ROHDE&SCHWARZ

USER MANUAL

Analog/Digital IO Module 2

R&S®TS-PIO2

User Manual

for ROHDE & SCHWARZ Analog/Digital IO Module R&S TS-PIO2

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Safety Instructions

Attention!
Electrostatic sensitive devices require special care

CERTIFICATE

DQS GmbH

Deutsche Gesellschaft zur Zertifizierung von Managementsystemen

hereby certifies that the company

Rohde & Schwarz GmbH & Co. KG

Mühldorfstrasse 15
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with the production sites as listed in the annex

for the scope
Design and Development, Production, Sales, Services of Electronic-Measurement and Communication-Equipment and Systems

has implemented and maintains a

Quality Management System.

An audit, documented in a report, has verified that this quality management system fulfills the requirements of the following standard:

DIN EN ISO 9001 : 2000

December 2000 edition

The quality management system of the sites marked with (*) in the annex fulfills the requirements set out by the international and German Road Traffic Regulations
including the approval objects as listed in the appendix.

This certificate is valid until	2008-01-23
Certificate Registration No.	001954 QM/ST
Frankfurt am Main	2005-01-24

This certificate is based on a quality audit in cooperation with the CETECOM ICT Services GmbH as a Notified Body under the Scope of the EC directive 99/5/EC.
It was verified by the Notified Body that the supplementary requirements of the Annex V of the European Concil Directive 99/5/EC are fulfilled.

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Appendix to Certificate Registration No.: 001954 QM/ST

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The international and German Road Traffic Law
was audited regarding the following approval objects:

No.: 22 Electrical/Electronic Sub Assembly

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Annex to Certificate Registration No.: 001954 QM ST

Rohde & Schwarz GmbH & Co. KG

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ROHDE & SCHWARZ GmbH & Co. KG Service Centre Cologne **ROHDE & SCHWARZ Systems GmbH** Graf-Zeppelin-Strasse 18 D-51147 Köln	Technical services in the field of measuring/communication techniques maintenance/repair calibration training technical documentation Development, production, systems
Rohde & Schwarz FTK GmbH Wendenschloßstrasse 168 D-12557 Berlin	Design and Development, Production and Sale of Communication Equipment, Installations and systems
Rohde & Schwarz GmbH & Co. KG Kaikenrieder Strasse 27 D-94244 Teisnach	Design and Development, Production, Sales, Services of Electronic-Measurement and Communication-Equipment and Systems
Rohde & Schwarz závod Vimperk s.r.o. Spidrova 49 CZE-38501 Vimperk Tschechische Republik	Design and Development, Production, Sales, Services of Electronic-Measurement and Communication-Equipment and Systems
(*) **Rohde & Schwarz GmbH & Co. KG** Mühldorfstrasse 15 81671 München	Design and Development, Production, Sales, Services of Electronic-Measurement and Communication-Equipment and Systems
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If you have any technical queries about this Rohde & Schwarz equipment, our Hotline at the Support Center of Rohde & Schwarz Sales-GmbH will be glad to help.

Our team will discuss your queries and look for solutions to your problems.

The Hotline is open Mondays to Fridays from 08.00 to 17.00 hrs.

For queries outside office hours, you can leave a message or send a note via fax or email. We will then get back to you as soon as possible.

ROHDE & SCHWARZ

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1 Usage

1.1 General

The Analog/Digital IO Module R&S TS-PIO2 can be operated on the R&S CompactTSVP and R&S PowerTSVP test platforms. The card receives its ground-free power supply from a Rear-I/O module of type R&S TS-PDC. The R&S TS-PIO2 is controlled by the CAN bus present in the R&S CompactTSVP and R&S PowerTSVP.

The R&S TS-PIO2 module provides 16 combined analog / digital input channels and 16 combined analog / digital output channels. The channels are arranged in groups of four. The last output channel in each group has special properties. These include a higher speed, adjustable current limiting, a higher maximum output current and the capability of using sense lines. Some of the settings for a channel can be made channel-specifically or group-specifically (the same for all channels in a group). Each channel also provides the user with a 100-Ohm precision resistor with contact available via the front side connector.

Each of the 16 output channels can be operated in the one of the following operating modes:

- Analog output
- Digital static output
- Digital dynamic output
- Arbitrary waveform
- Square wave

All 16 input channels are wired to comparators and also to the input of an analog/digital converter. The limits of the comparators are adjustable. This makes the following evaluations of a signal possible:

- Voltage measurements against module ground
- Differential voltage measurements between two channels
- Digital evaluation

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Timing control of bit sampling and measurement data recording as well as output of digital bit patterns and analog arbitrary waveform values run in parallel for all IO channels through a central sequence control. Four memory units with a depth of 5000 values each are available on the module for digital and analog inputs and outputs. The sequence control can be started by various trigger sources. The sampling interval can be adjusted in a range from 200 µs to 1 sec.

The output channels can generate a square wave independently of sequence control. The level, frequency, and duty cycle are also adjustable.

Inputs and outputs can also be flexibly connected via relays. Each output can be connected to either the front side connector or the corresponding input. The inputs of each channel can also be connected to the front side connector or the TSVP analog bus.

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1.2 Features of the R&S TS-PIO2

Features R&S TS-PIO2
Potential-free
16 input channels and 16 output channels
Output voltage range ±27 V
Input voltage range ±7 V, ±14 V, ±28 V
Maximum output current for the 12 standard channels 25 mA, 100 mA for the extended channels
Sense lines and programmable current limiting for the extended channels
Differential voltage measurement (optional)
High accuracy; resolution 24 bits
Maximum sampling rate during measurement and update rate for output 5 kHz
Memory for 4 x 5000 values (analog and digital measurement values; digital bit pattern and arbitrary waveform output)
Access to analog bus
Trigger options via PXI trigger bus
Self-test capability
Soft Panel for interactive operation
LabWindows/CVI driver available

Table 1-1 Features R&S TS-PIO2

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1.3 Features of the TS-PDC module

The Rear I/O Module R&S TS-PDC is used as a floating DC voltage source for the Analog/Digital IO Module R&S TS-PIO2. It contains two identical DC/DC converters. The following floating voltages are obtained from an input voltage of 5 VDC:

– +15 VDC ±5%, 0.5A (2x)

– -15 VDC ±5%, 0.5A (2x)

– +5 VDC ±5%, 0.5A (2x)

– +3.3 VDC ±5%, 0.25A (2x)

1.4 Safety instructions

WARNING!

The R&S CompactTSVP/ R&S PowerTSVP production platform and the Analog/Digital IO Module R&S TS-PIO2 are designed so that users can operate at voltages up to 125 V. The requirements according to EN61010-1 for operation with "hazardous live" voltages must be observed.

For additional details see Chapter 5.1.17 and the leaflet entitled "Safety Instructions" in the user manual for the R&S CompactTSVP/ R&S PowerTSVP production platform.

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2 View

Figure 2-1 shows the Analog/Digital IO Module R&S TS-PIO2 without the accompanying Rear I/O Module R&S TS-PDC.

The Rear I/O Module R&S TS-PDC is shown in Figure 2-2 .

Figure 2-1 View of the R&S TS-PIO2

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Figure 2-2 View of the Rear-I/O Module R&S TS-PDC

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3 Block Diagrams

Figure 3-1 shows the simplified functional block diagram of the Analog/Digital IO Module R&S TS-PIO2 and the Rear I/O Module R&S TS-PDC in the R&S PowerTSVP .

Figure 3-2 shows the block diagram of the Analog/Digital IO Modules R&S TS-PIO2 .

Figure 3-3 shows the block diagram of the Rear I/O Module R&S TS-PDC.

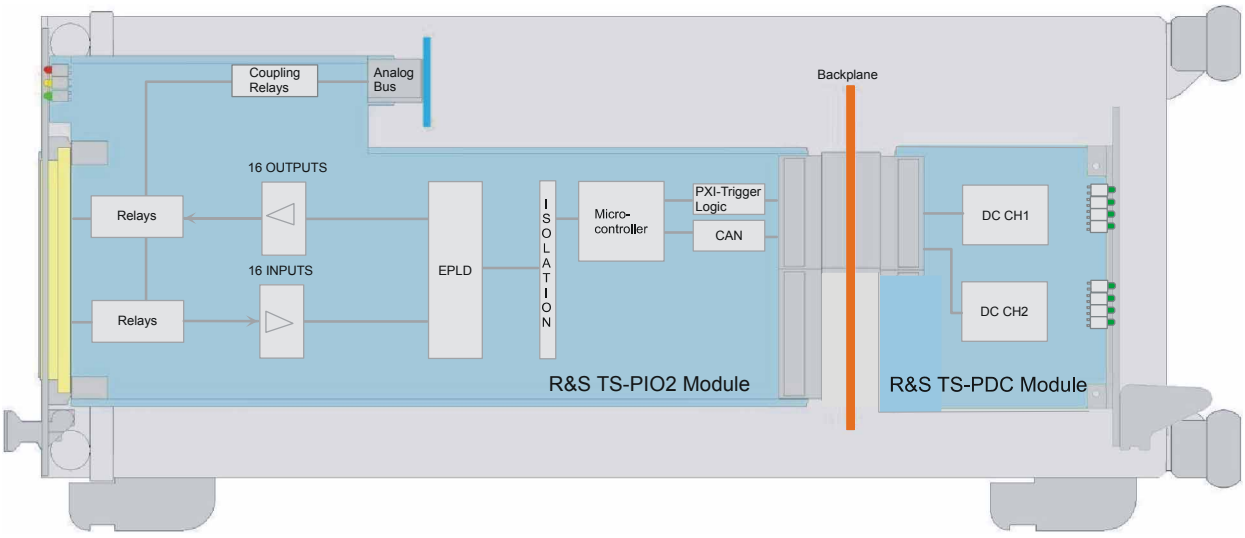

Figure 3-1 Functional block diagram of R&S TS-PIO2 with R&S TS-PDC in the R&S PowerTSVP

