R&S®TS-PSAM
Analog Stimulus Measurement Module
User Manual

1142987812
Version 13

ROHDE&SCHWARZ
Make ideas real

This manual describes the following R&S®TSVP module:

- R&S®TS-PSAM

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1142.9878.12 | Version 13 | R&S®TS-PSAM

The following abbreviations are used throughout this manual: R&S®PSAM is abbreviated as R&S PSAM.

Contents

1 Safety information (multilingual)

This option or accessory is designed for a specific Rohde & Schwarz product. Multilingual safety information is delivered with the product. Follow the provided installation instructions.

Esta opción o este accesorio están diseñados para un producto Rohde & Schwarz concreto. El producto va acompañado de información de seguridad en varios idiomas. Siga las instrucciones de instalación puestas a disposición.

Diese Option oder dieses Zubehör ist für ein bestimmtes Rohde & Schwarz Produkt vorgesehen. Mit dem Produkt werden mehrsprachige Sicherheitsinformationen geliefert. Befolgen Sie die mitgelieferten Installationsanweisungen.

Cette option ou cet accessoire est conçu pour un produit Rohde & Schwarz spécifique. Des informations de sécurité multilingues sont fournies avec le produit. Suivez les instructions d'installation fournies.

Questa funzione opzionale o accessoria è progettata per un prodotto Rohde & Schwarz specifico. Con il prodotto sono fornite informazioni sulla sicurezza in formato multilingue. Seguire le istruzioni di installazione allegate.

Esta(e) opção ou acessório foi concebida(o) para um produto específico da Rohde & Schwarz. Serão fornecidas informações de segurança multilingues com o produto. Siga as instruções de instalação fornecidas.

Αυτή η προαιρετική επιλογή ή εξάρτημα έχει σχεδιαστεί για συγκεκριμένο προϊόν Rohde & Schwarz. Μαζί με το προϊόν παρέχονται πληροφορίες ασφαλείας σε πολλές γλώσσες. Ακολουθήστε τις παρεχόμενες οδηγίες εγκατάστασης.

Din l-għażla jew aċċessorju huma mfassla għal prodott Rohde & Schwarz speċifiku. L-informazzjoni multilingwi dwar is-sikurezza hija pprovduta mal-prodott. Segwi l-istruzzjonijiet ipprovduti għall-installazzjoni.

Deze optie of dit accessoire is ontwikkeld voor een specifiek product van Rohde & Schwarz. Het product wordt geleverd met veiligheidsinformatie in meerdere talen. Volg de meegeleverde installatie-instructies.

Denne mulighed eller tilbehørsdel er designet til et specifikt Rohde & Schwarz produkt. En flersproget sikkerhedsanvisning leveres sammen med produktet. Følg de medfølgende installationsanvisninger.

Detta tillval eller tillbehör är avsett för en särskild produkt från Rohde & Schwarz. Säkerhetsinformation på flera språk medföljer produkten. Följ de medföljande installationsanvisningarna.

Tämä vaihtoehto tai lisävaruste on suunniteltu tietylle Rohde & Schwarz -yrityksen tuotteelle. Tuotteen mukana on toimitettu monikieliset turvallisuusohjeet. Noudata annettuja asennusohjeita.

Dette alternativet eller ekstrautstyret er utformet for et spesifikt Rohde & Schwarz produkt. Flerspråklig sikkerhetsinformasjon leveres med produktet. Overhold installasjonsveiledningen som følger med.

See valik või lisaseade on mõeldud konkreetsele Rohde & Schwarz tootele. Tootega on kaasas mitmekeelne ohutusteave. Järgige kaasasolevaid paigaldusjuhiseid.

Šī opcija vai piederums ir izstrādāts īpaši Rohde & Schwarz produktam. Produktam pievienota drošības informācija vairākās valodās. Ievērojiet sniegtos uzstādīšanas norādījumus.

Ši parinktis ar priedas skirti konkrečiam Rohde & Schwarz gaminiui. Su gaminiu pateikiama saugos informacijos keliomis kalbomis. Laikykitės pateikiamų montavimo nurodymų.

Þessi auka- eða fylgibúnaður er hannaður fyrir tiltekna Rohde & Schwarz vöru. Öryggisupplýsingar á mörgum tungumálum fylgja með vörunni. Fylgið meðfylgjandi uppsetningarleiðbeiningum.

Tá an rogha nó an oiriúint seo ceaptha le haghaidh táirge Rohde & Schwarz sonrach. Cuirtear eolas sábháilteachta ilteangach ar fáil leis an táirge. Lean na treoracha suiteála a thugtar.

Эта опция или принадлежность предназначена для конкретного продукта Rohde & Schwarz. В комплект поставки продукта входят инструкции по технике безопасности на нескольких языках. Соблюдайте прилагаемые инструкции по установке.

Ця опція або приладдя призначені для конкретного виробу Rohde & Schwarz. Інструкції з техніки безпеки кількома мовами постачаються разом із виробом. Дотримуйтеся наданих інструкцій зі встановлення.

Ta opcja lub akcesorium jest przeznaczone do określonego produktu Rohde & Schwarz. Dostarczany produkt zawiera informacje w wielu językach dotyczące bezpieczeństwa. Należy postępować zgodnie z dostarczonymi instrukcjami instalacji.

Tato varianta nebo příslušenství je určeno pro konkrétní produkt Rohde & Schwarz. S produktem jsou dodávány vícejazyčné bezpečnostní informace. Řiďte se přiloženými pokyny k instalaci.

Táto verzia alebo príslušenstvo je navrhnutá pre špecifický výrobok Rohde & Schwarz. S výrobkom sa dodávajú viacjazyčné bezpečnostné pokyny. Riaďte sa dodanými pokynmi na inštaláciu.

Ta možnost ali dodatek je zasnovan za določen izdelek podjetja Rohde & Schwarz. Izdelku so priložena varnostna navodila v več jezikih. Upoštevajte priložena navodila za namestitev.

Ezt a beállítást vagy tartozékot egy adott Rohde & Schwarz termékhez tervezték. A termékhez többnyelvű biztonsági információt mellékelünk. Kövesse a mellékelt szerelési utasításokat.

Тази опция или аксесоар са проектирани за специфичен продукт на Rohde & Schwarz. Многоезикова информация за безопасност се доставя с продукта. Следвайте предоставените инструкции за монтаж.

Ova opcija ili oprema namijenjena je za određeni proizvod tvrtke Rohde & Schwarz. Uz proizvod su dostavljene sigurnosne napomene na više jezika. Pratite isporučene upute za ugradnju.

Ova opcija ili pribor je dizajniran za određeni Rohde & Schwarz proizvod. Proizvodu su priložene sigurnosne informacije na više jezika. Slijedite priložena uputstva za instalaciju.

Ova opcija ili dodatni pribor je projektovan za određeni Rohde & Schwarz proizvod. Bezbednosne informacije na više jezika se isporučuju uz proizvod. Sledite dostavljena uputstva za instalaciju.

Această opțiune sau acest accesoriu a fost conceput pentru un produs specific Rohde & Schwarz. Informațiile multilingve privind siguranța sunt livrate împreună cu produsul. Urmați instrucțiunile de instalare furnizate.

Ky opsion ose aksesor është krijuar për një produkt specifik Rohde & Schwarz. Bashkë me produktin jepen edhe informacionet e sigurisë në shumë gjuhë. Ndiqni udhëzimet e dhëna të instalimit.

Оваа опција или додаток се наменети за одреден производ на Rohde & Schwarz. Со производот се испорачани повеќејазични безбедносни упатства. Следете ги дадените упатства за инсталација.

Bu opsiyon veya aksesuar, belirli bir Rohde & Schwarz ürünü için tasarlanmıştır. Çok dilli güvenlik uyarıları ürünle birlikte teslim edilir. Size sağlanan kurulum talimatlarına uyun.

אפשרות זו או האביזר מיועדים למוצר ספציפי של Rohde & Schwarz. מידע רב-לשוני בנושא בטיחות מצורף למוצר. יש לפעול בהתאם להנחיות ההתקנה המצורפות.

تم تصميم هذا الخيار أو الملحق لمنتج معين من منتجات Rohde & Schwarz. يتم تزويد معلومات السلامة متعددة اللغات مع المنتج. اتبع تعليمات التركيب الموضحة.

این قابلیت یا وسیله جانبی منحصراً برای محصول به خصوص Rohde & Schwarz طراحی شده است. اطلاعات ایمنی چندزبانه همراه این دستگاه ارائه شده است. دستورالعمل‌های نصب ارائه شده را دنبال کنید.

اس اختیار یا حصے کو مخصوص Rohde & Schwarz پروڈکٹ کے لئے تیار کیا گیا ہے۔ پروڈکٹ کے ساتھ کثیر السانی زبانوں میں تحفظ کی معلومات فراہم کی جاتی ہیں۔ فراہم کردہ تنصیب کی ہدایات پر عمل کریں۔

Şu opsiýa ýa-da esbap Rohde & Schwarz anyk önüm üçin niýetlenilen. Dürli dildäki howpsuzlyk barada maglumat önüm bilen bile üpjün edilýär. Üpjün edilen gurnama ugrukdyrmalaryny ýerine ýetiriň.

इस विकल्प या एक्सेसरी को एक विशेष Rohde & Schwarz उत्पाद के लिए डिज़ाइन किया गया है. उत्पाद के साथ बहुभाषी सुरक्षा जानकारी दी जाती है. प्रदान किए गए इंस्टालेशन अनुदेशों का पालन करें.

本**选**件或附件**专门设计**用于特定的 Rohde & Schwarz **产**品。**产**品随附多**种语**言版本的安全**资讯**。**谨**遵文件中的安装**说**明。

本オプションアクセサリは、特定の Rohde & Schwarz 製品向けに設計されています。多言語で記載された安全情報が製品に付属します。付属のインストール手順に従ってください。

이 옵션 또는 액세서리는 특정 Rohde & Schwarz 제품용으로 설계되었습니다. 제품과 함께 다국어로 작성된 안전 정보가 제공됩니다. 함께 제공된 설치 지침을 따르십시오.

本選配或配件專門設計用於特定的 Rohde & Schwarz **產**品。**產**品隨附多種語言版本的安全資訊。遵守文件中的安裝**說**明。

Tùy chọn hoặc phụ kiện này dành riêng cho một sản phẩm Rohde & Schwarz cụ thể. Thông tin an toàn đa ngôn ngữ được cung cấp kèm theo sản phẩm. Thực hiện theo hướng dẫn lắp đặt kèm theo.

ตัวเลือกหรืออุปกรณ์เสริมนี้ออกแบบมาสำหรับผลิตภัณฑ์ Rohde & Schwarz โดยเฉพาะ โดยจะมีการจัดส่งข้อมูลด้านความปลอดภัยหลายภาษามาให้พร้อมกับผลิตภัณฑ์ ปฏิบัติตามคำแนะนำในการติดตั้งที่ให้ไว้

Pilihan atau aksesori ini direka bentuk untuk produk Rohde & Schwarz yang tertentu. Maklumat keselamatan berbilang bahasa disertakan bersama produk. Ikut arahan pemasangan yang diberikan.

Opsi atau aksesori ini dirancang untuk produk Rohde & Schwarz tertentu. Informasi keamanan dalam beberapa bahasa juga disertakan bersama produk. Ikuti petunjuk pemasangan yang disediakan.

Esta opción o este accesorio están diseñados para un producto Rohde & Schwarz en concreto. El producto va acompañado de información de seguridad en varios idiomas. Siga las instrucciones de instalación proporcionadas con el producto.

Esta opção ou acessório foi desenvolvido para um produto Rohde & Schwarz específico. Informações de segurança em vários idiomas acompanham o produto. Siga as instruções de instalação disponibilizadas.

2 Documentation overview

This section provides an overview of the R&S TSVP (test system versatile platform) user documentation.

