
- R&S®TS-PSM1 power switching module 1
- R&S®TS-PSM2 multiplex / switch module 2

In addition to the Rohde & Schwarz modules, hardware components complying with the CompactPCI and PXI standards may also be integrated into the system without any modifications being necessary.
System diagnostics ensure high efficiency

The selftest capability of all modules in the R&S®CompactTSVP product line is the basis for efficient system diagnostics and fast restoration of system functions. Since the detailed selftest report allows comprehensive system diagnostics, production downtimes can be avoided.

Owing to the generally bidirectional I/O interface of all digital modules, you can read back the signals on the output channels via the input channels.

Full-scope, user-ready software

In addition to software drivers, interactive user interfaces (soft panels) are provided. They enable you to perform almost all functions available in each module without having to write any routines yourself. Putting a test setup into operation thus becomes extremely easy and takes less time.

Summary

The CompactPCI / PXI-based R&S®CompactTSVP open test platform from Rohde & Schwarz is a flexible and highly efficient test solution that covers the full scope of digital functional testing necessary for electronic assemblies and components. Depending on the individual application, the test system can be flexibly expanded by adding measurement, stimulation, and switching modules from Rohde & Schwarz as well as OEM modules that conform to the CompactPCI / PXI standard.

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More information and data sheets at www.rohde-schwarz.com (search term: CompactTSVP)

FIG 7 Ideal for production requirements: A variety of modules make the CompactPCI / PXI-based R&S®CompactTSVP test platform ideal for everyday use in production.