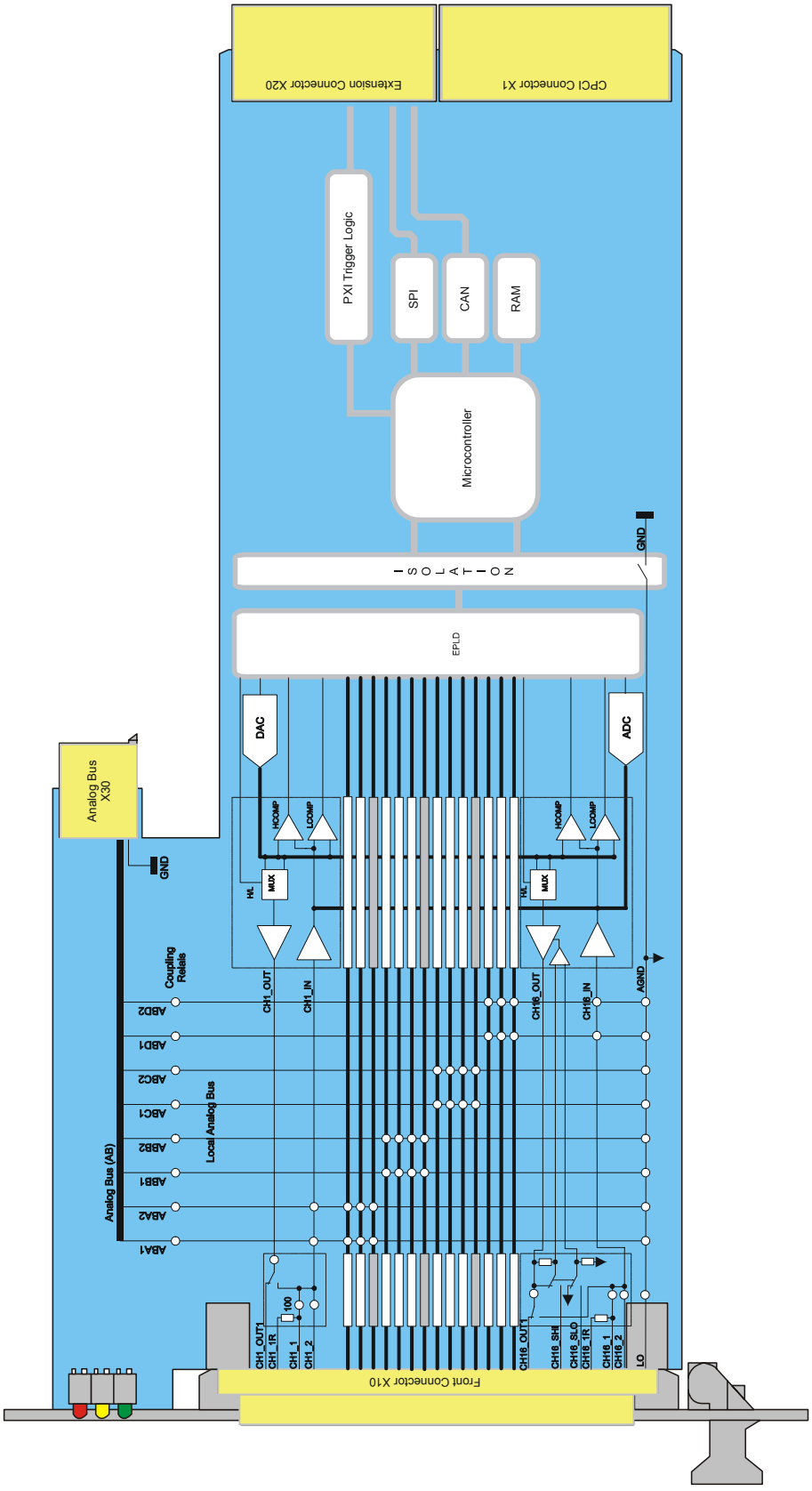

Figure 3-2 Block diagram Analog/Digital IO Module R&S TS-PIO2

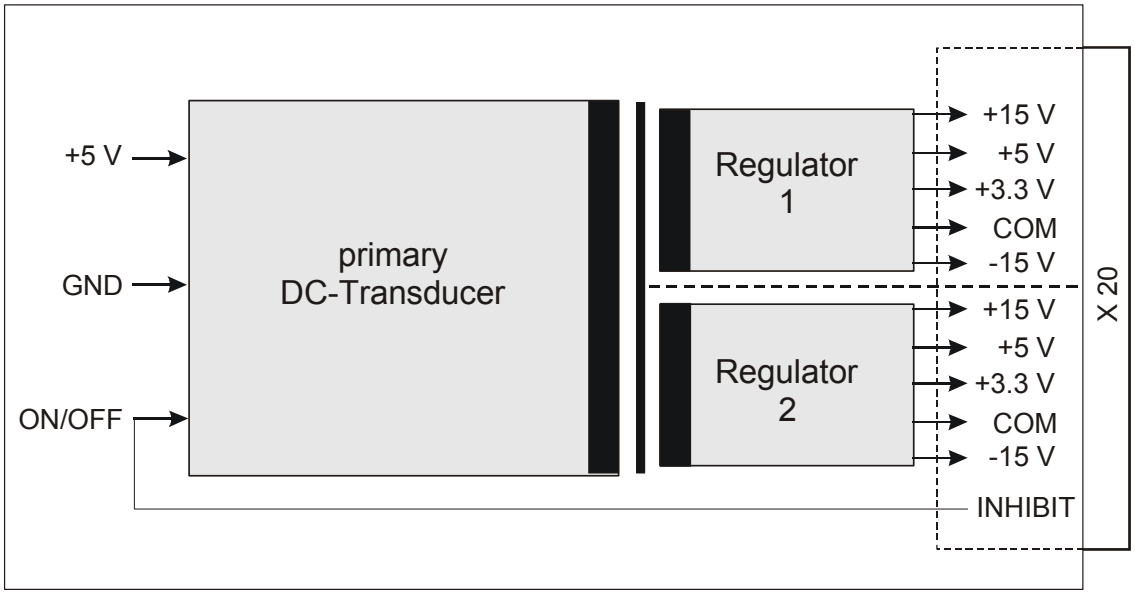

Figure 3-3 Block diagram Rear-I/O Modul R&S TS-PDC

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4 Layout

4.1 Mechanical layout of the module R&S TS-PIO2

The Analog/Digital IO Module R&S TS-PIO2 is designed as a long plug-in card for front installation in test platforms R&S CompactTSVP or R&S PowerTSVP.

The front-side connector X10 is used to connect test objects. The connector X30 connects the module with the analog bus backplane in the R&SCompactTSVP /R&S PowerTSVP. The connectors X20/X1 connect the module with the CompactPCI backplane/PXI control backplane.

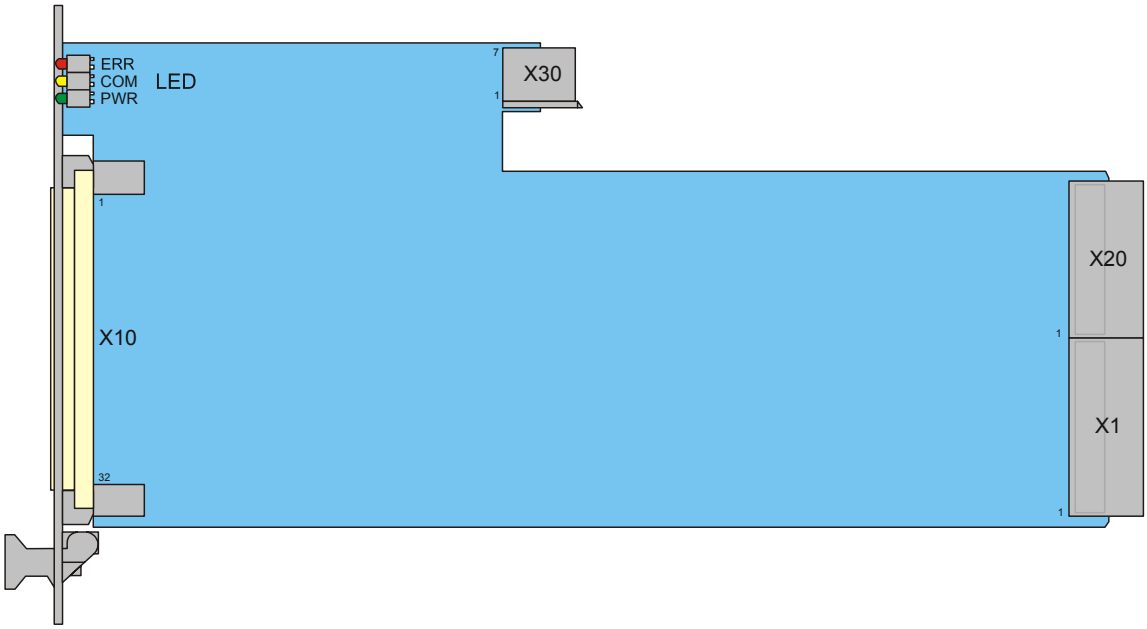

Figure 4-1 Arrangement of the connectors and LEDs on the module R&S TS-PIO2

Name	Use
X1	cPCI Connector
X10	Front Connector
X20	cPCI Connector
X30	Analog Bus Connector

Table 4-1 Connectors on the R&S TS-PIO2

4.2 Display elements of the module R&S TS-PIO2

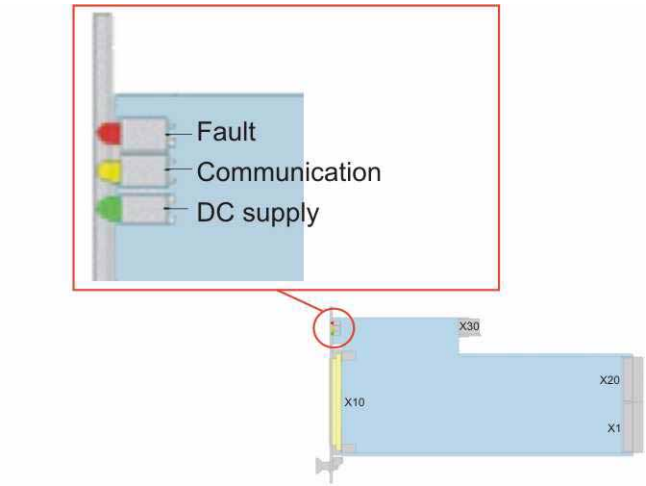

Figure 4-2 Arrangement of the LEDs on the module R&S TS-PIO2

On the front side of the module R&S TS-PIO2 there are three LEDs which show the current status of the module. The LEDs have the following meaning:

LED	Description
red	Fault condition: Lights up when a fault is detected on the R&S TS-PIO2 module during the power-on test after the supply voltage is switched on. This means that there is a hardware problem on the module. (also see section 8: Self-test)
yellow	Communication: Lights up when data is exchanged across the interface.
green	Supply voltage OK: Lights up when all necessary supply voltages are present (incl. the R&S TS-PDC voltages).

Table 4-2 Display elements on the module R&S TS-PIO2

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4.3 Mechanical layout of R&S TS-PDC

The rear I/O Module R&S TS-PDC is designed for rear installation in the R&S CompactTSVP/R&S PowerTSVP. The height of the module's circuit board is 3 HE (134 mm). The module is fastened in place by two fastening screws on the front baffle plug connector X20 connects module R&S TS-PDC with the extension backplane in the R&S CompactTSVP/R&S PowerTSVP. Module R&S TS-PDC must always be used with the correct Rear-I/O slot for the main module (for example module R&S TS-PIO2).

CAUTION!

The module R&S TS-PDC must always be plugged into the corresponding rear I/O slot (same slot code) of the module R&S TS-PIO2 .
If it is not correctly plugged in (e.g. cPCI/PXI standard modules in the front area) both modules may be destroyed.

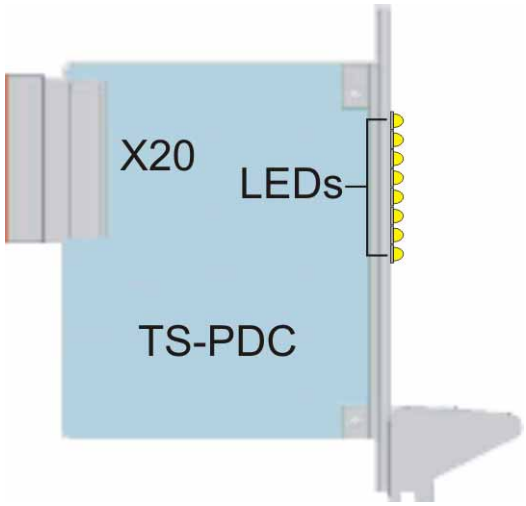

Figure 4-3 Arrangement of the connector and LEDs on the module R&S TS-PDC

Name	Use
X20	Extension (rear I/O)

Table 4-3 Connector of the module R&S TS-PDC

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4.4 Display elements of the module R&S TS-PDC

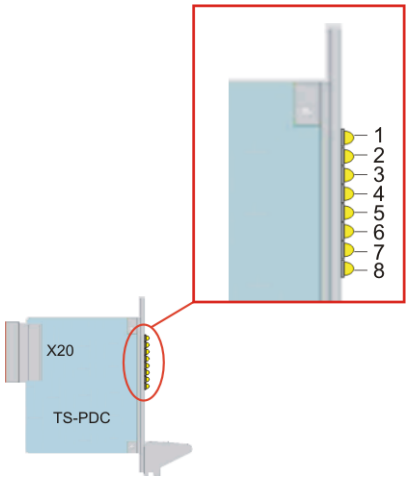

Figure 4-4 Arrangement of the LEDs on the module R&S TS-PDC

Eight light-emitting diodes (LEDs) are located on the front of the R&S TS-PDC module to show the current status of the generated supply voltages. The individual LEDs have the following meanings:

LED	Description
1, lights up	+15 VDC (CHA), present
2, lights up	+5 VDC (CHA), present
3, lights up	+3.3 VDC (CHA), present
4, lights up	-15 VDC (CHA), present
5, lights up	+15 VDC (CHB), present
6, lights up	+5 VDC (CHB), present
7, lights up	+3.3 VDC (CHB), present
8, lights up	-15 VDC (CHB), present

Table 4-4 Display elements on the module R&S TS-PDC

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5 Function Description

5.1 Function description of the R&S TS-PIO2 module

5.1.1 General

The Analog/Digital IO Module R&S TS-PIO2 makes 16 IO channels (CH1 to CH16) available. The channels are arranged in four groups from A to D. The last output channel of each group (CH4, CH8, CH12 and CH16) has special properties.