All documents are delivered with the Generic Test Software Library ("R&S GTSL") installation package. After installing the software, you can open all the documentation from the Windows "Start" menu. Additionally, you can find detailed information about the software interfaces in the "R&S GTSL Help" folder in the Windows "Start" menu.

The user documentation and "R&S GTSL" installation package are also available for download in GLORIS at:

https://gloris.rohde-schwarz.com/

For details, see the R&S TSVP Getting Started manual.

2.1 Getting started manual

Introduces the R&S TSVP (test system versatile platform) and describes how to set up and start working with the product. It includes safety information.

A printed version is delivered with the instrument.

2.2 User manuals

Separate manuals are provided for the base units, the individual plug-in module types, as well as for the control software and the calibration tool:

- Base unit manual
  The base unit user manuals introduce the base units and describes how to set up and operate the product. It includes safety information and information on maintenance and instrument interfaces. It includes the contents of the getting started manual.
- Plug-in module manuals
  Contain the description of the specific modules. Basic information on setting up the R&S TSVP (test system versatile platform) is not included.
- In-System calibration user manuals
  Provide all the information required for installation and operation of the in-system calibration R&S TS-ISC solution.
- Control software
  - R&S GTSL
    Generic Test Software Library
  - R&S EGTSL
    Enhanced Generic Test Software Library
  - R&S IC-Check

Generic Test Software Library

2.3 System manual

Describes the complete R&S TSVP (test system versatile platform) as a whole, including the combined use of R&S CompactTSVP and R&S PowerTSVP, plug-in modules and generic test software. It also includes typical use cases.

Additionally, it describes known installation problems (hardware and software) along with possible solutions.

2.4 Service manual

Describes the self-test to check correct operation, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

2.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

2.6 Brochures and specifications

Separate brochures are provided for the base unit, the individual plug-in module types, as well as for the control software. The brochures provide an overview of the base units and each additional module, and also contain the technical specifications. They also list the hardware options and their order numbers, and optional accessories.

2.7 Release notes and open source acknowledgment

The release notes list new features, improvements and known issues of the current software version. In addition, the available firmware versions and the firmware update procedure for plug-in modules are described.

The open-source acknowledgment document provides verbatim license texts of the used open source software.

3 Welcome to the R&S TS-PSAM

The R&S TS-PSAM analog stimulus and measurement module is available for PXI based R&S TSVP base units. The module is used to perform analog measuring tasks, in-circuit measurements, and the self-test. The module's floating DC supply voltage is provided via the associated R&S TS-PDC rear I/O module.

The R&S TS-PSAM module is inserted in the front of the chassis. It is based on the PXI standard.

The front connector ends flush with the front panel of the base unit and is used for contacting the test products or measurement sensors. At the back, the R&S TS-PSAM module is connected to the PXI control bus and the PXI trigger bus. Instead of using the front connector, measurement signals can be routed via the analog measuring bus.

A LabWindows IVI DMM driver is provided for the DMM functions on the card. All other functions are controlled using specific extensions of the driver. As is typical for a LabWindows CVI driver, Function Panels and Online Help are available.

The R&S TS-PSAM modules include a ground-connected discharge circuit, a floating programmable voltage source, and a floating measurement unit. These components can be switched to the analog bus via a relay matrix. Measuring tasks can be synchronized using the trigger lines across the PXI bus and the trigger inputs on the front connector. Two relay multiplexers with four channels each are also provided. The major features of these three function blocks is explained in detail in the following section:

Floating DC voltage source (DCS)

- adjustable voltage and current limiting
  - ±5 V, 100 mA max.
- fast settling time
- four-quadrant operation
- sense wires

Floating measurement unit (MU):

- Measurements DC
  - up to 120 V
  - up to 1 A
- Measurement range AC (RMS)
  - up to 50 V
  - up to 1 A
- triggered measurements across the PXI trigger bus
- 2 triggers derived from the measurement signal with programmable threshold
- 4 filters
- 16-bit converter
  - Sampling rate 200 kHz (max.)
  - Single or „multipoint“ measurement with storage depth up to 8 k samples

Discharge circuit (DCH)

- Discharge current 400 mA (max.)
- Discharge voltage 120 V (max.)

Features of the R&S TS-PDC

The R&S TS-PDC module is used as a floating DC voltage source for the R&S TS-PSAM module. It is configured with two identical DC/DC converters. The following floating direct voltages are obtained from an input voltage of 5 VDC:

- +15 VDC ±5%, 0,5 A (2x)
- -15 VDC ±5%, 0,5 A (2x)
- +5 VDC ±5%, 0,5 A (2x)
- +3,3 VDC ±5%, 0,25 A (2x)

4 Module tour

4.1 R&S TS-PSAM

The R&S TS-PSAM module is designed as a long plug-in module for mounting in the front of PXI based base units. To ensure that it is inserted correctly into the base unit, the front panel is furnished with a locating pin. The module is secured in place with the two retaining screws on the front panel.

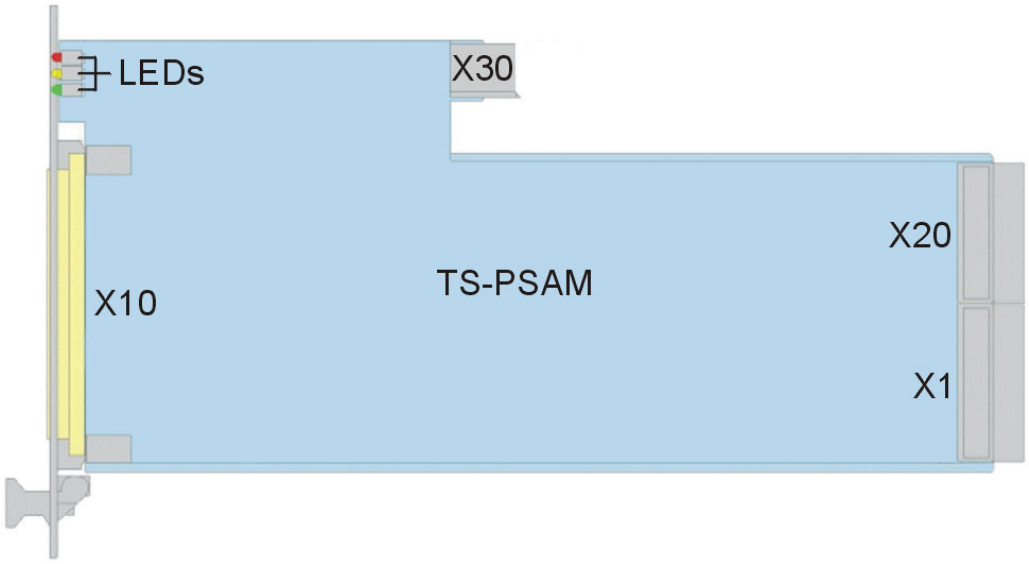

Figure 4-1: Overview of connectors and LEDs on the R&S TS-PSAM module

LEDs = Chapter 4.1.1, "Status LEDs", on page 13
X1 = Chapter 4.1.2, "Connectors X1 and X20", on page 14
X10 = Chapter 4.1.3, "Connector X10", on page 14
X20 = Chapter 4.1.2, "Connectors X1 and X20", on page 14
X30 = Chapter 4.1.4, "Connector X30", on page 14

4.1.1 Status LEDs

The LEDs on the front indicate the current status of the module.

- "PWR" (green LED)
  Indicates that all necessary supply voltages are present.
- "COM" (yellow LED)
  Indicates data exchange via the interface.
- "ERR" (red LED)
  Indicates an error condition if illuminated.

4.1.2 Connectors X1 and X20

Type: PXI bus

Interface to connect the module to the PXI backplane of PXI based R&S TSVP base units.

See Chapter C.1.4, "Connector X1 (cPCI Bus Connector)", on page 53 and Chapter C.1.2, "Connector X20 (Extension Connector)", on page 52 for a detailed description of the connectors.

4.1.3 Connector X10

Interface to connect test objects and UUTs to the module.

See Chapter C.1.1, "Connector X10 (Front Connector)", on page 50 for a detailed description of the connector.

4.1.4 Connector X30

Type: Analog bus

Interface to connect the module to the analog bus backplane in the housing of the R&S TSVP.

See Chapter C.1.3, "Connector X30", on page 53 for a detailed description of the connector.

4.2 R&S TS-PDC

The R&S TS-PDC is a rear panel I/O module that you must connect with the R&S TS-PSAM in a PXI based base unit.

The module R&S TS-PDC exists in 3 different models:

- Grouted in a black housing - version up to 1.8 (1157.9804.02 obsolete)
- Encapsulated in metal housing with cooling fins - version 1.9 (1157.9804.02 obsolete)
- Without case - version from 2.0 (1157.9804.12 current version)

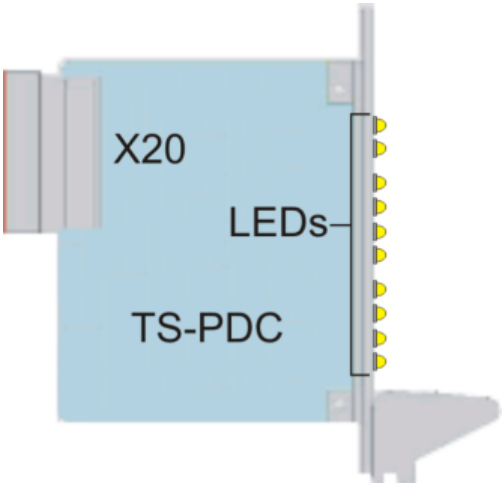

Figure 4-2: Overview of the connector and LEDs on the R&S TS-PDC module

LEDs = Chapter 4.2.1, "Status LEDs", on page 15
X20 = Chapter 4.2.2, "Connector X20", on page 16

4.2.1 Status LEDs

The meaning of the status LEDs depend on the module version.

Module version < 2.0 (1157.9804.02)

Eight green LEDs indicate the status of the module. Each LED indicates the presence of an output voltage.

In fault free operation all 8 LEDs must light up simultaneously.

Module version ≥ 2.0 (1157.9804.12)

Ten LEDs indicate the status of the module. The LEDs have the following meaning.

- "PWR" (green color)
  Indicates that the module is on and running.
- "ERR" (orange color)
  Indicates that the module has shut down because of an overload or a temperature that is too high.
- "<xx> V" (eight LEDs in green color)
  Indicate the presence of an output voltage.
  In fault free operation all 8 voltage LEDs must light up simultaneously.

Figure 4-3: LEDs on the R&S TS-PDC module from Version 2.0

4.2.2 Connector X20

Interface to connect the R&S TS-PDC to the backplane in a PXI based base unit.

See Chapter C.2, "R&S TS-PDC", on page 54 for a detailed description of the connector.

5 Installing the module

The R&S TS-PSAM is a module installed on the front panel of PXI based base units. It requires a TS-PDC rear I/O supply module.

1. Install the R&S TS-PSAM front module as described in the user manuals for the base units.
2. Install the R&S TS-PDC supply module in the matching rear I/O slot as described in the user manuals for the base unit.
3. **WARNING!** Risk of electric shock. The test environment, e.g the UUT or additional power supplies, can supply high voltages to the instruments. In this case, the voltage can also apply to the signal output connectors of the R&S TSVP, in particular the analog bus connector X2.
   Therefore, do not connect or disconnect devices from the X2 connectors while connected to an external power supply or UUT.

   Always connect both ends of the cable connecting the R&S CompactTSVP and R&S PowerTSVP. Thus, you avoid the risk of touching the X2 connector with a possibly hazardous voltage applied.

   Take the system into operation as described in the user manuals for the base unit.

6 Typical applications

The module is used to perform analog measuring tasks, in-circuit measurements, and the R&S CompactTSVP self-test. In these tests, the module functions as a measuring device with adjustable sampling rate for voltage, current and resistance measurements. The measurement unit and the adjustable DC voltage source are cross-connected with each other in a suitable manner for measuring resistance. If necessary, the source can also be connected with GND. The measurement unit and the DC voltage source can also be operated independently of one another. In the in-circuit test (ICT), the R&S TS-PSAM module performs the following measuring tasks:

- Discharging capacitors
- 2- and 4-wire resistance measurements (Figure 6-1 to Figure 6-4)
- Contact test
- Short circuit test
- Connection test

6.1 Resistance Measurements

Resistance measurements are taken with the aid of the DC voltage source and the measurement unit. 2- and 4-wire measurements are possible. Two different procedures may be followed depending on the resistance value to be measured. If necessary, the source can be connected to GND.

- **Mode C** for small resistances
  In this method, a constant current is applied and the voltage is measured. (see Figure 6-1 to Figure 6-2)

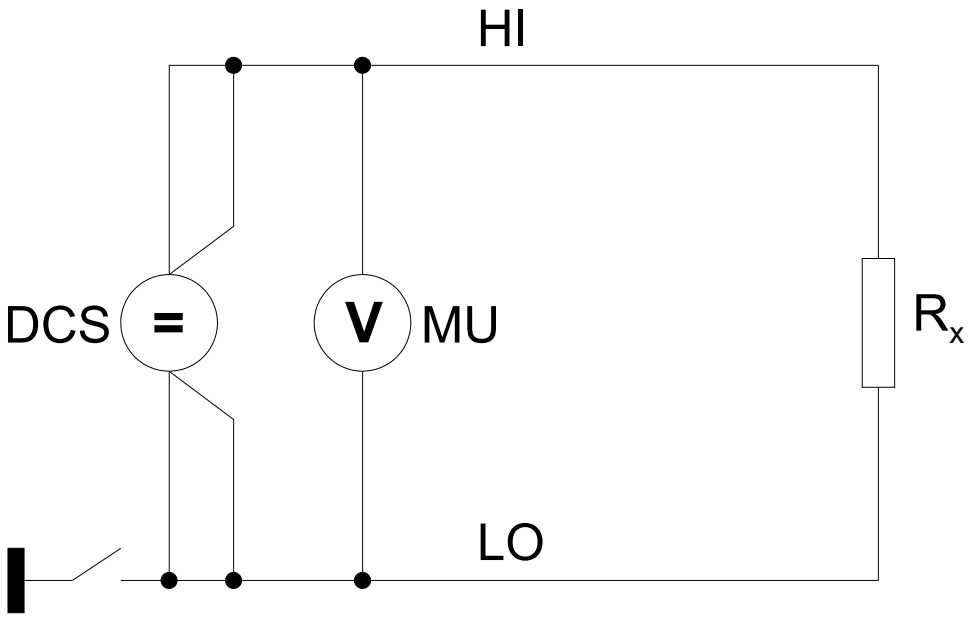

Figure 6-1: Cross-connection for 2-wire resistance measuring in Mode C

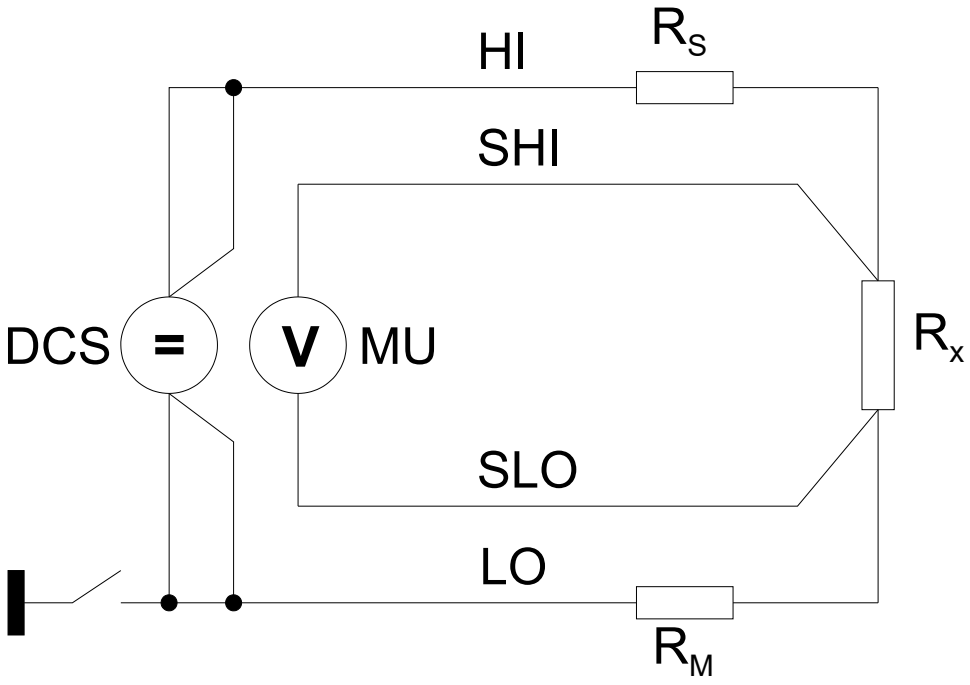

Figure 6-2: Cross-connection for 4-wire resistance measuring in Mode C

- **Mode V** for large resistances
  In this method, the voltage is applied and the current is measured. (see Figure 6-3 to Figure 6-4)

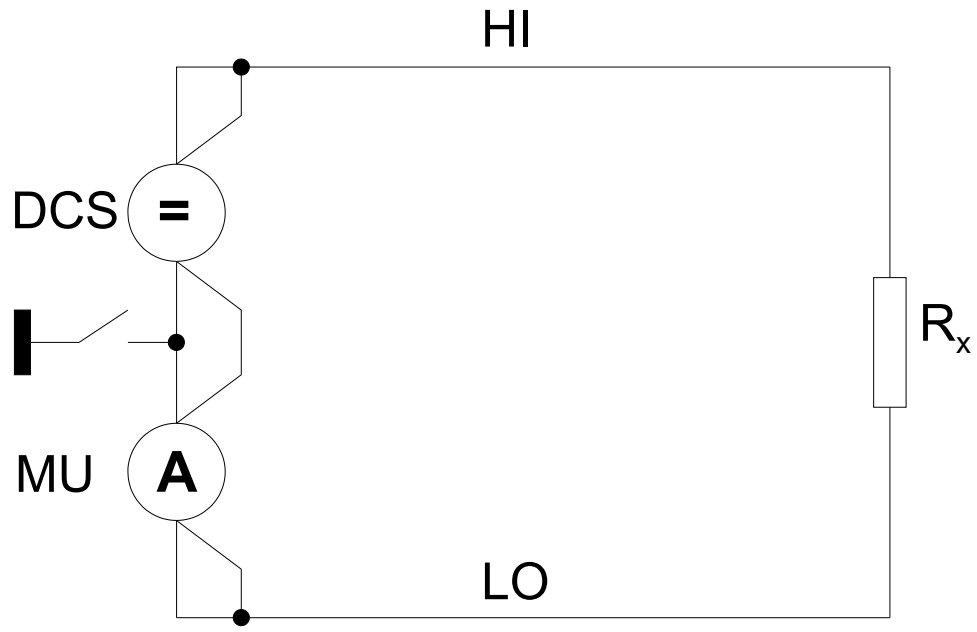

Figure 6-3: Cross-connection for 2-wire resistance measuring in Mode V

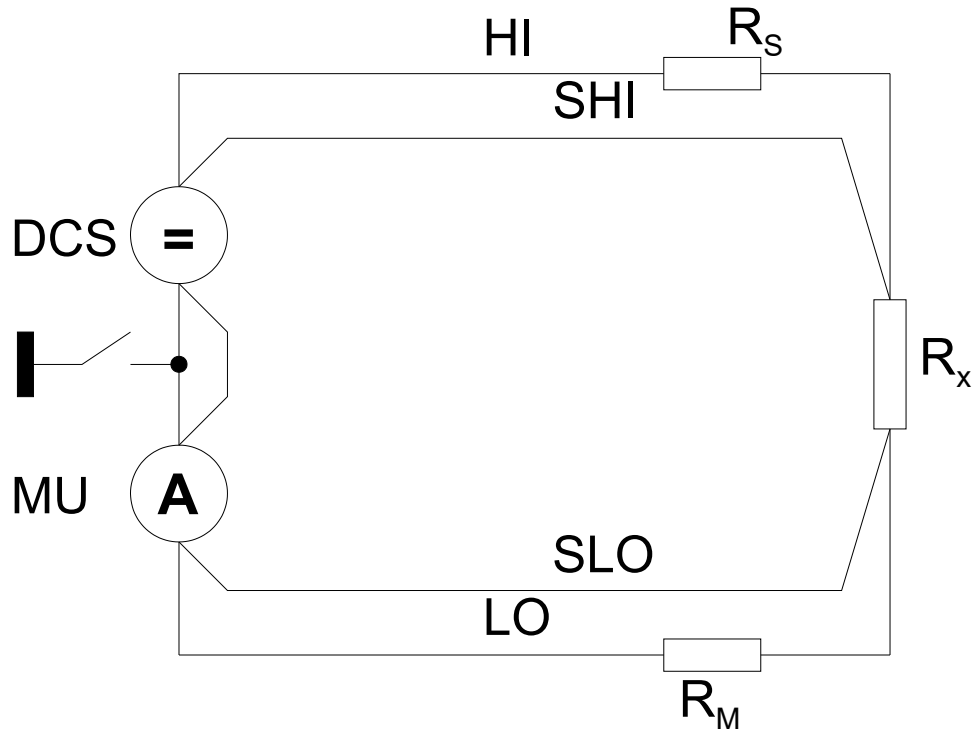

Figure 6-4: Cross-connection for 4-wire resistance measuring in Mode V

6.2 ICT Measurements with R&S TS-PICT

Further in-circuit measurements can be made in conjunction with the R&S TS-PICT module (ICT expansion module). These are:

- Diode and transistor test
- Guarded resistance measurements (3, 4 and 6 wires)
- Impedance measurements (3, 4 and 6 wires)

For this purpose, the R&S TS-PICT module provides a special AC voltage source (AOS) and current measurement unit (CMU).

The UUT is connected for the in-circuit test (ICT) via the R&S TS-PMB module (matrix module B).