Channel	Group	Analog bus access	Note
CH1	A	ABa1, ABa2	
CH2	A	ABa1, ABa2	
CH3	A	ABa1, ABa2	
CH4	A	ABa1, ABa2	Extended channel
CH5	B	ABb1, ABb2	
CH6	B	ABb1, ABb2	
CH7	B	ABb1, ABb2	
CH8	B	ABb1, ABb2	Extended channel
CH9	C	ABc1, ABc2	
CH10	C	ABc1, ABc2	
CH11	C	ABc1, ABc2	
CH12	C	ABc1, ABc2	Extended channel
CH13	D	ABd1, ABd2	
CH14	D	ABd1, ABd2	
CH15	D	ABd1, ABd2	
CH16	D	ABd1, ABd2	Extended channel

Table 5-1 Channels and corresponding groups

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The outputs of the various channels are capable of functioning in the following operating modes:

- Analog
- Digital Static
- Digital Dynamic
- Waveform
- Square Wave

The individual modes are described in greater detail in the following chapters.

Some of the settings for a channel can be made channel-specifically or group-specifically. The following illustration is a graphical representation showing the possible settings for channel outputs in group A. The output level depends on the contents of the level registers and the state of the pattern register. With square wave output, the corresponding switch is switched cyclically between H and L while a „1“ is entered in the pattern register for this channel.

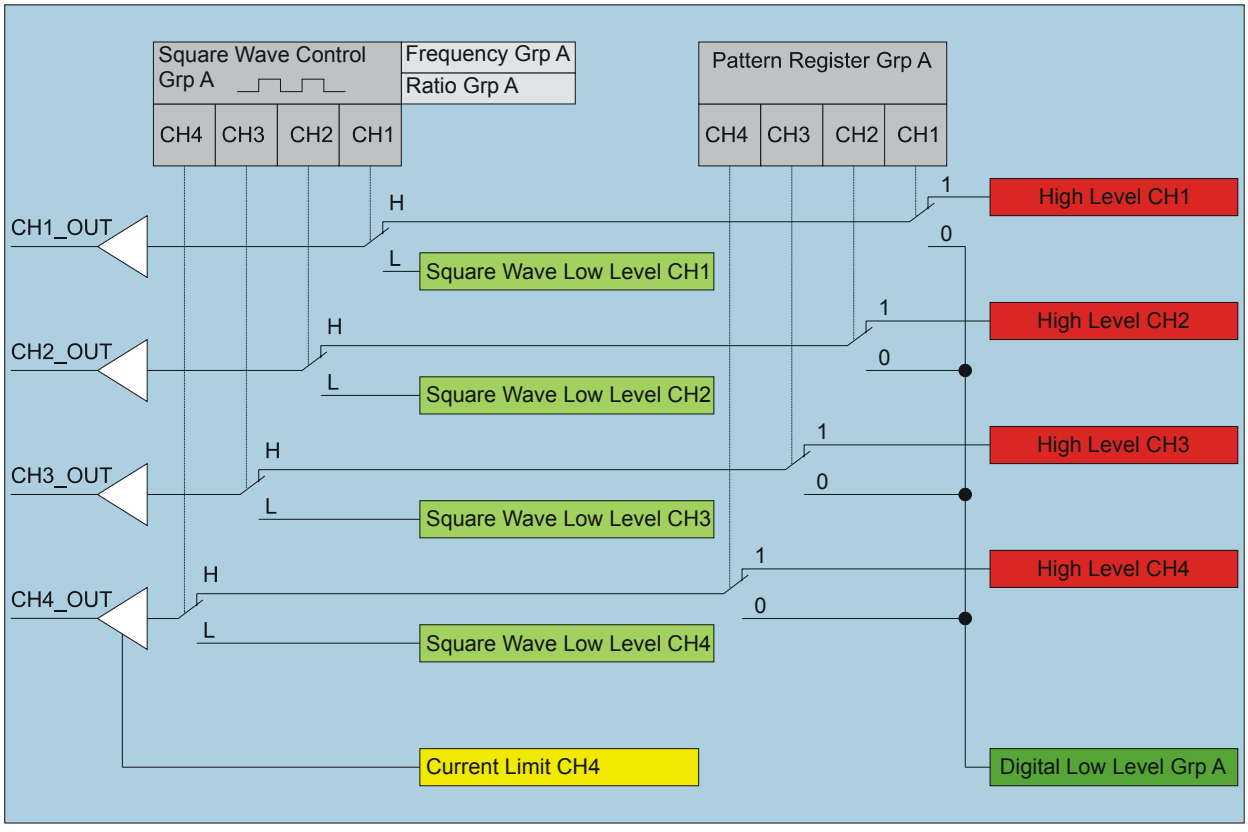

Figure 5-1 Channel- and group-specific parameters of the outputs (group A)

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5.1.2 Application examples

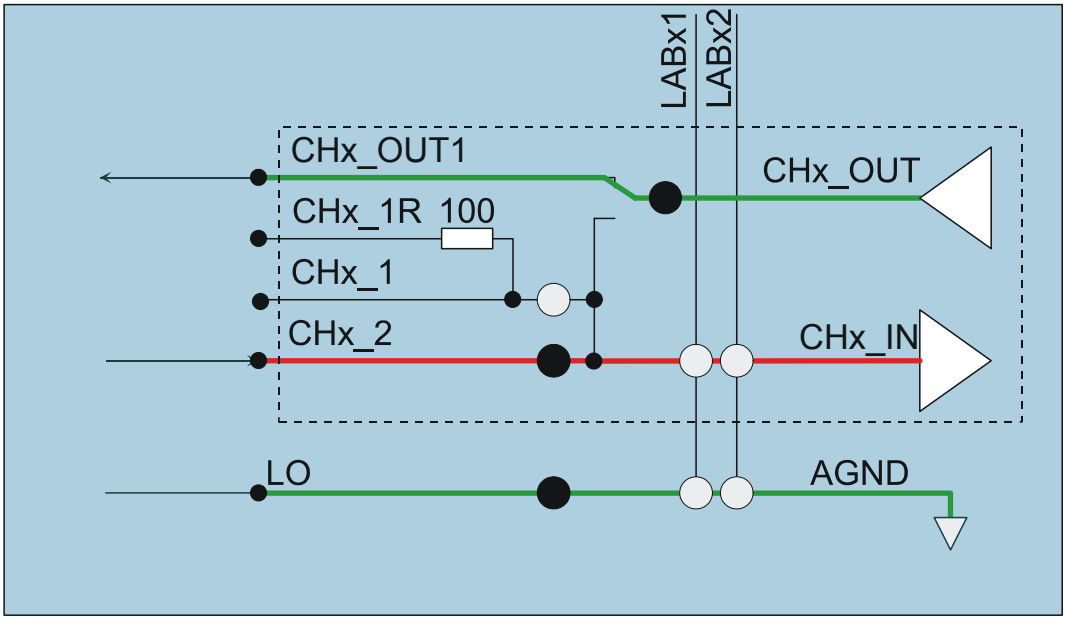

Figure 5-2 Independent use of input and output

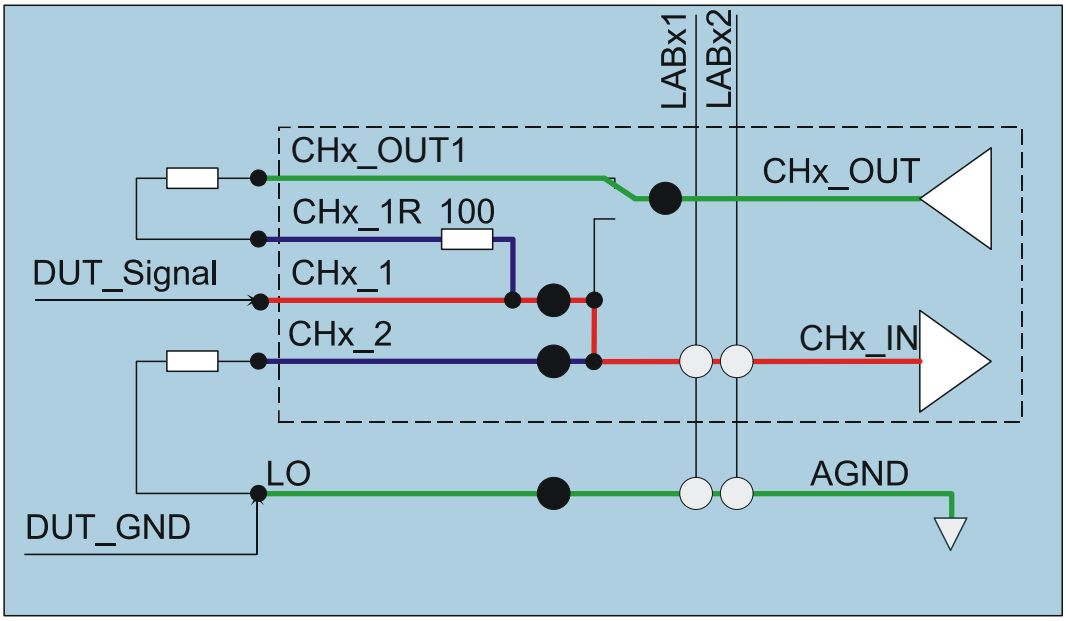

Figure 5-3 Switchable loads (pull-up and pull-down of digital inputs)

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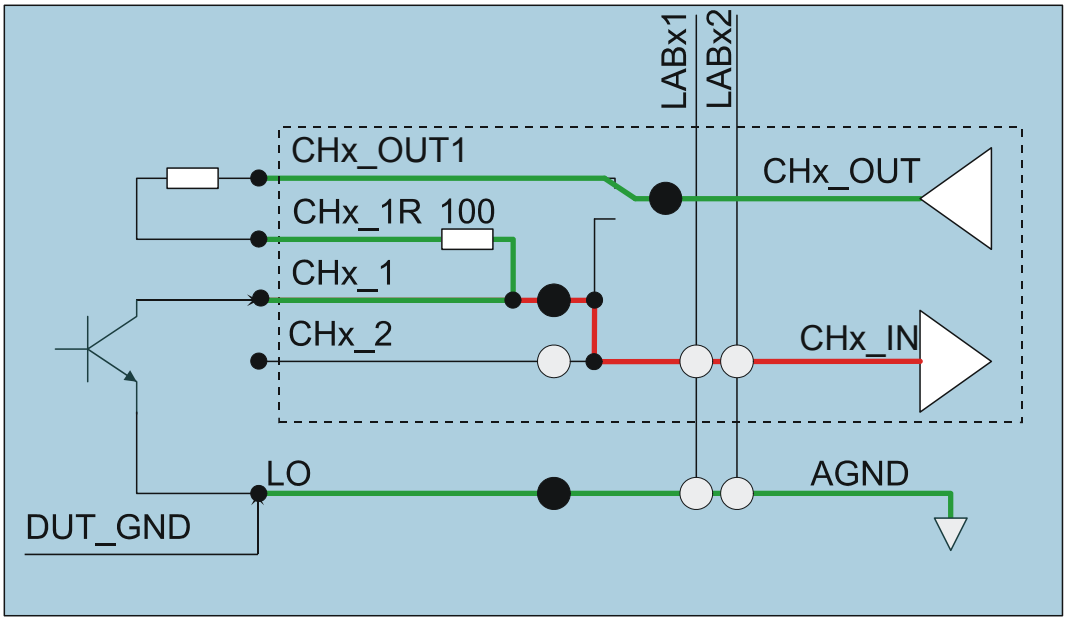

Figure 5-4 Test of „Low-Side“ outputs (OC, OD, optocoupler, switch, etc.)

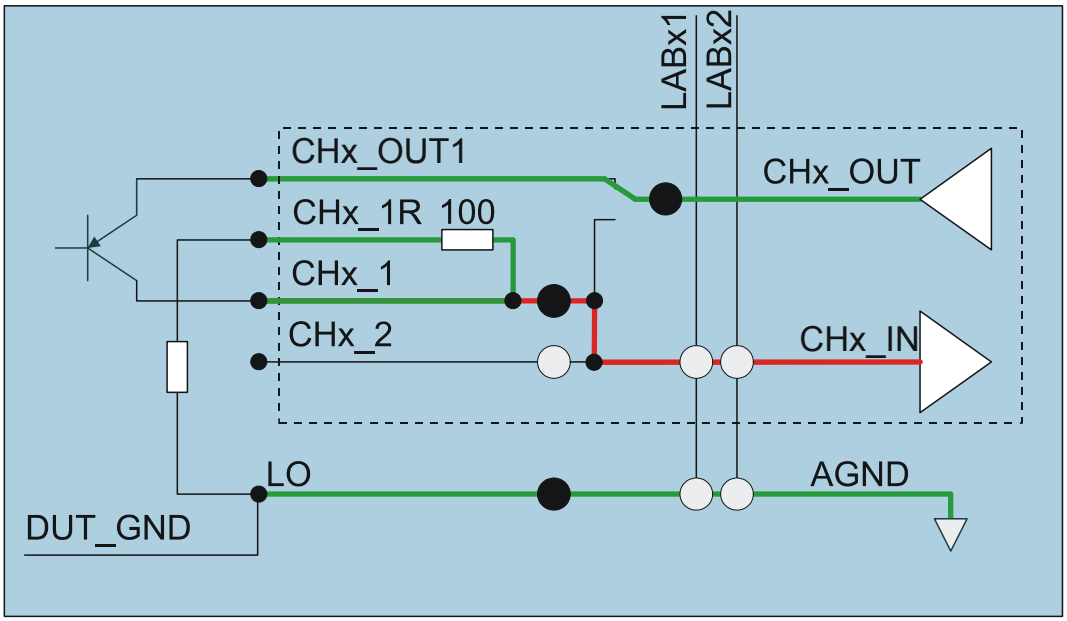

Figure 5-5 Test of „High-Side“ outputs (OC, OD, optocoupler, switch, etc.)