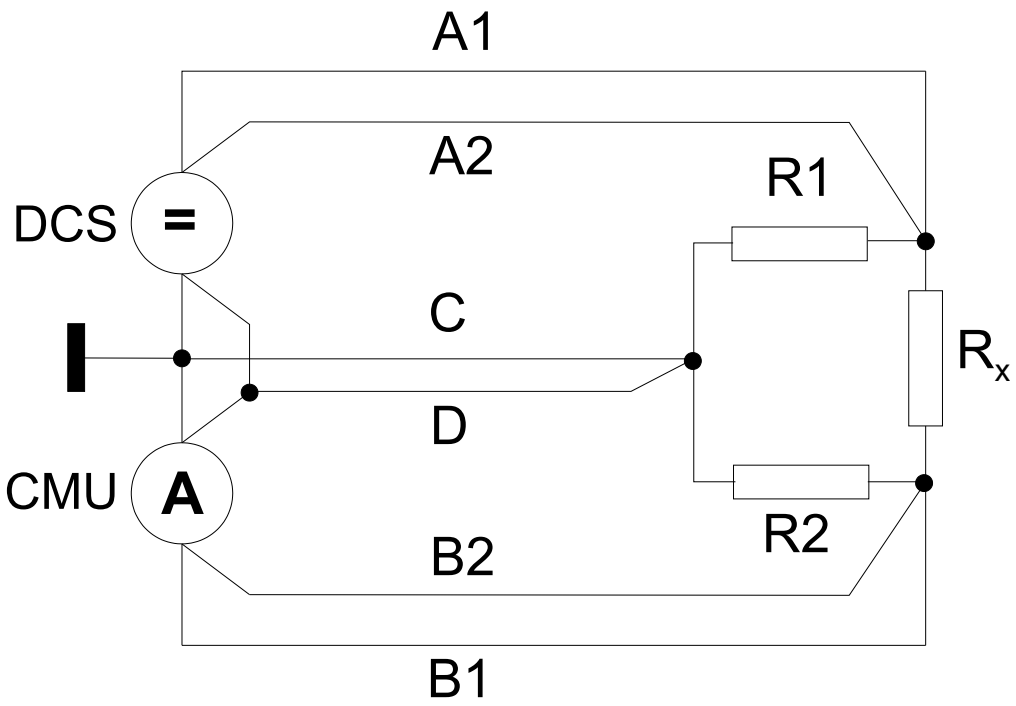

Figure 6-5: Cross-connection in a guarded resistance measurement (6-wire)

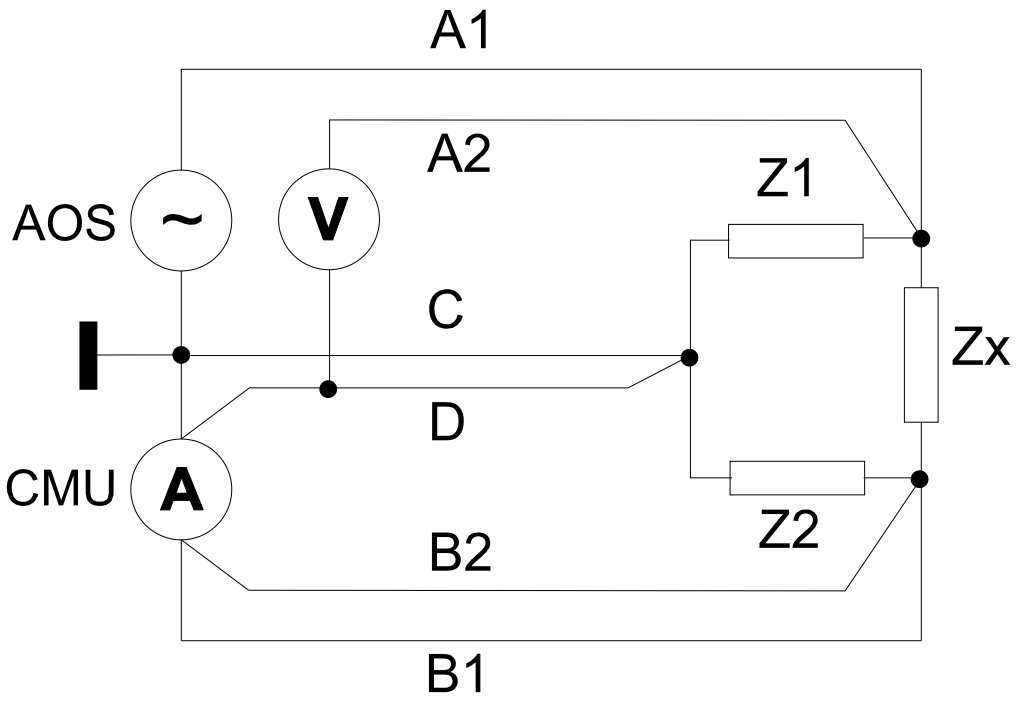

Figure 6-6: Cross-connection in a guarded impedance measurement (6-wire)

7 Functions

7.1 R&S TS-PSAM

7.1.1 Primary matrix and analog measuring bus

On this topic, see also Figure B-1

1. **NOTICE!** Risk of module damage. The input of the measurement unit gets lowly resistive when you performing current or resistance measurements. Applying an external voltage to the input therefore leads to a current flow through the instrument, which can destroy the relays on the module.
   To avoid damage to the module, always configure the R&S TS-PSAM for voltage measurements first.

   Configure the R&S TS-PSAM for voltage measurements.
2. Connect the input to the test points.

Figure 7-1 shows a number of typical permissible voltage configurations between the analog buses and ground.

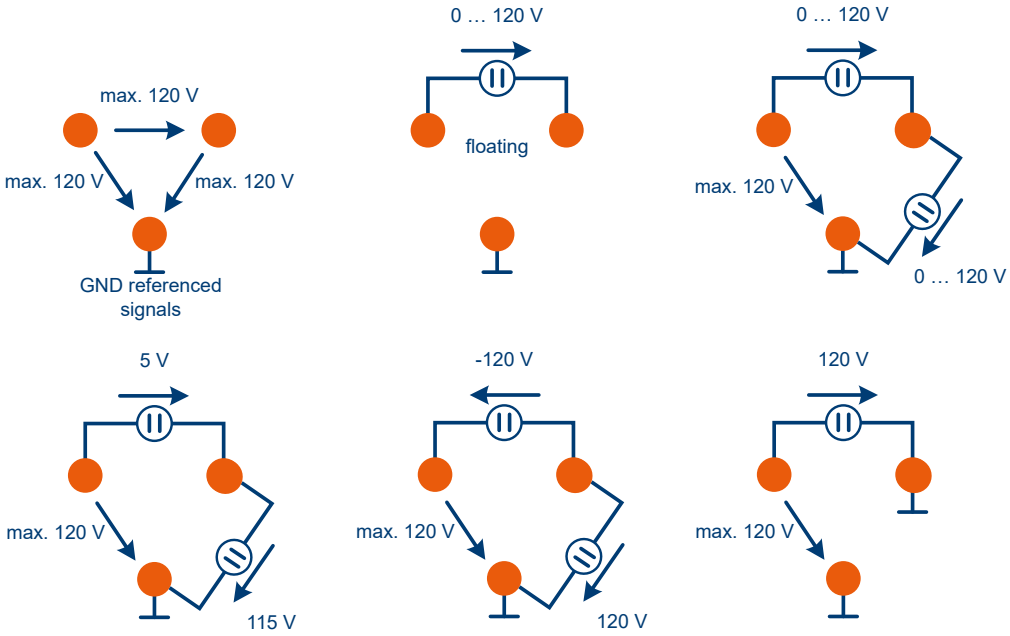

Figure 7-1: Permissible voltages on analog bus lines

Matrix relays

The stimulus and measurements can be cross-connected in any permutation through a full matrix to a local analog bus (8-wires LABx). The discharge circuit can only be connected to wires a1 and a2.

For the cross-connection of the relays matrix, there are two possibilities:

- route functions
- low-level-switching function

Route functions

Using the `rspsam_Connect`, `rspsam_Disconnect` and `rspsam_DisconnectAll` functions, you can control the following channels of the matrix:

Local analog bus:

ABa1, ABa2, ABb1, ABb2, ABc1, ABc2, ABd1, ABd2

DMM resistance measurement function:

DMM_HI, DMM_LO, DMM_SHI, DMM_SLO

Single components:

DCH_HI MU_HI, MU_LO, DCS_HI, DCS_LO, DCS_SHI, DCS_SLO

The "ABxy" channel names always indicate the services of the local analog buses, independently from the bus coupling relays configuration (`rspsam_ConfigureCoupling`). The route functions of the driver do not control the bus coupling relay.

The channels of the single components MU and DSC cannot be cross-connected if the resistance measurement function (`rspsam_ConfigureMeasurement`) is configured. In this case, use the DMM channels. During resistance measurement, the MU and DCS components will be connected through internal configuration relays, depending on the chosen range (see figures from Figure 6-1 to Figure 6-4). For example, during a 4-wire resistance measurement in modus C, the DMM_SHI wire corresponds to the channel MU_HI of the measurement unit. During a 4-wire resistance measurement in modus V, the DMM_LO wire corresponds to the MU_HI channel of the measurement unit.

If you need to use the MU and DSC components independently from each other, you need to operate the measurement unit in the voltage or current measurement function (`rspsam_ConfigureMeasurement`). With these functions, the configuration relays are set so that the channels of the single components can be cross-connected.

The switch channels can be controlled using the GTSL routing library too. The route functions constitute the interface for this library. The bus coupling relays will be automatically controlled by the routing library.

Low level switching function

The function `rspsam_cnx_Matrix` controls the relays of a lower software level. Not to be used together with the route functions (`rspsam_Connect und rspsam_Disconnect`).

Bus coupling relays

Through the `rspsam_ConfigureCoupling` function you can connect the wires of the local analog buses to the system wide analog buses of the Compact TSVP. You can therefore multiplex the components of the module on many test points, using the matrix switch modules (e.g., TS-PMB) .

The "Signal Routing" GTSL library controls the bus coupling relays automatically.

The `rspsam_DisconnectAll` function does not open the bus coupling relays.

Ground relays

The MU_LO and DCS_LO channels can be connected to the system mass, if needed. The components will then be earth tied. The `rspsam_ConfigureGround` function enables the corresponding relays, depending on the chosen measurement function. During a resistance measurement DSC_LO will be connected to GND. During all other measurement, the MU_LO function will be cross-connected to GND. If you need to use the MU and DSC components independently, you can configure the earth tied operation through the `rspsam_cnx_Gnd` function.

Resistance measurements in which GND is ment to be used as DMM_LO are only possible for a 1 Ohm and 10 Ohm range. In these ranges Mode C is used and DMM_LO can be replaced by GND. See Chapter 3, "Welcome to the R&S TS-PSAM", on page 11 and Chapter 7.1.4, "Resistance measurement", on page 27.

The GTSL libraries DMM and DCPWR make the `DMM_Conf_Ground_Relay` and `DCPWR_Conf_Ground_Relay` functions available for the configuration of the earth tied operation.

For technical reasons, a component that is not cross-connected (all matrix relays opened) will automatically be grounded with the corresponding ground relay. It will be automatically opened again, if the component is configured as floating, before a new cross-connection to the analog bus wires is performed.

The `rspsam_DisconnectAll` function does not open the ground relays.

Configuration Relays

The configuration relays connect MU and DCS for the resistance measurement. These relays will be automatically controlled from the device driver software, depending on the measurement function and the measurements range. The `rspsam_dmc_Select` function should be used only in exceptional cases

7.1.2 Voltage and current measurement unit (MU)

(MU = Measurement Unit)

AC and DC voltages and currents are measured with the MU. Both MU inputs can be switched to the local 8-wire analog bus via the full matrix.

DC voltage measurement

The floating DC voltage measurement unit has programmable pre-filtering and adjustable input voltage ranges. Analog/Digital conversion is performed with a serial A/D converter whose output data are stored in a FIFO memory.

Low Pass Filter (-3 dB): (MU Filter)	4 ranges, 400 Hz, 4 kHz, 40 kHz, 100 kHz (the same applied for current measurements)
Overvoltage protection:	120 V max.
Analog bandwidth (-3 dB):	>500 kHz
A/D converter:	Resolution: 16-bit sampling rate: 200 kHz max.
FIFO:	8 k

AC voltage measurement

AC voltage is measured using an RMS-to-DC converter. AC voltage that is present at the inputs is converted to a DC output voltage that is proportional to the real RMS value of the input signal. The converted DC output voltage is processed by the A/D converter.

As an alternative to the RMS-to-DC converter, you can measure the waveform in DC mode with following analysis to find the actual quantity value. The `rspsam_ConfigureRmsMethod` and `rspsam_ConfigureRmsEval` functions are available.

DC current measurement

The measurement unit for current is capable of taking readings in a range from a few hundred nanoamperes to a 1 A. It can be switched to the 8-wire analog bus without limitation through a full matrix. Currents larger than 100 mA are measured using a shunt resistor. On the other hand, currents smaller than 100 mA are measured actively using a current-voltage converter (I/U converter).

AC current measurement

The AC current is converted to an AC voltage using a shunt or I/U converter; the AC voltage is converted to a DC voltage with an RMS-to-DC converter, and the DC voltage is processed by the A/D converter.

As an alternative to the RMS-to-DC converter, you can measure the curve form in DC mode with following analysis to find the actual quantity value. The `rspsam_ConfigureRmsMethod` and `rspsam_ConfigureRmsEval` functions are available.

Operation

Together with the driver functions, the DMM GTSL library is available for operating the measurement unit.

7.1.3 DC stimulus source (DCS)

(DCS = DC Source)

The DCS is a potentialless, programmable DC voltage source with adjustable current limiting and sense wires for compensating voltage drops in circuits to the load. Depending on the test requirements, it can function either in voltage mode or in current limiting mode. Also a pulse mode is possible.

DC stimulus source specification

Table 7-1: Voltage mode

Voltage range:	0 ... ±5 V
Current:	0 ... ±100 mA max.

Table 7-2: Current limiting mode

Voltage range:	±0,1 V ... ±5 V max.
Current limit ranges:	±100 mA, 10 mA, 1 mA, 0,1 mA

Operation

You can operate the DSC component by using the following functions:

```
rspsam_dcs_ConfigureOutputEnabled
rspsam_dcs_ConfigureVoltageLevel
rspsam_dcs_ConfigureCurrentLimitRange
rspsam_dcs_ConfigureCurrentLimit
rspsam_dcs_ConfigurePulsedMode
rspsam_dcs_QueryOutputState
```

Also the DCPWR GTSL library supports the DCS component of the TS-PSAM module.

7.1.4 Resistance measurement

With the DC Stimulus (DCS) and current measurement unit (MU), resistances can be measured in the following ways:

- A known DC voltage Vs is applied to the resistor that is to be measured and the resulting current is measured with the MU (Mode V).
- A known DC current Is is applied to the resistor via the DCS and the resulting drop in voltage at the resistor is measured with the MU (Mode C).

The resistance measurement is activated via the "rspsam_ConfigureMeasurement" function. Depending on the "measurementFunction" parameter, a 2-wire (RSPSAM_VAL_2_WIRE_RES) or 4-wire (RSPSAM_VAL_4_WIRE_RES) measurement is configured. The range parameter configures i.a. the connection between the components MU and DCS. In the 1 Ohm and 10 Ohm range "Mode C" is set (See Figure 6-1 and Figure 6-2). In every other range "Mode V" is activated (See Figure 6-3

and Figure 6-4). The resistance measurement of TS-PSAN is optimized for in-circuit tests. Because the voltage is imprinted in Mode V, resistors parallel to a capacitor can be measured quickly, due to relatively high charging power. Mode V however has the disadvantage that the LO-wire cannot be replaced by GND (See figure 1-3). Also in Mode V, too low resistance values lead to invalid measurements. This is due to limited current because of an automatic voltage lowering by the source, if the set max current of the DCS is exceeded. The correlations are shown in the following table:

Range	Mode	Voltage	Ampere
0.1 Ω to 1 Ω	C	0.5 V max.	100 mA
1 Ω to 10 Ω	C	0.2 V max.	10 mA
10 Ω to 100 Ω	V	0.2 V	25 mA max.
100 Ω to 1 kΩ	V	0.2 V	2.5 mA max.
1 kΩ to 10 kΩ	V	0.2 V	1 mA max.
10 kΩ to 100 kΩ	V	0.2 V	0.1 mA max.
100 kΩ to 1 MΩ	V	1 V	0.1 mA max.
1 MΩ to 10 MΩ	V	5 V	0.1 mA max.

It is possible to measure resistors greater than 10 Ohm with GND by using an individual programming and wiring of the MU and DCS components. Especially for configurations with high resistance, parallel capacitors and current input, charging times must be considered.

7.1.5 Discharge unit DCH

(DCH = Discharge Unit)

The discharge unit is provided to allow the controlled discharge of capacitors on the UUT, to prevent the circuit relays in the test system from being irreparably damaged or the UUT from becoming charged as a result of the test procedure. For this purpose, a constant discharge current is generated with an active current limiter. The circuit is protected against overload by an integrated heat cutout. The residual voltage after discharge is typically less than 100 mV. The DCH can be connected to the local analog bus via relays.

In order to minimize loading on the circuit relays, the circuit path should be set first, before the DCH is activated.

Table 7-3: Specifications

Discharge current ranges: (typical)	400 mA, 275 mA, 150 mA und 10 mA
Discharge mode	Constant current
Maximum voltage:	±120 VDC
Discharge residual voltage	<100 mVDC
Discharge power: (average)	2 W max.

Überspannungsschutz	200 VDC max.
Overvoltage protection	Thermal sensor

The `rspsam_dch_ConfigureEnabled` and `rspsam_dch_ConfigureCurrent` functions control the discharge.

7.1.6 Trigger logic

On this topic, see also Figure 7-2.

The R&S TS-PSAM module can be synchronized with other system components by trigger signals from the PXI trigger bus, or by local trigger events or “software triggers“ . In all such events, the R&S TS-PSAM module can function as a “trigger master“ or “ a trigger slave“.

Trigger inputs

The internal FPGA Hardware uses the global trigger input signals from the PXI trigger bus (PXI_TRIG0 ... PXI_TRIG7) and the local TTL trigger inputs on the front connector (XTI1, XTI2). In addition, the trigger signals (XTA1, XTA2) derived from the analog input signal and the four internal feedback trigger circuits of the trigger logic blocks (IT01 ... IT04) are all used to detect a trigger event. The signals to be considered and their levels (high/low) are selected in configuration registers.

Trigger logic blocks

There are 4 blocks implemented for the module. Blocks 1 and 2 are available to the user. You can use them to generate the trigger impulses (single pulses, pulse trains etc). Block 3 is reserved for the pulsed use of the DSC component. Block 4 controls the scan of the measurement unit.

Trigger outputs

The outputs from the trigger logic blocks can be switched to the trigger outputs on the front connector (XTOx) and to the PXI trigger bus (PXI_TRIGx). The polarity of the trigger signal is programmable. The trigger output signals are TTL compatible and are buffered using driver circuits.

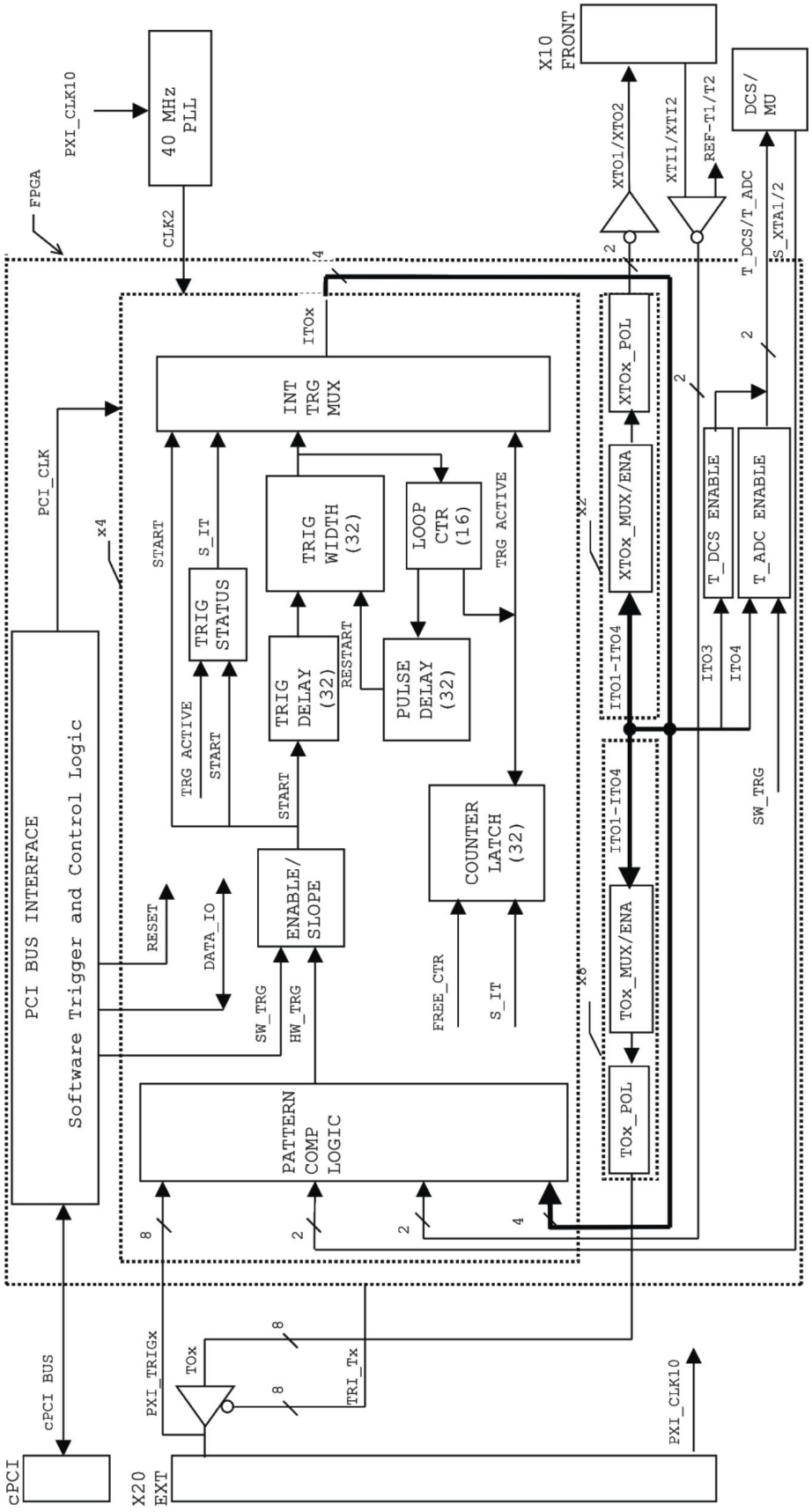

Figure 7-2: Block Diagram of the Trigger Hardware

Operation

The following functions are available to configure the trigger logic:

```
rspsam_trig_ConfigureOutput
rspsam_trig_ConfigureSignal
rspsam_trig_Abort
rspsam_trig_EnableOutput
rspsam_trig_SendSoftwareSignal
```

7.2 R&S TS-PDC

On this topic, see also Figure B-2.

The rear I/O module R&S TS-PDC is configured as a primary switched DC/DC converter. The input voltage (5 VDC) is transfered 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)

8 Software

8.1 Driver software

A LabWindows IVI DMM driver is provided for the DMM functions on the card. All other functions are controlled using specific extensions of the driver. The driver is part of the ROHDE & SCHWARZ GTSL software. All the functions of the driver are described fully in the on-line help and in the LabWindows CVI Function Panels.

During driver installation, the following software modules are installed:

Table 8-1: Driver installation R&S TS-PSAM

Module	Path	Comment
rspsam.dll	<GTSL directory>\Bin	Driver
rspsam.chm	<GTSL directory>\Bin	Help files
rspsam.fp	<GTSL directory>\Bin	LabWindows CVI Function Panel file, function panels for CVI development interface
rspsam.sub	<GTSL directory>\Bin	LabWindows CVI attribute file. This file is required by some „function panels“.
rspsam.lib	<GTSL directory>\Bin	Import Library
rspsam.h	<GTSL directory>\ Include	Header file for the driver

To use the driver, the IVI and VISA libraries from National Instruments are necessary.

8.2 Soft panel

On this topic, see also Figure 8-1.

A soft panel R&S TS-PSAM is provided for the module. The soft panel is based on the LabWindows CVI driver. It enables the measurement module to be operated interactively. The measurement values are output in digital or graphical format (Multipoint Measurements).