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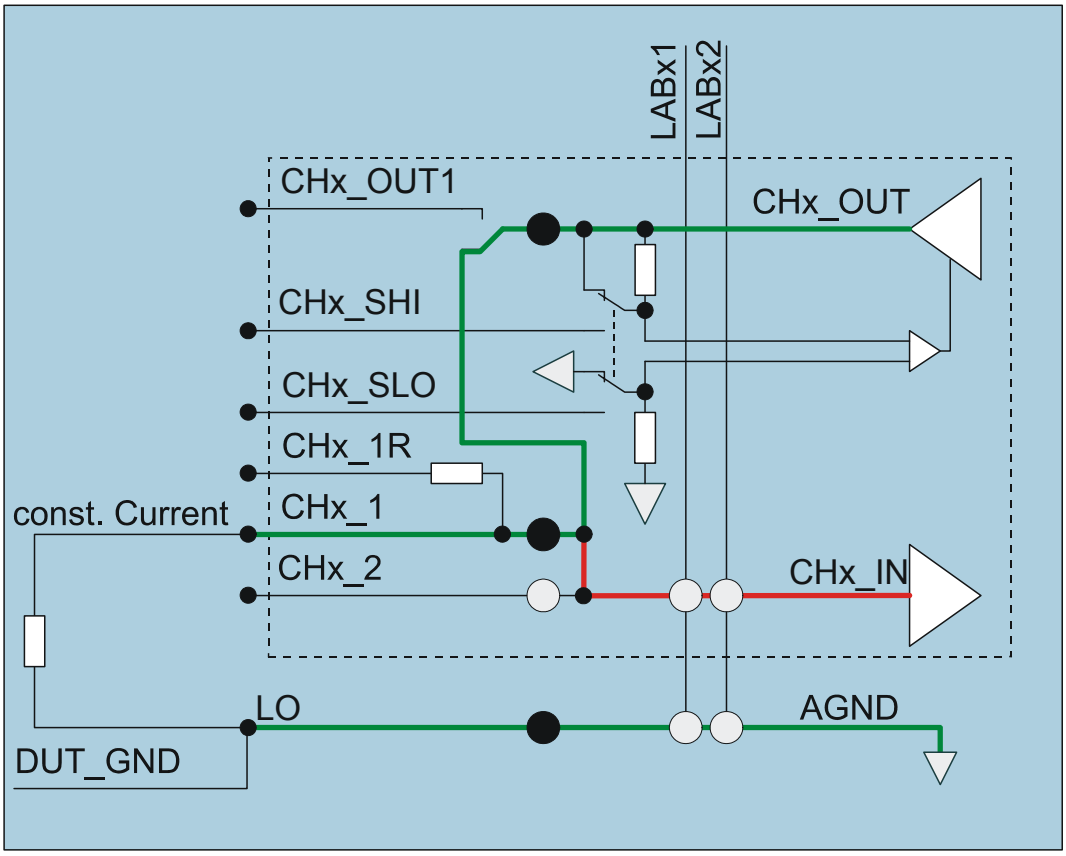

Figure 5-6 Extended channel for implementing current interfaces (0.5 mA …100 mA, actuators)

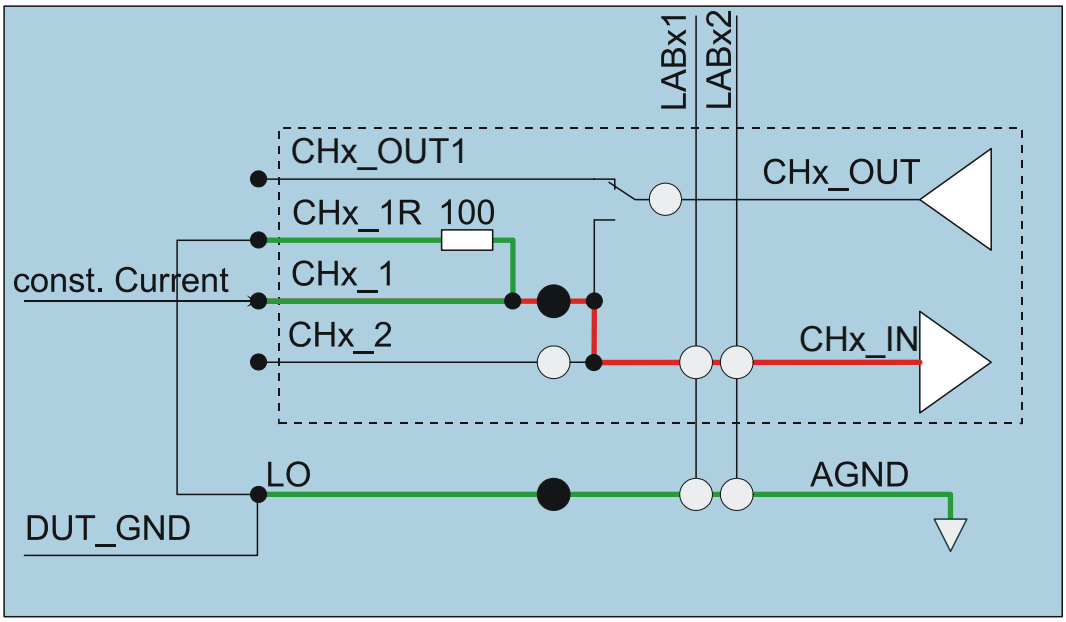

Figure 5-7 Evaluation of current interfaces (sensors)

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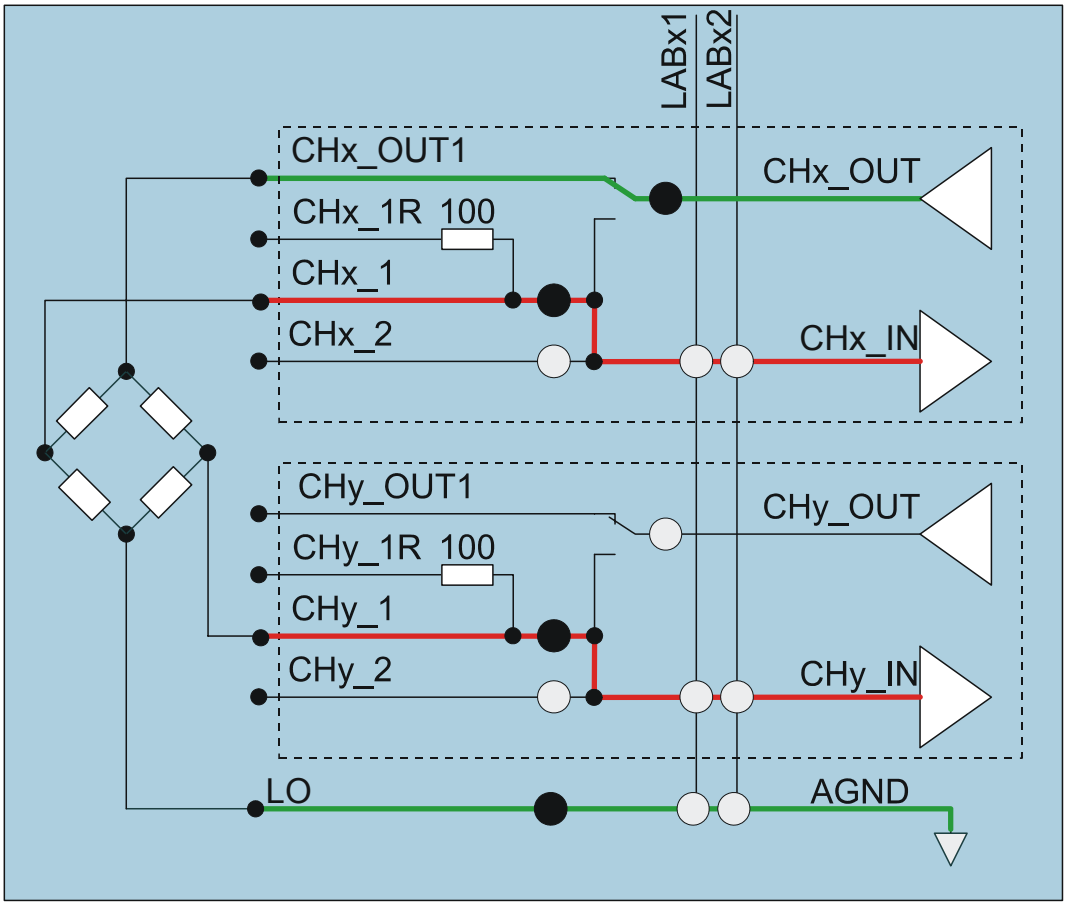

Figure 5-8 Differential measurement on bridge sensors

5.1.3 Signal wiring

5.1.3.1 General

All signal wiring of the R&S TS-PIO2 module is performed with the aid of relays. Since relays have an operate and release time as well as a bounce time, you should wait until the signals are stable in a test program before wiring connections. Function `rspio2_IsDebounced` can be used to determine whether the switching processes are complete. `rspio2_WaitForDebounce` waits until all switching processes are complete and then returns control to the test program.

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CAUTION!

To avoid destroying the relay contacts, the relays should only be switched with currents in the specified range.

5.1.3.2 Module ground wiring

The module ground (potential-free common reference point of IO channels, AGND) can be connected via relays with the front side connector (LO) and with each line of the analog bus (ABxy).

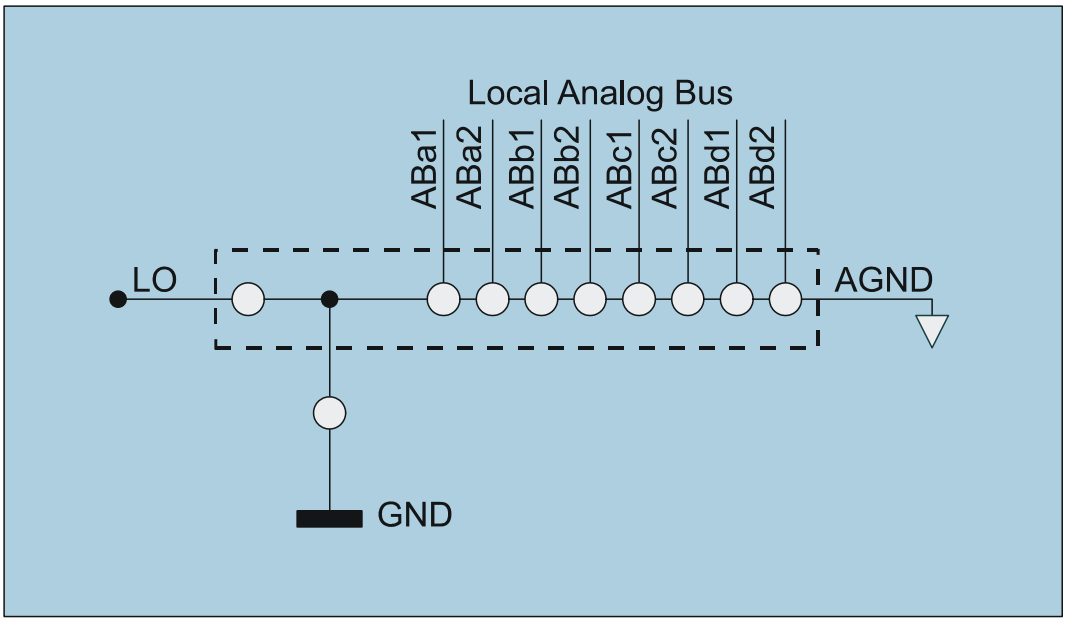

Figure 5-9 Relays for wiring the module ground

The following functions are available to operate these relays:

- `rspio2_Connect`
- `rspio2_Disconnect`
- `rspio2_DisconnectAll`

Function `rspio2_DisconnectAll` can be used to break all connections created with`rspio2_Connect` with a single function call.