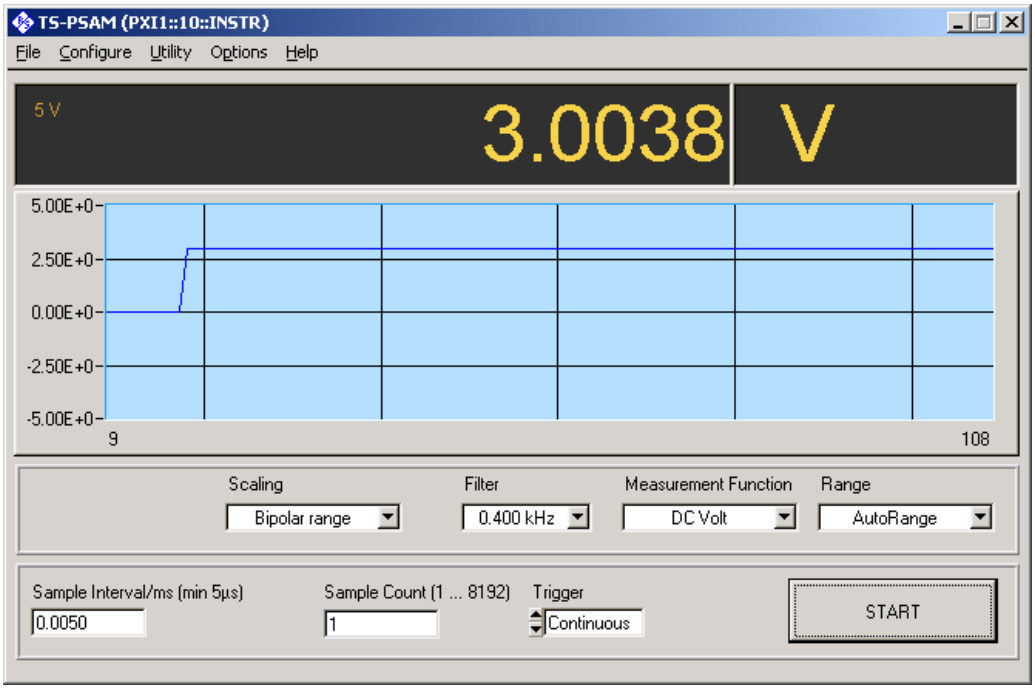

Figure 8-1: Soft PanelR&S TS-PSAM

8.3 Programming example

8.3.1 Programming with device driver

This example shows the use of the DCS and MU components. Furthermore, the application of the resistance measurement function with the DMM channels is shown in a second test case. In this example, the device under test is connected with the front connector of the TS-PSAM module. The bus coupling relays are not closed.

```
/* Example using driver functions */
#include <utility.h>
#include <ansi_c.h>

#include "rspsam.h"

/* adapt the resource descriptor to your test system! */
static char resDesc[] = "PXI6::10::INSTR";

static ViStatus sta;
static ViSession vi;

/* prototypes */
static void chk ( char * funcName );
```

```
static void runMuTest ( void );
static void runDmmTest ( void );

/* FUNCTION ***********************************************************/
/* loads the driver and runs the test
**********************************************************************/
int main(int argc, char *argv[])
{
  printf("Use of driver functions\n\n");

  /* open a session to the device driver */
  sta = rspsam_InitWithOptions(resDesc, VI_TRUE, VI_TRUE, "Simulate=0", & vi);
  /* check return value */
  chk ("rspsam_InitWithOptions");

  if (VI_SUCCESS == sta)
  {
    runMuTest();

    runDmmTest();

    /* close the driver */
    sta = rspsam_close(vi);
    chk ("rspsam_close");
  }

  printf("\nPress 'Enter' to terminate\n");
  getchar();

  return 0;
}

/* FUNCTION ***********************************************************/
/* checks the return status of a driver call
**********************************************************************/
static void chk ( char * funcName )
{
  if ( sta != VI_SUCCESS )
  {
    char errorMessage[256];

    rspsam_error_message(vi, sta, errorMessage);
    printf ("%s returned 0x%08X; %s\n", funcName, sta, errorMessage);
  }
}


/* FUNCTION ***********************************************************/
/* configures a test using MU and DCS separately
**********************************************************************/
```

```
static void runMuTest ( void )
{
  ViReal64 reading;

  /* configure DCS earth tied */
  sta = rspsam_cnx_Gnd(vi, RSPSAM_VAL_INSTRLINE_DCS_LO,
                       RSPSAM_VAL_RELAY_CLOSED);
  chk ("rspsam_cnx_Gnd");

  /* connect DCS to local analog bus */
  sta = rspsam_Connect(vi, "DCS_HI","ABa1");
  chk ("rspsam_Connect");

  sta = rspsam_Connect(vi, "DCS_LO","ABd1");
  chk ("rspsam_Connect");


  /* connect MU to local analog bus */
  sta = rspsam_Connect(vi, "MU_HI","ABb1");
  chk ("rspsam_Connect");

  sta = rspsam_Connect(vi, "MU_LO","ABc1");
  chk ("rspsam_Connect");

  /* configure DC supply */
  sta = rspsam_dcs_ConfigureCurrentLimit(vi, 0.010);
  chk ("rspsam_dcs_ConfigureCurrentLimit");

  sta = rspsam_dcs_ConfigureVoltageLevel(vi, 1.1);
  chk ("rspsam_dcs_ConfigureVoltageLevel");

  /* select 5 V mesurement range */
  sta = rspsam_ConfigureMeasurement(vi, RSPSAM_VAL_DC_VOLTS, 5.0, 0.001);
  chk ("rspsam_ConfigureMeasurement");

  /* switch on DC supply */
  sta = rspsam_dcs_ConfigureOutputEnabled(vi, VI_TRUE);
  chk ("rspsam_dcs_ConfigureOutputEnabled");

  /* wait until configurations have settled; perform measurement */
  sta = rspsam_Read(vi, 5000, & reading);
  chk ("rspsam_Read");

  /* switch off DC supply */
  sta = rspsam_dcs_ConfigureOutputEnabled(vi, VI_FALSE);
  chk ("rspsam_dcs_ConfigureOutputEnabled");

  /* disconnect components from local analog bus */
  sta = rspsam_DisconnectAll(vi);
  chk ("rspsam_DisconnectAll");
```

```
  /* configure DCS earth free again; default state */
  sta = rspsam_cnx_Gnd(vi, RSPSAM_VAL_INSTRLINE_DCS_LO,
                       RSPSAM_VAL_RELAY_OPEN);
  chk ("rspsam_cnx_Gnd");

  /* report the result */
  if (VI_SUCCESS == sta)
  {
    printf("Reading: %.3f V\n", reading);
  }
}


/* FUNCTION ****************************************************************/
/* configures a test using the DMM for a 4 wire resistor measurement
*****************************************************************************/
static void runDmmTest ( void )
{
  ViReal64 reading;

  /* select function and range */
  sta = rspsam_ConfigureMeasurement(vi, RSPSAM_VAL_4_WIRE_RES, 1000.0, 0.001);
  chk ("rspsam_ConfigureMeasurement");

  /* configure DMM earth tied */
  sta = rspsam_ConfigureGround (vi, VI_TRUE);
  chk ("rspsam_ConfigureGround");

  /* connect DMM to local analog bus */
  sta = rspsam_Connect(vi, "DMM_HI","ABa1");
  chk ("rspsam_Connect");

  sta = rspsam_Connect(vi, "DMM_SHI","ABb1");
  chk ("rspsam_Connect");

  sta = rspsam_Connect(vi, "DMM_LO","ABc1");
  chk ("rspsam_Connect");

  sta = rspsam_Connect(vi, "DMM_SLO","ABd1");
  chk ("rspsam_Connect");

  /* wait until configurations have settled; perform measurement */
  sta = rspsam_Read(vi, 5000, & reading);
  chk ("rspsam_Read");

  /* disconnect components from local analog bus */
  sta = rspsam_DisconnectAll(vi);
  chk ("rspsam_DisconnectAll");
```

```
  /* configure DMM earth free again; default state */
  sta = rspsam_ConfigureGround(vi, VI_FALSE);
  chk ("rspsam_ConfigureGround");

  /* select default function and range */
  sta = rspsam_ConfigureMeasurement(vi, RSPSAM_VAL_DC_VOLTS, 100.0, 0.001);
  chk ("rspsam_ConfigureMeasurement");

  /* report the result */
  if (VI_SUCCESS == sta)
  {
    printf("Reading: %.1f Ohm\n", reading);
  }
}
```

8.3.2 Programming with GTSL libraries

This example shows the use of the DCS and MU components with the GTSL libraries "Route", "Dmm" and "DCPWR". In the first test case, the single components are operated. Furthermore, the second test shows the application of the resistance measurement function with the DMM channels. In this example, the device under test is connected with the front connector of a TS-PMB matrix module. The matrix and bus coupling relays of the TS-PSAM and TS-PMB modules are automatically controlled by the signal routing library.

```
/* Programming example with GTSL libraries

  The following configuration files are used in this example:

physical.ini
------------
  [device->PSAM]
  Description  = "TS-PSAM Module in Frame 1 Slot 8"
  Type         = PSAM
  ResourceDesc = PXI6::10::INSTR
  Frame        = 1
  Slot         = 8
  DriverDll    = rspsam.dll
  DriverPrefix = rspsam
  DriverOption = "Simulate=0,RangeCheck=1"
  RioType      = PDC

  [device->PMB_6]
  Description  = "TS-PMB Module in Frame 1 Slot 6"
  Type         = PMB
  ResourceDesc = CAN0::0::1::6
```

```
  Frame         = 1
  Slot          = 6
  DriverDll     = rspmb.dll
  DriverPrefix  = rspmb
  DriverOption  = "Simulate=0,RangeCheck=1"
  RioType       = PCAL2
  SFTDll        = sftmpmb.dll
  SFTPrefix     = SFTMPMB

  ; Analog bus pseudo-device, used by ROUTE
  [device->ABUS]
  Type          = AB
```