NOTE:

`rspio2_DisconnectAll` has no effect on the configuration of outputs, coupling relays, or the ground relay.

The potential-free module ground can also be connected to ground with the aid of the ground relay (see Section 5.1.3.6)

5.1.3.3 Switching inputs

The inputs of each channel can be switched via a multiplexer to the front side connector (CHx_1 or CHx_2) or the TSVP analog bus (see Table 5-1 channels and corresponding groups).

The following functions are available to operate these relays:

- `rspio2_Connect`
- `rspio2_Disconnect`
- `rspio2_DisconnectAll`

Function `rspio2_DisconnectAll` can be used to break all connections created with`rspio2_Connect` with a single function call.

NOTE:

`rspio2_DisconnectAll` has no effect on the configuration of outputs, coupling relays, or the ground relay.

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5.1.3.4 Switching outputs

Function `rspio2_ConfigureOutputMux` configures the switching state of the outputs of a channel. The following settings are possible:

- Output disconnected
- Output connected with front side connector (CHx_OUT1)
- Output connected with corresponding input (CHx_IN)

NOTE:

Please note that function `rspio2_DisconnectAll` does not affect this setting!

5.1.3.5 Coupling relay

The coupling relays connect the local analog bus (LAB) on the module with the analog bus in the R&S CompactTSVP or R&S PowerTSVP. The function `rspio2_ConfigureCoupling` defines the status of the coupling relays.

NOTE:

Please note that function `rspio2_DisconnectAll` does not open these relays!

5.1.3.6 Ground relays

The R&S TS-PIO2 module has a ground relay that can be used to connect the potential-free module ground (AGND) with ground (GND).

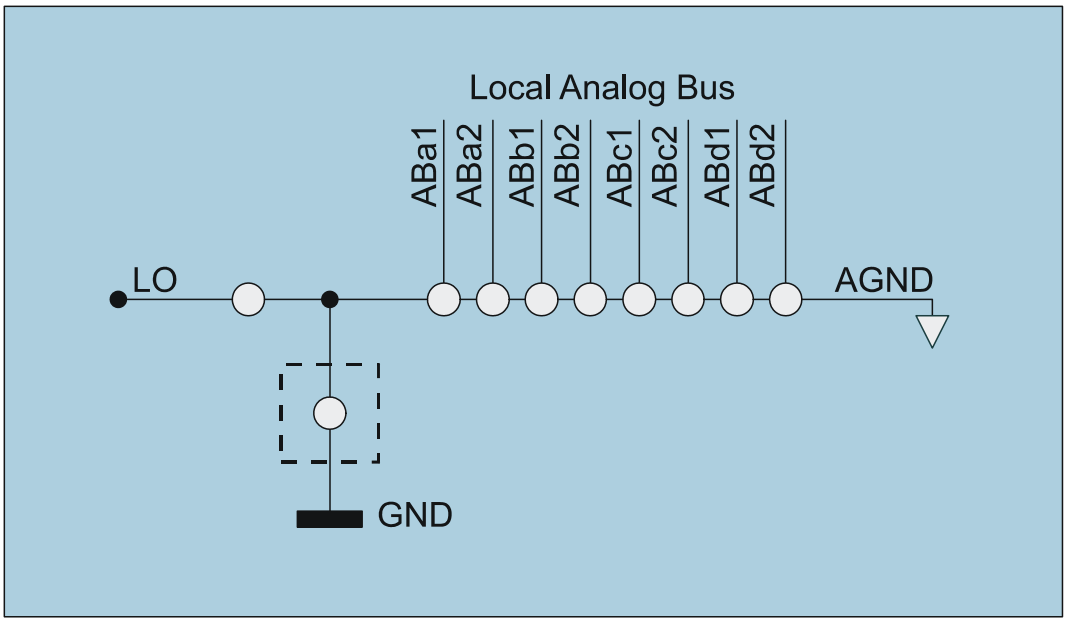

Figure 5-10 Ground relay

The module is operated ground-free in its basic state. This state can be changed using the function `rspio2_ConfigureGround`.

NOTE:

Please note that function `rspio2_DisconnectAll` does not open the ground relays!

NOTE:

For technical reasons, a non-switched R&S TS-PIO2 module (no connection of signals to the front side connector or analog bus) is automatically grounded through the ground relay. This relay is automatically opened again before new switching is performed. This applies if the R&S TS-PIO2 module is configured ground-free.

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5.1.4 Using sense lines

To compensate for voltage drops in the power supply to the external load, the extended channels (CH4, CH8, CH12 and CH16) of R&S TS-PIO2 can be set to external sensing. Two additional lines directly to the test object are required for this purpose. The measured difference in voltage on these lines is automatically controlled to the target voltage by R&S TS-PIO2.

The sense lines on the front side connector (CHx_SHI und CHx_SLO) are switched using function `rspio2_ConfigureRemoteSensing`..

5.1.5 Adjusting current limiting

The extended channels (CH4, CH8, CH12 and CH16) of the R&S TS-PIO2 make it possible to adjust current limiting. The set value is independent of the mode of a channel and is always applied to it. Function `rspio2_ConfigureChannelCurrentLimit`facilitates this setting.

5.1.6 Output of static voltages

In the basic state of the module, all outputs are in the „Analog“ operating mode. If necessary, this mode can also be selected with function `rspio2_ConfigureChannelMode`.

The voltage can be adjusted channel-specifically with function `rspio2_ConfigureChannelLevels`. Parameter „Output High Level“ determines the output voltage.

5.1.7 Output of static digital bit patterns

A channel can be switched to „Digital Static“ mode using function `rspio2_ConfigureChannelMode`. Any number of channels can be operated in this mode. Depending on which bit pattern is programmed, either the channel-specific voltage „Output High Level“ or the voltage assigned to a group „Output Digital Low Level“ is generated.

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Pattern value	Generated voltage	Setting function of the voltage value
0	Output Digital Low Level	`rspio2_ConfigureGroup`
1	Output High Level	`rspio2_ConfigureChannelLevels`

Table 5-2 Output Voltages in Mode„Digital Static“ and „Digital Dynamic“

The pattern value for channels in „Digital Static“ mode can be set with function`rspio2_SetDigitalOutputState`. One parameter of this function serves as a mask so that the individual channels can be operated.

NOTE:

When switching from the „Analog“, „Waveform“ or „Square Wave“ mode to „Digital Static“ mode, level „Output High Level“ is generated (pattern value „1“).

5.1.8 Output of dynamic digital bit patterns

In the „Digital Dynamic“ operating mode, the output voltage of the relevant channels is determined by a digital bit pattern which is updated cyclically after sequence control begins (see Section 5.1.13).

This mode can be selected for a channel using function `rspio2_ConfigureChannelMode`. Any number of channels can be switched to this mode.

The high and low level for the relevant channels can be set like in „Digital Static“ mode (see Section 5.1.7).

Before sequence control begins, the bit pattern must be loaded into the R&S TS-PIO2 module. Function `rspio2_SetDigitalDynamicMemory` is used for this purpose. A maximum of 5000 values can be written to memory. If fewer values have been stored in memory than sequence control needs to generate, the last value is repeated.

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NOTE:

When switching from „Analog“, „Waveform“ or „Square Wave“ mode to „Digital Dynamic“ mode, level „Output High Level“ is generated (pattern value „1“). If level „Output Digital Low Level“ should be present before dynamic bit pattern output begins, pattern value „0“ must first be set in the „Digital Static“ mode.

5.1.9 Output of arbitrary waveforms

One of the 16 channels can be switched to the „Waveform“ mode using function `rspio2_ConfigureChannelMode`. To do this, the pattern register value is set to “1” for that channel. After sequence control has started (see Section 5.1.13), the output voltage of this channel is determined by the values in arbitrary waveform memory. The values are transferred to the „High Level“ register.

Function `rspio2_SetAnalogWaveformMemory` is used to transfer the values to the R&S TS-PIO2 module. As in the case of digital bit patterns, a maximum of 5000 values can be written to memory. If fewer values have been stored in memory than sequence control needs to generate, the last value is repeated.

NOTE:

Operating modes „Waveform“ and „Square Wave“ cannot be selected simultaneously within one group.

5.1.10 Output of square wave signals

For a channel to generate a square wave signal, the „Square Wave“ operating mode must first be activated with function `rspio2_ConfigureChannelMode`. Multiple channels can be operated simultaneously in this mode.

When square wave signals are generated, both the high and low level can be adjusted channel-specifically using function `rspio2_ConfigureChannelLevels`. When square wave generating stops, the „Output High Level“ is always generated. The frequency and duty cycle are always determined for the corresponding group. This is done with function `rspio2_ConfigureSquareWave`. The frequency and duty cycle can also be changed while the signal is being

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generated.

When adjusting the square wave signal, the rise and fall times of channels specified on the data sheet must be taken into consideration. The extended channels have longer times.

Output of square wave signals is finally started for a group with function `rspio2_SquareWaveEnabled`. The same function is used to stop generating square wave signals. The parameters of the function make it possible to start output for several groups synchronously.

Generation of square wave signals is independent of sequence control for recording of measurement values and of the output of digital bit patterns and arbitrary waveforms.

NOTE:

if the output of a square wave signal is enabled for a group, the following settings cannot be modified for any channels in that group:

- **Output High Level**
- **Output Square Wave Low Level**
- **Output Current Limit**
- **Output Digital Low Level**
- **Input Digital High Threshold**
- **Input Digital Low Threshold**

5.1.11 Recording digital measurement values

Each input is directed to two comparators with adjustable trip levels. This makes it possible to implement a hysteresis for evaluating signals. The limits can be set using function `rspio2_ConfigureGroup`. This makes it possible to set individual limits for each group of channels.

The result of the signal evaluation of a channel is „1“ if the input level is greater than value „Input Digital High Threshold“. The result of the signal evaluation of a channel is „0“ if the input level is less than value „Input Digital Low Threshold“.

If the input level is between limit values, the last state is always retained.

Digital measurement values are recorded in parallel to the voltage measurement. The process is started with sequence control (see Section 5.1.13). The results can be retrieved with function

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`rspio2_FetchDigital`.

5.1.12 Voltage measurements

Two methods are available for voltage measurement on inputs:

Method	Note
Single Ended	The level is measured between one input (CHx_IN) and module ground (AGND or LO on the front side connector)
Differential	The level between two inputs is determined by taking the difference. The following combinations of inputs are possible: CH1 - CH9 CH2 - CH10 CH3 - CH11 CH4 - CH12 CH5 - CH13 CH6 - CH14 CH7 - CH15 CH8 - CH16

Table 5-3 Methods for voltage measurement

The following measurement ranges can be set:

- 7 V
- 14 V
- 28 V

Voltage measurement can be configured with function `rspio2_ConfigureAnalogMeasurement`.

Recording of measurement values is monitored by sequence control (see Section 5.1.13). The setting of the the time interval also determines the conversion time of the ADC and thus the input bandwith and accuracy that can be achieved. Because of this, parameter „Sample Interval“ of function `rspio2_ConfigureSampling` is meaningful even if only one measurement value („Sample Count“ = 1) will be recorded!

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Interval			Input Bandwidth	Accuracy
200 µs	<= Sample Interval	< 1 ms	High	Lower
1 ms	<= Sample Interval	< 13.8 ms	Medium	Higher
13.8 ms	<= Sample Interval	< 1 s	Low	Best

Table 5-4 Effect of „Sample Interval“ on bandwidth and accuracy

Recording of measurement values is started by sequence control (see Section 5.1.13). The results can be queried with function `rspio2_FetchAnalog`. If you are only interested in the average value of all the samples recorded, it can be retrieved with `rspio2_FetchAverage`.

5.1.13 Triggering and sequence control

Measurement values are recorded and output of digital bit patterns is monitored by a central control system. Function `rspio2_ConfigureSampling` can be used to define the number of „Samples“ that will be recorded or generated. The time interval between the „Samples“ can be adjusted with this function.

The following actions are performed by sequence control in each time slot:

- A digital bit pattern is generated if at least one output is in „Digital Dynamic“ mode
- An analog waveform value is generated if a channel is running in „Waveform“ mode
- A pulse is generated on the configured trigger lines
- A digital bit pattern is read
- A measurement value is read

Various trigger sources are available to start sequence control:

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Trigger source	Note
Immediate	Sequence control starts immediately when function `rspio2_Initiate` is called
External	Ground referenced TTL input XTI1 on the front side connector; positive signal edge triggers sequence control
Software	Sequence control is started with function `rspio2_SendSoftwareTrigger`
PXI0 … PXI7	Positive signal edges on the PXI trigger lines start sequence control

Table 5-5 Trigger sources

Function `rspio2_ConfigureTriggerSource` determines the trigger source. Function `rspio2_Initiate` is used to enable the previously configured trigger source. Sequence control is in the „Initiated“ state. As soon as the trigger event has occurred, the control system switches to the „Sampling“ state. After the set number of „Samples“ has been read in or generated, sequence control returns to its basic state. Then the data that was read in can be retrieved with the corresponding functions (`rspio2_FetchAnalog`, `rspio2_FetchAverage`, `rspio2_FetchDigital`). These functions have a „Timeout“ parameter. If sequence control has not expired during the time that was transferred, an error is returned. Otherwise the results are returned.

NOTE:

If sequence control is in the „Initiated“ or „Sampling« mode, some functions cannot be performed. In that case, those functions return an error message. If necessary, sequence control can be switched to its basic state with the `rspio2_Abort` function.

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5.1.14 Generating trigger signals

The R&S TS-PIO2 module is capable of generating trigger signals on the following lines:

Name	Note
XTO1	Ground referenced TTL output XTO1 on the front side connector
PXI0 … PXI7	PXI trigger lines on the backplane

Table 5-6 Trigger outputs

For a change to occur on the trigger lines, an event must be assigned to the selected line that generates the trigger pulse. The following settings are possible:

Name	Note
General Purpose Trigger	Function `rspio2_InitiateTrigger` generates a pulse approximately 1 µs in length on the configured trigger lines.
Sequence Start	A pulse approximately 1 µs in length is generated on the configured trigger lines when sequence control starts.
Sample Clock	A pulse approximately 1 µs in length is generated in each time slot of sequence control on the configured trigger lines.

Table 5-7 Events for generating a trigger pulse

The polarity of the trigger signal can also be determined for the individual outputs. The output drivers for the PXI trigger lines can also be switched off.

All settings are made with the aid of function `rspio2_ConfigureTriggerOutput`.

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5.1.15 Autocorrection

To make it possible to achieve higher levels of accuracy, a process must be started under some circumstances to determine new correction values automatically. This process is performed with the aid of function `rspio2_PerformAutoCorrection`. It takes about one minute to determine the correction values. The function is not finished until the process is complete. After the correction procedure, the R&S TS-PIO2 module is in its reset state.

The autocorrection must be performed after no more than 24 hours of operating time, or if the temperature on the R&S TS-PIO2 module changes by 5 degrees Celsius. The driver monitors these parameters. Function `rspio2_QueryDeviceState` can be used to query whether the correction procedure must be started.

NOTE:

Function `rspio2_QueryDeviceState` always requests an autocorrection if the R&S TS-PIO2 module has just been turned on or reset by a hardware reset.

5.1.16 Excess temperature protection

There are four temperature sensors on the R&S TS-PIO2 module. If one of these sensors reports an inadmissible temperature, the module switches off automatically. The functions for switching signals and activating outputs return an error message in this state. Complete operation of R&S TS-PIO2 is not possible until the temperature is in the permissible range and use of the protective measure has been acknowledged by calling function `rspio2_reset`. Function `rspio2_QueryDeviceState` can be used to query the state of temperature monitoring.

5.1.17 Instructions for operation with voltages dangerous to the touch

In conformity with EN 61010-1, the following voltage limit values are considered „Hazardous live“.

- 70 V DC
- 33 V AC eff
- 46.7 V AC peak

WARNING!

When operating the Analog/Digital IO Module R&S TS-PIO2 above these voltage limit values, the requirements of EN61010-1 must be observed.

The Analog/Digital IO Module R&S TS-PIO2 and Test System Versatile Platform R&S CompactTSVP / R&S PowerTSVP are designed for a maximum voltage of 125 V between ground-free measurement devices, analog busses, and GND. Care must be taken to ensure that this limit is not exceeded at any time, even as the sum of voltages, and thus not as a results of alternating signals.

Figure 5-11 shows a typical permissible voltage configuration between analog busses and ground.

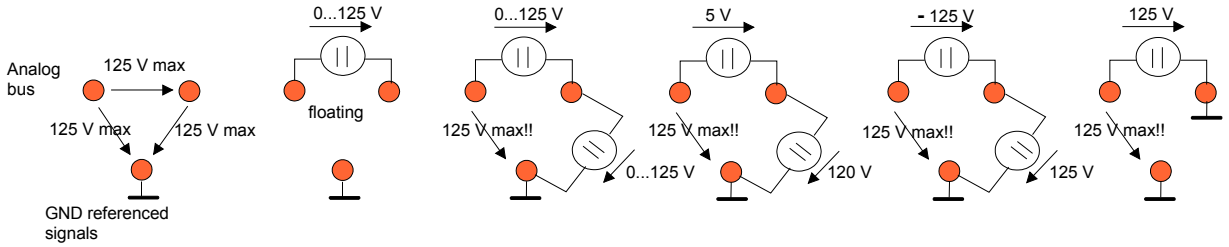

Figure 5-11 Permissible voltages on analog bus lines

For reasons of fire prevention in conformity with EN 61010-1, we recommend limiting the current or output for DC sources to 150 VA.

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5.2 Description of functions of the module R&S TS-PDC

The Rear I/O Module R&S TS-PDC is configured as a primary reference DC/DC converter. The input voltage (5 VDC) is transferred to two secondary potentials and rectified to the nominal voltage by line controllers. The status of the output voltage is displayed in each case by an LED.

The following DC voltages are generated:

– +15 VDC, 0.5A (2x)

– -15 VDC, 0.5A (2x)

– +5 VDC, 0.5A (2x)

– +3.3 VDC, 0.25A (2x)

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6 Commissioning

6.1 Installation of the R&S TS-PIO2 module

To install plug-in module R&S TS-PIO2 , proceed as follows:

- Shut down and turn off the R&SCompactTSVP / R&SPowerTSVP.
- Select a suitable front side connection slot. For more information, see the operating manual for „CompactTSVP R&S TS-PCA3“ or„PowerTSVP R&S TS-PWA3“, in both cases Section “Permitted module configurations”.
- Remove the appropriate front plate section on the R&S CompactTSVP / R&S PowerTSVP housing by loosening the two screws.

CAUTION!

Check the backplane connectors for bent pins! Any pins that are bent must be straightened!
Failure to observe this instruction may result in permanent damage to the backplane!

- Press in the module applying moderate pressure.
- The upper catch pin of the R&S TS-PIO2 module must be guided into the right hole, while the lower catch pin is guided into the left hole of the R&S CompactTSVP / R&S PowerTSVP housing.

CAUTION!

When the R&S TS-PIO2 module is connected, it must be guided with both hands and carefully pressed into the backplane connector.

- When the R&S TS-PIO2 module is correctly inserted, you will feel it reach a definite mechanical limit
- Tighten the upper and lower screws on the front plate of the R&S TS-PIO2 module.

NOTE:

Install the Rear-I/O R&S TS-PDC module as described in Section 6.2.

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6.2 Installation of the R&S TS-PDC module

To install the plug-in module, proceed as follows:

- Previous installation of the R&S TS-PIO2 module is required.
- Select the appropriate Rear-I/O slot for module R&S TS-PIO2.
- Loosen the two screws and remove the appropriate back plate section on the TSVP housing.

CAUTION!

For use in a CompactTSVP R&S TS-PCA3 beginning with serial number 100109, a R&S TS-PDC module with at least version number V1.4 (serial number greater than 1003xx) is required.

CAUTION!

Check the backplane connectors for bent pins! Any pins that are bent must be straightened!
Failure to observe this instruction may result in permanent damage to the backplane!

- Press in the module applying moderate pressure.

CAUTION!

When the R&S TS-PDC module is connected, it must be guided with both hands and carefully pressed into the backplane connector.

- When the R&S TS-PDC module is correctly inserted, you will feel it reach a definite mechanical limit
- Tighten the upper and lower screws on the front plate of the R&S TS-PDC module.

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7 Software

7.1 Driver software

A LabWindows IVI driver that supports the class IVI SWTCH is available for the functions of the Analog/Digital IO Module R&S TS-PIO2. The driver is a component of the ROHDE & SCHWARZ GTSL software program. All functions of the driver are documented extensively in online Help and in the LabWindows/CVI Function Panels.

The following software modules are installed during driver installation:

Module	Path	Note
rspio2.dll	<GTSL directory>\Bin	Driver
rspio2.hlp	<GTSL directory>\Bin	Help file
rspio2.fp	<GTSL directory>\Bin	LabWindows CVI Function Panel File, Function Panels for CVI Development Environment
rspio2.sub	<GTSL directory>\Bin	LabWindows CVI attribute file. This file is required by several „Function Panels“.
rspio2.lib	<GTSL directory>\Bin	Import library
rspio2.h	<GTSL directory>\Include	Header file for driver

Table 7-1 Driver installation R&S TS-PIO2

NOTE:

The IVI and VISA library of National Instruments are required to operate the driver.

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7.2 Soft Panel

A Soft Panel is available for the Analog/Digital IO Module R&S TS-PIO2 (Figure 7-1). The Soft Panel requires the IVI driver. The Soft Panel facilitates interactive operation of the module. Output of measurement values is in graphical format.

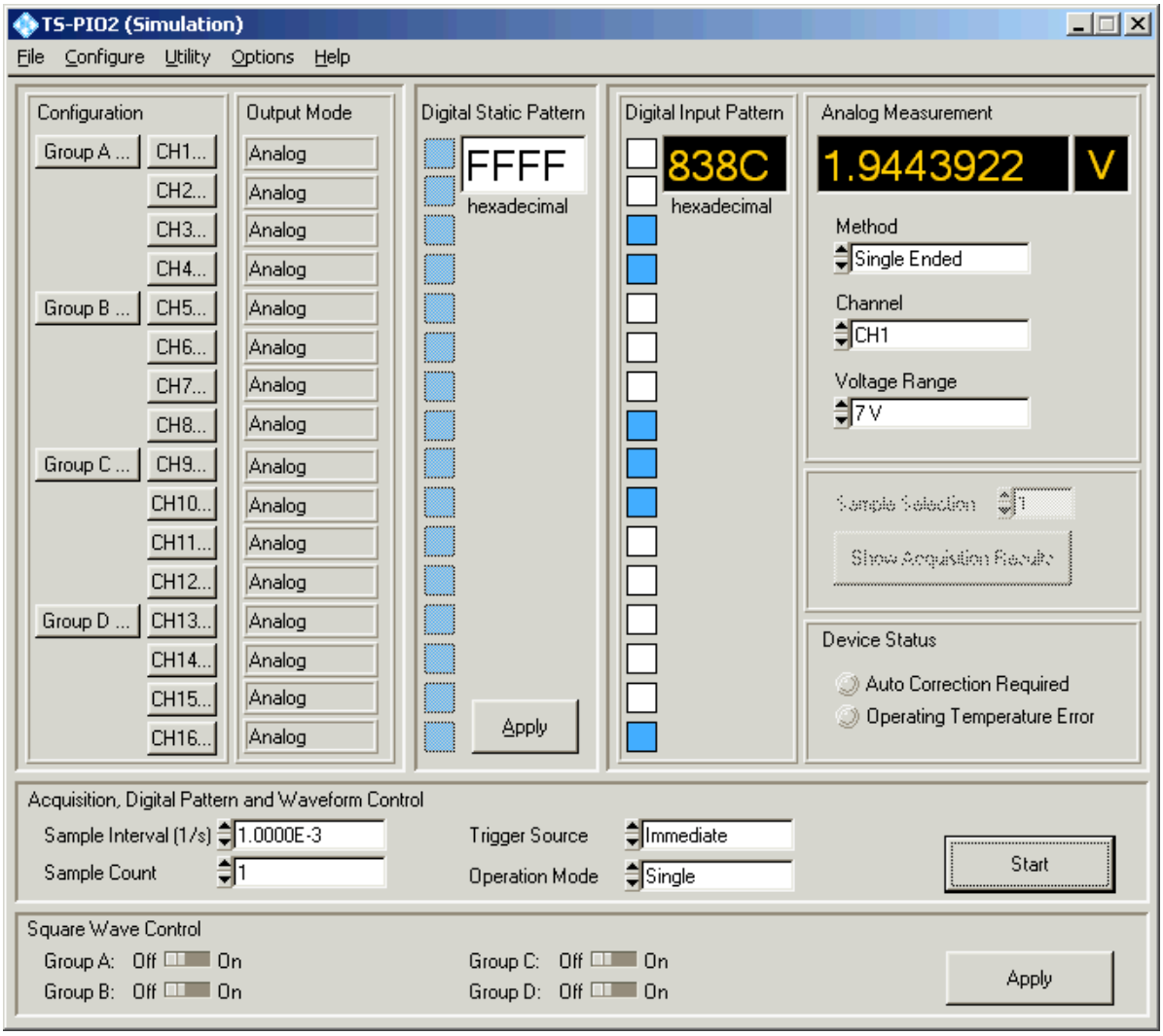

Figure 7-1 Soft Panel R&S TS-PIO2

NOTE:

The operation of the Soft Panel is described in Chapter 12 of the "R&S GTSL Software Description".