sampleApp.ini

```
  [ResourceManager]
  ; general trace settings (normally off)
  Trace            = 0
  TraceFile        = ResmgrTrace.txt

  [LogicalNames]
  PsamTest = bench->rspsamTest

  [bench->rspsamTest]
  Description          = test bench
  Simulation           = 0
  Trace                = 0
  SignalRoutingDisplay = 0
  DCPwrSupply          = device->PSAM
  DigitalMultimeter    = device->PSAM
  SwitchDevice1        = device->PSAM
  SwitchDevice2        = device->PMB_6
  AnalogBus            = device->ABUS
  DCPwrChannelTable    = io_channel->dcsupplies
  AppChannelTable      = io_channel->test

  [io_channel->dcsupplies]
  MainPower = PSAM!DCS_HI

  [io_channel->test]
  ;UUT connected to TS-PMB
  UUT_VCC  = PMB_6!P1
  UUT_R1.1 = PMB_6!P2
  UUT_R1.2 = PMB_6!P3
  UUT_GND  = PMB_6!P4
  ; DMM channel names
  HI       = PSAM!DMM_HI
  LO       = PSAM!DMM_LO
  SHI      = PSAM!DMM_SHI
```

```
  SLO      = PSAM!DMM_SLO
  ; PSAM components channel names
  MU_HI    = PSAM!MU_HI
  MU_LO    = PSAM!MU_LO
  DCS_HI   = PSAM!DCS_HI
  DCS_LO   = PSAM!DCS_LO
  DCS_SHI  = PSAM!DCS_SHI
  DCS_SLO  = PSAM!DCS_SLO
*/
#include <ansi_c.h>
#include "resmgr.h"
#include "route.h"
#include "dmm.h"
#include "dcpwr.h"

static short errorOccurred;
static long  errorCode;
static char  errorMessage[GTSL_ERROR_BUFFER_SIZE];

static long  residRoute = RESMGR_INVALID_ID;
static long  residDmm   = RESMGR_INVALID_ID;
static long  residDcpwr = RESMGR_INVALID_ID;

static char  benchName[] = "bench->rspsamTest";
static char  supplyName[] = "MainPower";

/* prototypes */
static void cs ( char * funcName );
static void runDcsTest ( void );
static void runDmmTest ( void );

/* FUNCTION ****************************************************************/
/* loads the libraries and runs the test
*****************************************************************************/
int main (int argc, char *argv[])
{
  printf("Example using GTSL libraries\n\n");

  /* setup libraries */
  RESMGR_Setup (0, "physical.ini", "sampleApp.ini",
    &errorOccurred, &errorCode, errorMessage);
  cs("RESMGR_Setup");

  if ( ! errorOccurred )
  {
    ROUTE_Setup (0, benchName, &residRoute,
      &errorOccurred, &errorCode, errorMessage);
    cs("ROUTE_Setup");
  }
```

```
  if ( ! errorOccurred )
  {
    DCPWR_Setup (0, benchName, &residDcpwr,
      &errorOccurred, &errorCode, errorMessage);
    cs("DCPWR_Setup");
  }

  if ( ! errorOccurred )
  {
    DMM_Setup (0, benchName, &residDmm,
      &errorOccurred, &errorCode, errorMessage);
    cs("DMM_Setup");
  }

  if ( ! errorOccurred )
  {
    runDcsTest ( );
    runDmmTest ( );
  }

  /* cleanup libraries */
  if (residDmm != RESMGR_INVALID_ID)
  {
    DMM_Cleanup (0, residDmm, &errorOccurred, &errorCode, errorMessage);
    cs("DMM_Cleanup");
  }

  if (residDcpwr != RESMGR_INVALID_ID)
  {
    DCPWR_Cleanup (0, residDcpwr, &errorOccurred, &errorCode, errorMessage);
    cs("DCPWR_Cleanup");
  }

  if (residRoute != RESMGR_INVALID_ID)
  {
    ROUTE_Cleanup (0, residRoute, &errorOccurred, &errorCode, errorMessage);
    cs("ROUTE_Cleanup");
  }

  RESMGR_Cleanup ( 0, &errorOccurred, &errorCode, errorMessage);
  cs("RESMGR_Cleanup");

  printf("\nPress 'Enter' to terminate\n");
  getchar();

  return 0;
}

/* FUNCTION ****************************************************************/
/* checks the return status of a library call
```

```
*****************************************************************************/
static void cs ( char * funcName )
{
  if ( errorOccurred )
  {
    printf ("%s returned 0x%08X\n%s\n\n", funcName, errorCode, errorMessage);
  }
}

/* FUNCTION ******************************************************************/
/* use of TS-PSAM components DCS and MU separately
*****************************************************************************/
static void runDcsTest ( void )
{
  ViInt32  resultCount = 0;
  ViReal64 result = 0.0;

  /* configure volatage measruement */
  DMM_Conf_Measurement (0, residDmm, "DC_VOLTS", 5.0,
                        "AUTO_RANGE_OFF", 1e-3,
                         &errorOccurred, &errorCode, errorMessage);
  cs("DMM_Conf_Measurement");

  /* DCS should be earth tied in this test */
  DCPWR_Conf_Ground_Relay (0, residDcpwr, supplyName, 1,
                           &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Ground_Relay");

  /* connect power supply */
  ROUTE_Execute (0, residRoute, "DCS_HI > UUT_VCC, DCS_LO > UUT_GND",
                 &errorOccurred, &errorCode, errorMessage);
  cs("ROUTE_Execute");

  /* connect measurement unit of TS-PSAM */
  ROUTE_Execute (0, residRoute, "MU_HI > UUT_R1.1, MU_LO > UUT_R1.2",
                 &errorOccurred, &errorCode, errorMessage);
  cs("ROUTE_Execute");

  /* configure power supply */
  DCPWR_Conf_Current_Limit (0, residDcpwr, supplyName,
                            DCPWR_VAL_REGULATE, 0.01,
                            &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Current_Limit");

  DCPWR_Conf_Voltage_Level (0, residDcpwr, supplyName, 1.1,
                              &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Voltage_Level");

  /* switch on power supply */
  DCPWR_Conf_Output_Enabled (0, residDcpwr, supplyName, 1,
```

```
                                &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Output_Enabled");

  /* read voltage */
  DMM_Read (0, residDmm, 0.1, 1, &result, & resultCount,
            &errorOccurred, &errorCode, errorMessage);
  cs("DMM_Read");

  /* report result */
  printf("Result: %.3f V\n", result);

  /* switch off power supply */
  DCPWR_Conf_Output_Enabled (0, residDcpwr, supplyName, 0,
                             &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Output_Enabled");

  /* disconnect all */
  ROUTE_Execute (0, residRoute, "||",
      &errorOccurred, &errorCode, errorMessage);
  cs("ROUTE_Execute");

  /* configure DCS earth free again; default */
  DCPWR_Conf_Ground_Relay (0, residDcpwr, supplyName, 0,
                           &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Ground_Relay");
}

/* FUNCTION ***********************************************************/
/* use of TS-PSAM for resistance measurement
**********************************************************************/
static void runDmmTest ( void )
{
  ViInt32  resultCount = 0;
  ViReal64 result = 0.0;

  /* configure 4-wire resistance measurement */
  DMM_Conf_Measurement (0, residDmm, "4_WIRE_RES", 1000.0,
                        "AUTO_RANGE_OFF", 1e-3,
                         &errorOccurred, &errorCode, errorMessage);
  cs("DMM_Conf_Measurement");


  /* DMM should be earth tied in this test */
  DMM_Conf_Ground_Relay (0, residDmm, 1,
                           &errorOccurred, &errorCode, errorMessage);
  cs("DMM_Conf_Ground_Relay");

  /* connect DMM to UUT */
  ROUTE_Execute (0, residRoute, "HI > UUT_VCC, LO > UUT_GND,"
                                "SHI > UUT_R1.1, SLO > UUT_R1.2, ?#",
```

```
                &errorOccurred, &errorCode, errorMessage);
  cs("ROUTE_Execute");

  /* read voltage */
  DMM_Read (0, residDmm, 0.1, 1, &result, & resultCount,
            &errorOccurred, &errorCode, errorMessage);
  cs("DMM_Read");

  /* report result */
  printf("Result: %.1f Ohm\n", result);

  /* disconnect all */
  ROUTE_Execute (0, residRoute, "||",
      &errorOccurred, &errorCode, errorMessage);
  cs("ROUTE_Execute");

  /* configure DMM earth free again; default */
  DMM_Conf_Ground_Relay (0, residDmm, 0,
                         &errorOccurred, &errorCode, errorMessage);
  cs("DCPWR_Conf_Ground_Relay");

  /* select default measurement function */
  DMM_Conf_Measurement (0, residDmm, "DC_VOLTS", 200.0,
                        "AUTO_RANGE_OFF", 1e-3,
                         &errorOccurred, &errorCode, errorMessage);
  cs("DMM_Conf_Measurement");
}
```

9 Maintenance, storage and disposal

9.1 Storage

Protect the product against dust. Ensure that the environmental conditions, e.g. temperature range and climatic load, meet the values specified in the data sheet.

9.2 Disposal

Rohde & Schwarz is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

Disposing electrical and electronic equipment

A product that is labeled as follows cannot be disposed of in normal household waste after it has come to the end of its service life. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Figure 9-1: Labeling in line with EU directive WEEE

Rohde & Schwarz has developed a disposal concept for the eco-friendly disposal or recycling of waste material. As a manufacturer, Rohde & Schwarz completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

10 Troubleshooting

If the system is not running properly, try to find the problem with the following tests. If the tests do not help to locate the problem, contact your Rohde & Schwarz service representative.

10.1 LED test

The module has three LEDs on its front panel that indicate its status.

After turning on the system, all LEDs light up for a short time to indicate that the power supply is present and that all LEDs are working.

- A single LED does not light up in that time frame:
  Indicates a faulty LED or faulty LED control.
- All LEDs do not light up during that time frame:
  Indicates that the power supply for the module is faulty.
  Check the status LEDs of the main power supply module in slot A3 and A4.

For rear modules, you have to check the LEDs separately, see "Power-on test for modules with a rear I/O supply module" on page 46.

10.2 Power-on test

The power-on test runs at the same time as the LED test. The following statements can be made regarding the different display states of the LEDs.

- "PWR LED" (green LED) = on
  Indicates that all power supply voltages are present.
- "PWR LED" (green LED) = off
  Indicates that at least one power supply voltage is missing.
- "ERR LED" (red LED) = off
  If the green LED is illuminated at the same time, indicates that the system is working without any errors.
- "ERR LED" (red LED) = on (or blinking)
  Indicates a hardware problem.

Power-on test for modules with a rear I/O supply module

If the green LED indicates a problem with the supply voltage, check the LEDs of the corresponding rear I/O supply module separately. If the LEDs on the rear I/O module also indicate a supply voltage failure, replace the rear I/O module.

10.3 R&S TSVP self-test

The R&S TSVP self-test is an extensive test procedure for the whole system or individual components. After the test is done, you receive a test report for all components that have been tested.

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

For more information about running the system self-test and the test procedures, refer to the R&S TSVP service manual.

10.4 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:

Figure 10-1: QR code to the Rohde & Schwarz support page

Annex

A Specifications

For an overview of technical specifications of the R&S TS-PSAM module, refer to the corresponding product brochure / data sheet.

If discrepancies exist between information in this manual and the values in the data sheet, the values in the data sheet take precedence.

B Block diagrams

Figure B-1shows the block diagram of the R&S TS-PSAM module and Figure B-2 shows the block diagram of the R&S TS-PDC module. Figure B-3 is a simplified functional block diagram of both modules in the R&S CompactTSVP.