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The signal paths connections of the R&S TS-PIO2 can also be determined by the Soft Panel (Figure 7-2).

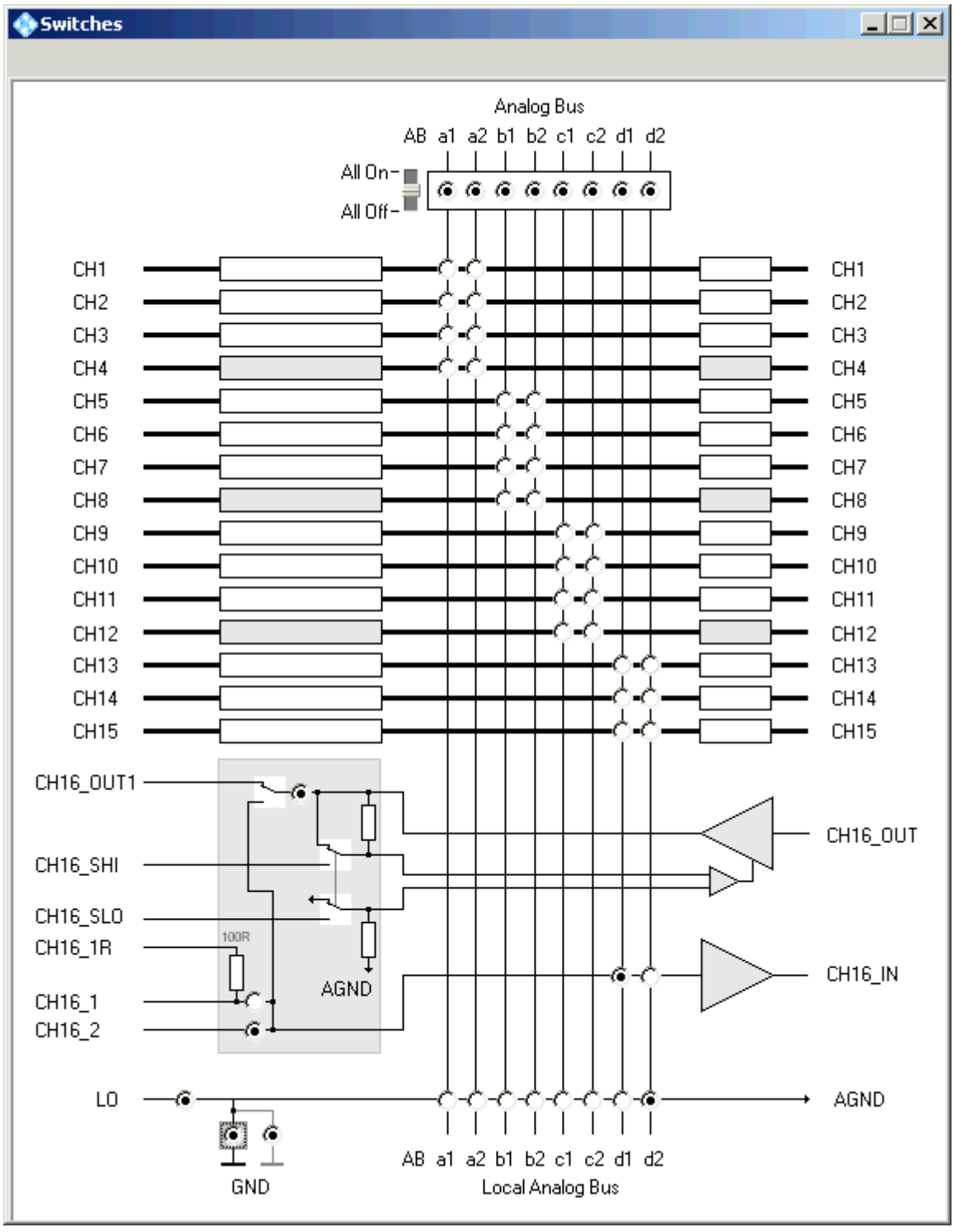

Figure 7-2 Soft Panel R&S TS-PIO2 connections

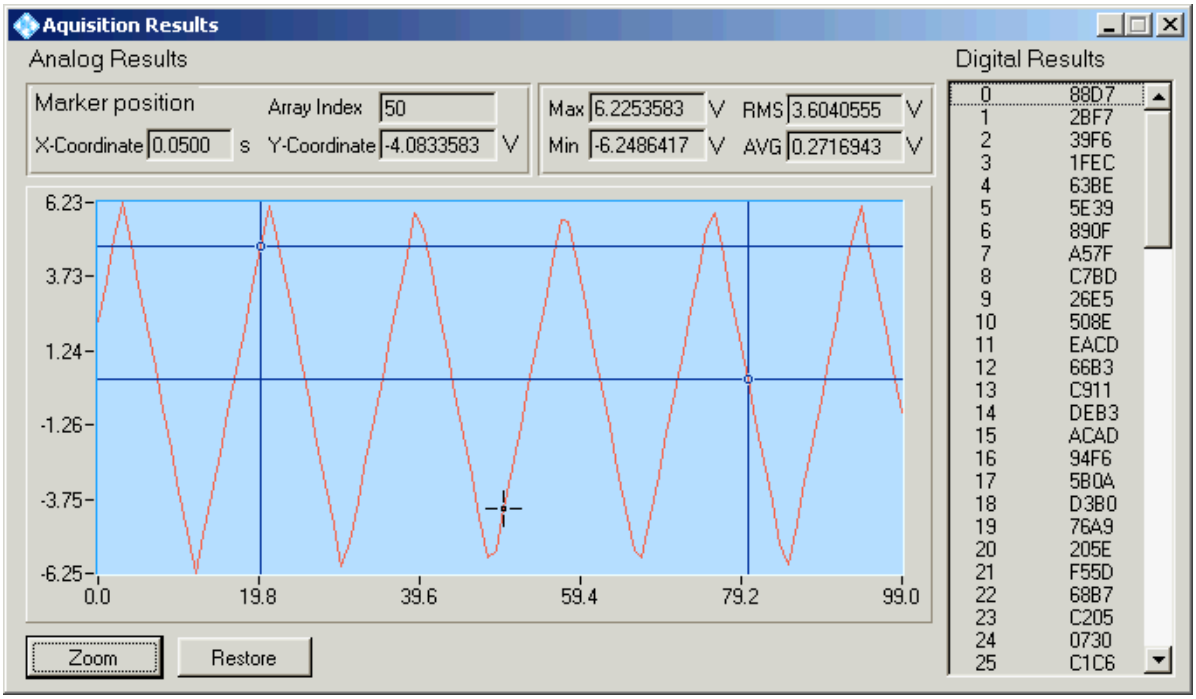

Figure 7-3 Soft Panel R&S TS-PIO2 measurement results

7.3 Sample program R&S TS-PIO2

```
/*
  This example connects all channels to the front connector, configures
  the channels and starts the output/acquisition sequence.

  Error handling is not considered in this sample in order to
  keep it easy to read. The return status should be checked for
  VI_SUCCESS after each driver call.
*/

#include <ansi_c.h>
#include "rspio2.h"


#define SAMPLE_COUNT        16
#define SAMPLE_INTERVAL     1E-3


static ViChar * s_pGrpName[] =
{
  "GRP_A",
  "GRP_B",
  "GRP_C",
  "GRP_D"
};

static ViUInt16 s_digiStim[SAMPLE_COUNT];
static ViUInt16 s_digiResp[SAMPLE_COUNT];
static ViReal64 s_waveform[SAMPLE_COUNT];
static ViReal64 s_measResult[SAMPLE_COUNT];

int main (int argc, char *argv[])
{
  ViSession vi;
  ViStatus  status;
  ViReal64  result;
  ViChar    chName[5], ch1[8], ch2[8];
  ViInt32   idx;

  /*
    open a session to the device driver. The resource descriptor
    depends on the slot number of the module and must be adapted
    to the target system.
  */
  status = rspio2_InitWithOptions ("CAN0::0::2::7::INSTR",
                                   VI_TRUE,
                                   VI_TRUE,
                                   "Simulate=0,RangeCheck=1",
                                   &vi);

  /* configure sample count and interval */
  status = rspio2_ConfigureSampling (vi, SAMPLE_COUNT, SAMPLE_INTERVAL);

  /* fill stimulus buffer */
  for (idx = 0; idx < SAMPLE_COUNT; idx++)
  {
    s_digiStim[idx] = idx;                              /* counter */
    s_waveform[idx] = idx * (10.0 / SAMPLE_COUNT);      /* ramp */
  }

  /* upload samples */
  status = rspio2_SetDigitalDynamicMemory (vi, SAMPLE_COUNT, s_digiStim);
  status = rspio2_SetAnalogWaveformMemory (vi, SAMPLE_COUNT, s_waveform);
```

```
/* configure voltage mesurement at CH16 */
status = rspio2_ConfigureAnalogMeasurement (vi, "CH16", 14.0);

/* configure square wave generation on CH9 and CH10 */
status = rspio2_ConfigureSquareWave (vi, "GRP_C", 2000, 50);



/* generate trigger puls at XTO1 when output/acquisition sequence starts */
status = rspio2_ConfigureTriggerOutput (vi, RSPIO2_TRIG_MASK_XTO1,
                                        RSPIO2_VAL_TRIG_SEQ_START, 0,
                                        RSPIO2_TRIG_MASK_XTO);

/* configure module earth tied (connect AGND to GND) */
status = rspio2_ConfigureGround (vi, VI_TRUE);

/* connect AGND to front connector */
status = rspio2_Connect (vi, "AGND", "LO");

/* connect all output channel to front connector */
for (idx = 1; idx <= 16; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureOutputMux (vi, chName,
                                      RSPIO2_VAL_OUTMUX_MODE_OUT1);
}

/* connect all input channel to front connector */
for (idx = 1; idx <= 16; idx++)
{
  sprintf(ch1, "CH%d_IN", idx);
  sprintf(ch2, "CH%d_1", idx);
  status = rspio2_Connect (vi, ch1, ch2);
}

/* wait until relays have settled; timeout 500 ms */
status = rspio2_WaitForDebounce (vi, 500.0);

/* configure channel 1 to 8 to mode digital dynamic */
for (idx = 1; idx <= 8; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelMode (vi, chName,
                                        RSPIO2_VAL_CH_MODE_DIGITAL_DYNAMIC);
}

/* configure channel 9 to 10 to mode square wave */
for (idx = 9; idx <= 10; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelMode (vi, chName,
                                        RSPIO2_VAL_CH_MODE_SQUAREWAVE);
}

/* configure channel 11 to 12 to mode digital static */
for (idx = 11; idx <= 12; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelMode (vi, chName,
                                        RSPIO2_VAL_CH_MODE_DIGITAL_STATIC);
}

/* configure channel 16 to mode waveform */
status = rspio2_ConfigureChannelMode (vi, "CH16",
                                      RSPIO2_VAL_CH_MODE_WAVEFORM);
```

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```
/* configure current limit for the extented channels */
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH4", 10.0e-3);
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH8", 10.0e-3);
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH12", 10.0e-3);
status = rspio2_ConfigureChannelCurrentLimit (vi, "CH16", 10.0e-3);


/* configure output high level to 3.3 V and square wave low level to 0 V */
for (idx = 1; idx <= 12; idx++)
{
  sprintf(chName, "CH%d", idx);
  status = rspio2_ConfigureChannelLevels (vi, chName, 3.3, 0.0);
}

/* configure output level for the analog channels */
status = rspio2_ConfigureChannelLevels (vi, "CH13",  3.3, 0.0);
status = rspio2_ConfigureChannelLevels (vi, "CH14",  5.0, 0.0);
status = rspio2_ConfigureChannelLevels (vi, "CH15", 12.0, 0.0);

/*
   configure group A, B, C for digital IO:

   output digital low level     0.0 V
   input digital high threshold 2.0 V
   input digital low threshold  0.8 V
*/
for (idx = 0; idx <= 2; idx++)
{
  rspio2_ConfigureGroup (vi, s_pGrpName[idx], 0.0, 2.0, 0.8);
}

/* set pattern for the digital static channel CH11 and CH12 */
status = rspio2_SetDigitalOutputState (vi, 0x0C00, 0x0800);

/* enable square wave */
status = rspio2_SquareWaveEnabled (vi, 0x4, 0x4);

/* start output/acquisition sequence with immediate trigger */
status = rspio2_Initiate (vi);

/* fetch the measurement results */
{
  ViInt32 actualPoints;
  ViInt32 maxTime = SAMPLE_COUNT * SAMPLE_INTERVAL * 1000;

  status = rspio2_FetchDigital (vi, maxTime, SAMPLE_COUNT,
                                s_digiResp, & actualPoints);
  status = rspio2_FetchAnalog (vi, maxTime, SAMPLE_COUNT,
                               s_measResult, & actualPoints);
}
```

```
  /* disable square wave generation */
  status = rspio2_SquareWaveEnabled (vi, 0x4, 0x0);
  /* disable all outputs */
  for (idx = 1; idx <= 16; idx++)
  {
    sprintf(chName, "CH%d", idx);

    /* set output high level to 0 V */
    status = rspio2_ConfigureChannelLevels (vi, chName,  0.0, 0.0);

    /* select output high level */
    status = rspio2_ConfigureChannelMode (vi, chName,
                                          RSPIO2_VAL_CH_MODE_ANALOG);
    /* disconnect output channel */
    status = rspio2_ConfigureOutputMux (vi, chName,
                                        RSPIO2_VAL_OUTMUX_MODE_OPEN);
  }

  /* disconnect the rest */
  status = rspio2_DisconnectAll (vi);

  /* configure module earth free again */
  status = rspio2_ConfigureGround (vi, VI_FALSE);

  /* reset module, close the driver session */
  status = rspio2_close (vi);

  return 0;
}
```

8 Self-Test

The Analog/Digital IO Module R&S TS-PIO2 has an integrated capability for self-test. The following tests are possible:

- LED test
- Power on test
- TSVP self-test

8.1 LED test

After the system is turned on, all five LEDs are lit for about three seconds. This indicates that the required power supply has been applied and all LEDs are in proper order. The following observations may be made about different display states:

LED	Description
One individual LED is not lit	– Hardware problem in the module – LED faulty
No LEDs are lit	+5 V power supply voltage missing

Table 8-1 Observations about the LED test

NOTE:

If diagnostic results indicate a faulty power supply, perform a visual inspection of the LEDs on the corresponding Rear-I/O module R&S TS-PDC. If the results confirm that the power supply voltage has failed, the R&S TS-PDC module must be replaced.

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8.2 Power on test

The power on test runs in parallel to the LED test. If a fault is discovered in the module, the red LED will light up to indicate the fault. The test is limited to checking the cPCI interface and the firmware of the R&S TS-PIO2. Note the following statements describing the different display states of the red and green LED after the LED test has been performed:

LED	Description
PWR LED (green) on	All power supply voltages are present
PWR LED (green) off	At least one power supply of module R&S TS-PIO2 or module R&S TS-PDC is not present
ERR LED (red) off	No error is present
ERR LED (red) is lit or flashing	Hardware error is present (processor is not starting)

Table 8-2 Observations about the power on test

NOTE:

If diagnostic results indicate a faulty power supply, perform a visual inspection of the LEDs on the corresponding Rear-I/O module R&S TS-PDC. If the results confirm that the power supply voltage has failed, the R&S TS-PDC module must be replaced.

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8.3 TSVP self-test

As part of the TSVP self test, an extensive test of the R&S TS-PIO2 module is performed and an exhaustive protocol is generated. This is done with the “Self-Test Support Library”.

The R&S TS-PSAM analog stimulus and measurement module is used as a measurement unit in the TSVP self-test. The functionality of the modules in the system is ensured by measurements via the analog bus.

First the global analog bus and then the local analog bus are tested for valid voltages. These voltages could possibly come from an outside source, for example through sources that are connected. After an isolation measurement between the buses, all the relays (coupling, matrix, multiplexer, sense relays) are tested. This is followed by measurements on all accessible components of the module. Then, if possible, triggering via PXI lines is tested.

NOTE:

You can find information about starting the self-test and the order of required work steps as well as a detailed description of parameters and sequences that are tested in the R&S CompactTSVP / R&S Power TSVP Service Manual.

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9 Interface description

9.1 Interface description R&S TS-PIO2

9.1.1 Connector X1

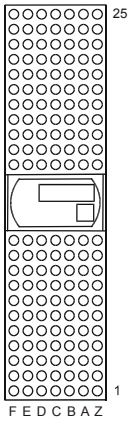

Figure 9-1 Connector X1 (view: plug side)

Pin	F	E	D	C	B	A	Z
25	GND	+5V				+5V	GND
24	GND				+5V		GND
23	GND		+5V				GND
22	GND				GND		GND
21	GND						GND
20	GND				GND		GND
19	GND		GND				GND
18	GND				GND		GND
17	GND		GND				GND
16	GND				GND		GND
15	GND		GND				GND
12..14							
11	GND		GND				GND
10	GND				GND		GND
9	GND		GND				GND
8	GND				GND		GND
7	GND		GND				GND
6	GND				GND		GND
5	GND		GND				GND
4	GND				GND		GND
3	GND		+5V				GND
2	GND				+5V		GND
1	GND	+5V				+5V	GND
Pin	F	E	D	C	B	A	Z

Table 9-1 Pin assignment for connector X1

9.1.2 Connector X20

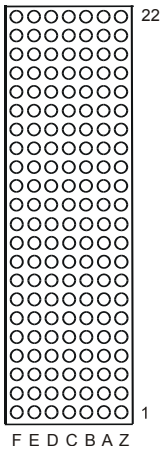

Figure 9-2 Connector X20 (view: plug side)

NC = not connected, NP = not populated

Pin	F	E	D	C	B	A	Z
22		GA0	GA1	GA2	GA3	GA4	
21					GA5		
20		+5V_IN	GND	+5V_IN			
19				+5V_IN	GND		
18		PXI_TRIG6	CAN_EN	PXI_TRIG5	PXI_TRIG4	PXI_TRIG3	
17		PXI_CLK10	+5V_IN	+5V_IN	GND	PXI_TRIG2	
16		PXI_TRIG7	GND		PXI_TRIG0	PXI_TRIG1	
15			+5V_IN	+5V_IN	GND		
14							
13							
12	NP	+15V_IN	+18.3V_IN	+20V_IN	AGND	+30V_IN	NP
11	NP						NP
10		-15V_IN			-30V_IN	AGND	
9							
8		+15V_IN	+15V_IN	+15V_IN	+15V_IN	+15V_IN	
7							
6		-15V_IN	-15V_IN	-15V_IN	-15V_IN	-15V_IN	
5							
4							
3			RRST#		GND	RSDO	
2			RSDI			RSCLK	
1		+5V_IN	CAN_L	CAN_H	GND	RCS#	
Pin	F	E	D	C	B	A	Z

Table 9-2 Pin assignment for connector X20

9.1.3 Connector X10

Plug type DIN 41612, 96 pin, female

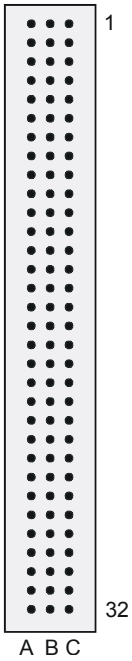

Figure 9-3 Connector X10 (view: front panel)

	A	B	C
1	CH1_OUT1	CH2_OUT1	CH3_OUT1
2	CH1_1R	CH2_1R	CH3_1R
3	CH1_1	CH2_1	CH3_1
4	CH1_2	CH2_2	CH3_2
5	LO	LO	LO
6	LO	CH4_1	CH4_SHI
7	CH4_OUT1	CH4_2	CH4_SLO
8	CH4_1R	CH6_OUT1	CH7_OUT1
9	CH5_OUT1	CH6_1R	CH7_1R
10	CH5_1R	CH6_1	CH7_1
11	CH5_1	CH6_2	CH7_2
12	CH5_2	LO	LO
13	LO	LO	CH8_SHI

Table 9-3 Pin assignment for connector X10 (view front panel)

	A	B	C
14	CH8_OUT1	CH8_1	CH8_SLO
15	CH8_1R	CH8_2	CH11_OUT1
16	CH9_OUT1	CH10_OUT1	CH11_1R
17	CH9_1R	CH10_1R	CH11_1
18	CH9_1	CH10_1	CH11_2
19	CH9_2	CH10_2	LO
20	LO	LO	LO
21	CH12_OUT1	CH12_1	CH12_SHI
22	CH12_1R	CH12_2	CH12_SLO
23	CH13_OUT1	CH14_OUT1	CH15_OUT1
24	CH13_1R	CH14_1R	CH15_1R
25	CH13_1	CH14_1	CH15_1
26	CH13_2	CH14_2	CH15_2
27	LO	LO	LO
28	CH16_OUT1	CH16_1	LO
29	CH16_1R	CH16_2	CH16_SHI
30	GND	GND	CH16_SLO
31	GND	GND	GND
32	XTO1	XTI1	CHA_GND

Table 9-3 Pin assignment for connector X10 (view front panel)

Comment:

The CHA_GND signal is connected with the front plate of the module and via two 10 nF capacitors with GND. The front plate itself has no direct connection to GND. When a test object is connected, the test object GND should be connected to GND. To avoid ripple loops, do not connect GND and CHA_GND.

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9.1.4 Connector X30

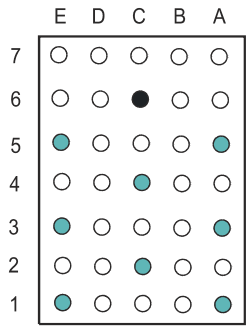

Figure 9-4 Connector X30 (view: plug side)

Pin	E	D	C	B	A
7					
6			GND		
5	ABC1				ABA1
4			ABB1		
3	ABC2				ABB2
2			ABA2		
1	ABD2				ABD1

Table 9-4 Pin assignment for connector X30

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9.2 Interface description R&S TS-PDC

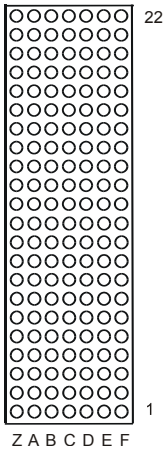

Figure 9-5 Connector X20 (view: plug side R&S TS-PDC)

Pin	Z	A	B	C	D	E	F	
22	GND						GND	
21	GND		GND or NC *3)				GND	
20	GND			+5V *1)	GND	+5V *1)	GND	
19	GND		GND	+5V *1)			GND	
18	GND				GND		GND	J20
17	GND		GND	+5V *2)	+5V *2)		GND	
16	GND			+5V *2)	GND		GND	
15	GND		GND	+5V *2)	+5V *1)		GND	
14	NC						NC	C
13	NC						NC	O
12	NP	+15V_1	-15V_1	+5V_1	+3.3V_1	COM_1	NP	N
11	NP						NP	N
10	NC	+15V_2	-15V_2	+5V_2	+3.3V_2	COM_2	NC	E
9	NC						NC	C
8	NC	COM_1	COM_1	COM_1	COM_1	COM_1	NC	T
7	NC						NC	O
6	NC	COM_2	COM_2	COM_2	COM_2	COM_2	NC	R
5	NC						NC	
4	NC						NC	
3	GND		GND		RRST#		GND	
2	GND	RSCLK			RSDI		GND	
1	GND	RCS#	GND			+5V *1)	GND	
Pin	Z	A	B	C	D	E	F	

*1) TS-PDC V1.0 is supplied via these pins from +5V, for backplanes up to V3.x
*2) TS-PDC V1.1 is supplied via these pins or pins from *1) , for backplanes V1.x to V4.x
*3) TS-PDC V1.1 and V1.2: GND, for version V1.3: NC (Not Connected)

Table 9-5 Pin assignment for connector X20 (R&S TS-PDC)

10 Specifications

NOTE:

Technical data for the Analog/Digital IO Module R&S TS-PIO2 and Rear-I/O module R&S TS-PDC is specified in the corresponding data sheets.
If there are discrepancies between the information in this operating manual and the values of the data sheet, the values of the data sheet take precedence.

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