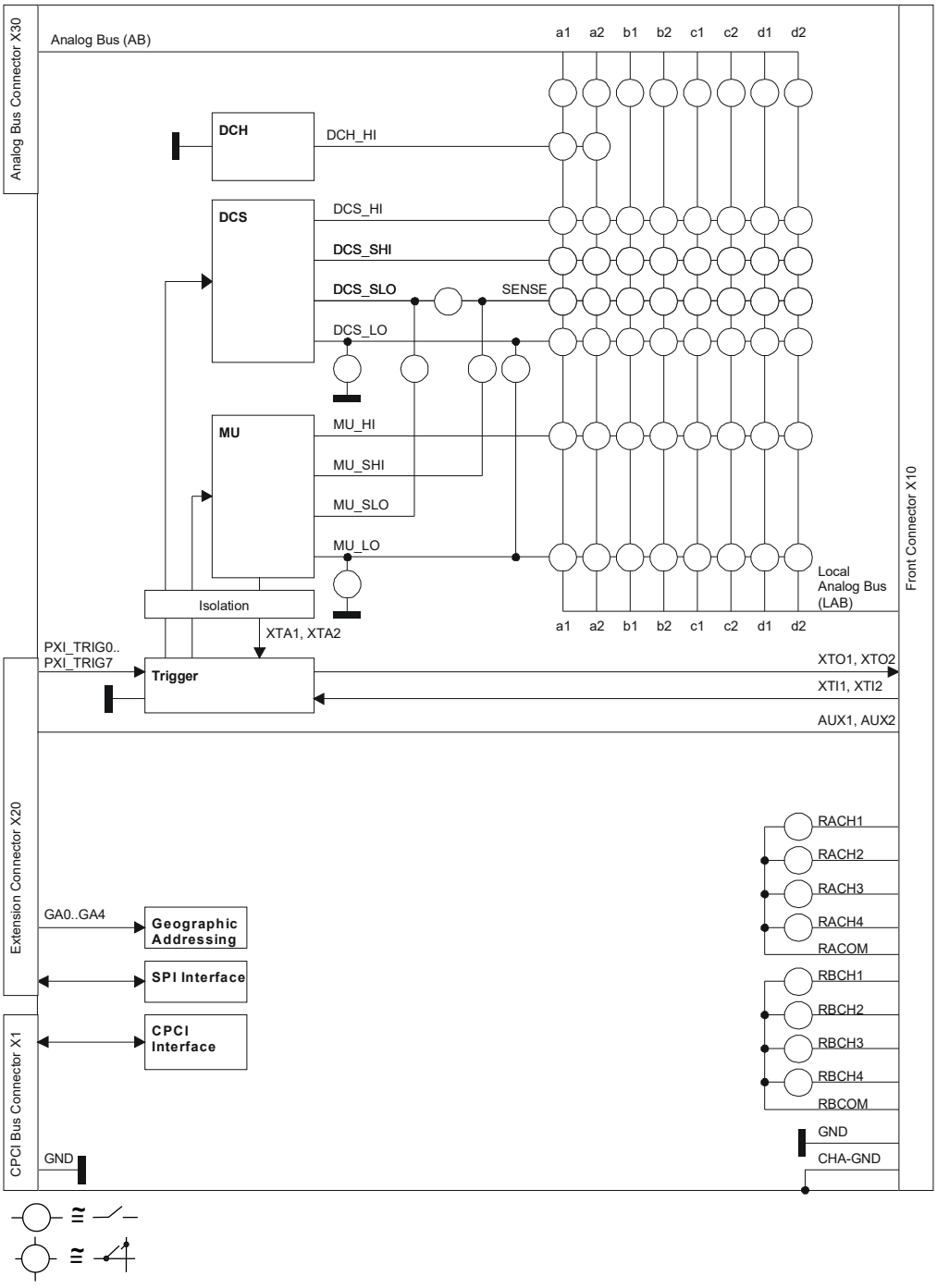

Figure B-1: Block Diagram of R&S TS-PSAM

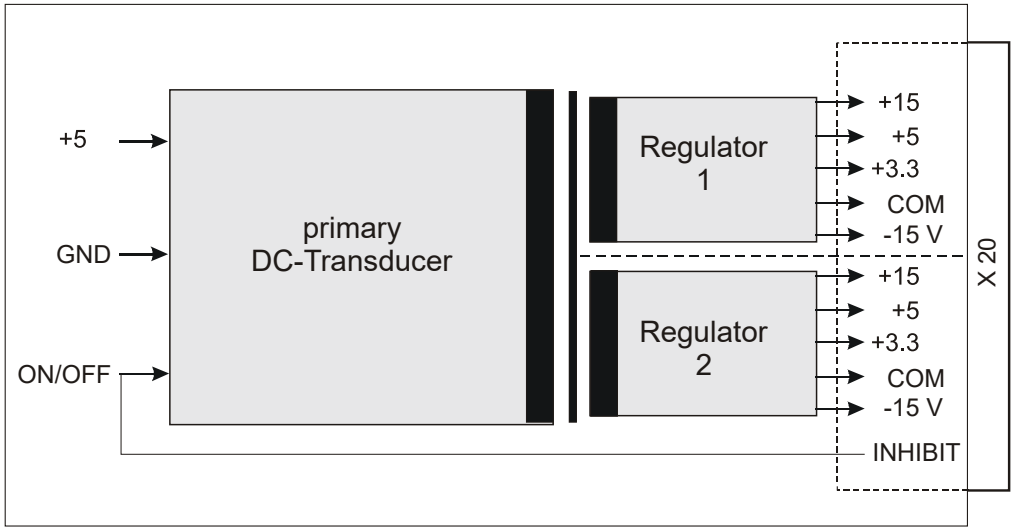

Figure B-2: Block Diagram of R&S TS-PDC

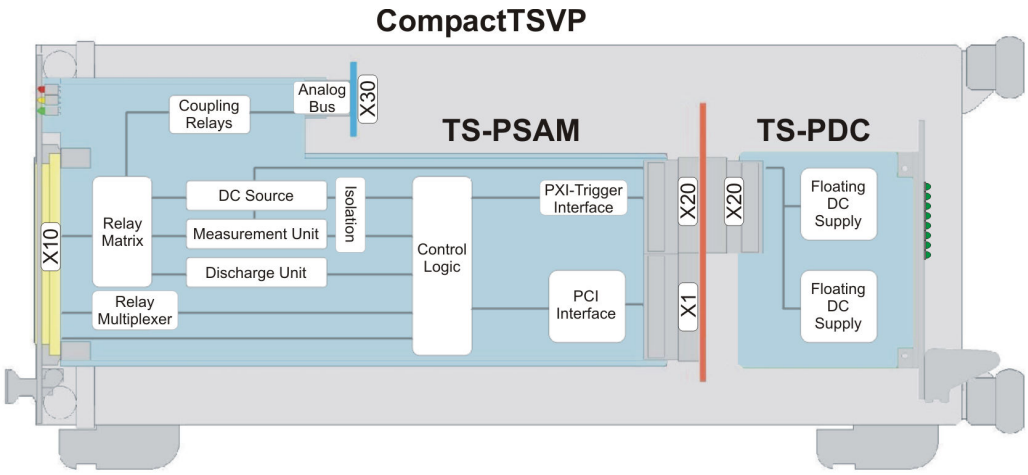

Figure B-3: Functional block diagram of R&S TS-PSAM with R&S TS-PDC in the R&S CompactTSVP

C Interface description

Below the interface description for the R&S TS-PSAM module and the R&S TS-PDC module is shown.

C.1 Interface description for R&S TS-PSAM

C.1.1 Connector X10 (Front Connector)

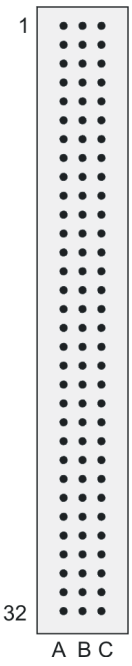

Figure C-1: Connector X10 (mating side)

Table C-1: Pin assignment for connector X10

Pin	A	B	C
1	LABA1	GND	LABA2
2	LABB1	GND	LABB2
3	LABC1	GND	LABC2
4	LABD1	GND	LABD2
5	GND	GND	GND
6	IL1	GND	IL2
7	GND	GND	GND
8			

Pin	A	B	C
9	RACH1		RBCH1
10	RACH2		RBCH2
11	RACH3		RBCH3
12	RACH4		RBCH4
13	RACOM		RBCOM
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24	GND	GND	GND
25		GND	
26	GND	GND	GND
27	AUX1	GND	AUX2
28	GND	GND	GND
29	XTO1	GND	XTO2
30	XTI1	GND	XTI2
31	GND	GND	GND
32	GND	GND	**CHA-GND**

The CHA-GND signal is connected to the front panel of the R&S TS-PSAM. The front panel is capacitively coupled to GND.

C.1.2 Connector X20 (Extension Connector)

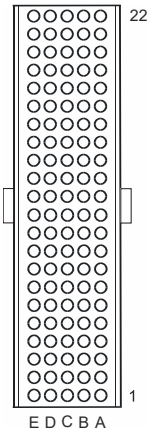

Figure C-2: Connector X20 (mating side)

Pin	F	E	D	C	B	A	
22	GND	GA0	GA1	GA2	GA3	GA4	
21	GND	PXI_LBR3	PXI_LBR2	PXI_LBR1	GND	PXI_LBR0	
20	GND	PXI_LBL1	GND	PXI_LBL0	AUX1	AUX2	
19	GND	AUX1	AUX2	PXI_LBL3	GND	PXI_LBL2	
18	GND	PXI_TRIG6	GND	PXI_TRIG5	PXI_TRIG4	PXI_TRIG3	
17	GND	PXI_CLK10			GND	PXI_TRIG2	X20
16	GND	PXI_TRIG7	GND		PXI_TRIG0	PXI_TRIG1	
15	GND				GND		
14	NC						C
13	NC						O
12	NP	COM_DCS	+3.3V_DCS	+5V_DCS	-VCC_DCS	+VCC_DCS	N
11	NP						N
10	NC	COM_MU	+3.3V_MU	+5V_MU	-VCC_MU	+VCC_MU	E
9	NC						C
8	NC						T
7	NC						O
6	NC						R
5	NC						
4	NC						
3	GND	RSA0	RRST#		GND	RSDO	
2	GND		RSDI	RSA1		RSCLK	
1	GND				GND	RCS#	

Figure C-3: Pin assignment for connector X20

C.1.3 Connector X30

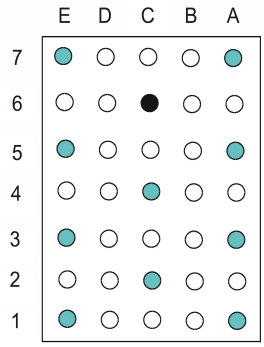

Figure C-4: Connector X30 (mating side)

Table C-2: X30 pinning schedule

Pin	E	D	C	B	A
7	IL2				IL1
6			GND		
5	ABc1				ABa1
4			ABb1		
3	ABc2				ABb2
2			ABa2		
1	ABd2				ABd1

C.1.4 Connector X1 (cPCI Bus Connector)

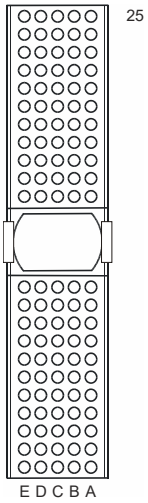

Figure C-5: Connector X1 (mating side)

Pin	F	E	D	C	B	A	
25	GND	5V	3.3V	ENUM#	REQ64#	5V	
24	GND	ACK64#	AD[0]	V(I/O)	5V	AD[1]	
23	GND	AD[2]	5V	AD[3]	AD[4]	3.3V	
22	GND	AD[5]	AD[6]	3.3V	GND	AD[7]	
21	GND	C/BE[0]#	M66EN	AD[8]	AD[9]	3.3V	
20	GND	AD[10]	AD[11]	V(I/O)	GND	AD[12]	X1
19	GND	AD[13]	GND	AD[14]	AD[15]	3.3V	
18	GND	C/BE[1]#	PAR	3.3V	GND	SERR#	
17	GND	PERR#	GND	IPMB_SDA	IPMB_SCL	3.3V	C
16	GND	LOCK#	STOP#	V(I/O)	GND	DEVSEL#	O
15	GND	TRDY#	BD_SEL#	IRDY#	FRAME#	3.3V	N
12..14				Key Area			N
11	GND	C/BE[2]#	GND	AD[16]	AD[17]	AD[18]	E
10	GND	AD[19]	AD[20]	3.3V	GND	AD[21]	C
9	GND	AD[22]	GND	AD[23]	IDSEL	C/BE[3]#	T
8	GND	AD[24]	AD[25]	V(I/O)	GND	AD[26]	O
7	GND	AD[27]	GND	AD[28]	AD[29]	AD[30]	R
6	GND	AD[31]	CLK	3.3V	GND	REQ#	
5	GND	GNT#	GND	RST#	BSRSV	BSRSV	
4	GND	INTS	INTP	V(I/O)	HEALTHY#	IPMB_PWR	
3	GND	INTD#	5V	INTC#	INTB#	INTA#	
2	GND	TDI	TDO	TMS	5V	TCK	
1	GND	5V	+12V	TRST#	-12V	5V	

Figure C-6: Pin assignment for connector X1

C.2 R&S TS-PDC

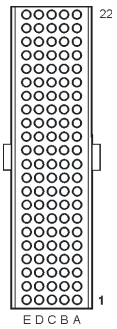

Figure C-7: Connector X20 (R&S TS-PDC mating side)

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

*1) TS-PDC Version 1.0 is supplied via these pins from +5V, for backplanes up to Version 3.x
*2) TS-PDC Version 1.1 or higher is supplied via these pins or pins from *1)
*3) TS-PDC Version 1.3 or higher: This pin is not connected
*4) TS-PDC Version 1.4 or higher: This pin is not connected

Figure C-8: Pin assignment for connector X20 (R&S TS-PDC)