

# R&S<sup>®</sup> ZN-Z84 Switch Matrix User Manual



1319541302  
Version 04

**ROHDE & SCHWARZ**  
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This manual describes the R&S®ZN-Z84 Base Unit and port extension options:

- R&S®ZN-Z84 "Matrix Base Unit 2x6 Configuration", order no. 1319.4500.02
- R&S®ZN-Z84-B22 "Additional Test Ports 7-12 (2 VNA Ports)", order no. 1319.4969.22
- R&S®ZN-Z84-B32 "Additional Test Ports 13-18 (2 VNA Ports)", order no. 1319.4969.32
- R&S®ZN-Z84-B42 "Additional Test Ports 19-24 (2 VNA Ports)", order no. 1319.4969.42
- R&S®ZN-Z84-B24 "Additional Test Ports 7-12 (4 VNA Ports)", order no. 1319.4969.24
- R&S®ZN-Z84-B34 "Additional Test Ports 13-18 (4 VNA Ports)", order no. 1319.4969.34
- R&S®ZN-Z84-B44 "Additional Test Ports 19-24 (4 VNA Ports)", order no. 1319.4969.44

The software contained in this product uses several valuable open source software packages. For information, see the "Open Source Acknowledgment" on the user documentation CD-ROM (included in delivery).

Rohde & Schwarz would like to thank the open source community for their valuable contribution to embedded computing.

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1319.5413.02 | Version 04 | R&S®ZN-Z84

The following abbreviation is used in this manual: R&S® is abbreviated as R&S.

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# 1 Safety and regulatory information

The product documentation helps you use the product safely and efficiently. Follow the instructions provided here and in the following chapters.

## Intended use

This product has been designed to be used with Rohde & Schwarz vector network analyzers R&S ZNA, R&S ZNB, R&S ZNBT and R&S ZND. They are intended for the development, production and verification of electronic components and devices in industrial, administrative and laboratory environments. Use the R&S ZN-Z84 only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

## Where do I find safety information?

Safety information is part of the product documentation. It warns you of potential dangers and gives instructions on how to prevent personal injury or damage caused by dangerous situations. Safety information is provided as follows:

- In [Chapter 1.1, "Safety instructions"](#), on page 7. The same information is provided in many languages as printed "Safety Instructions". The printed "Safety Instructions" are delivered with the product.
- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

## 1.1 Safety instructions

Products from the Rohde & Schwarz group of companies are manufactured according to the highest technical standards. To use the products safely, follow the instructions provided here and in the product documentation. Keep the product documentation nearby and offer it to other users.

Use the product only for its intended use and within its performance limits. Intended use and limits are described in the product documentation such as the data sheet, manuals and the printed "Safety Instructions". If you are unsure about the appropriate use, contact Rohde & Schwarz customer service.

Using the product requires specialists or specially trained personnel. These users also need sound knowledge of at least one of the languages in which the user interfaces and the product documentation are available.

Reconfigure or adjust the product only as described in the product documentation or the data sheet. Any other modifications can affect safety and are not permitted.

Never open the casing of the product. Only service personnel authorized by Rohde & Schwarz are allowed to repair the product. If any part of the product is damaged or broken, stop using the product. Contact Rohde & Schwarz customer service at <https://www.rohde-schwarz.com/support>.

### **Lifting and carrying the product**

The maximum weight of the product is provided in the data sheet. You can lift or carry the product by yourself, if you can manage the weight on your own. Alternatively, you can use lifting or transporting equipment. Follow the instructions provided by the equipment manufacturer.

### **Choosing the operating site**

Only use the product indoors. The product casing is not waterproof. Water that enters can electrically connect the casing with live parts, which can lead to electric shock, serious personal injury or death if you touch the casing. If Rohde & Schwarz provides accessories designed for your product, e.g. a carrying bag, you can use the product outdoors.

Unless otherwise specified, you can operate the product up to an altitude of 2000 m above sea level. The product is suitable for pollution degree 2 environments where nonconductive contamination can occur. For more information on environmental conditions such as ambient temperature and humidity, see the data sheet.

### **Setting up the product**

Always place the product on a stable, flat and level surface with the bottom of the product facing down. If the product is designed for different positions, secure the product so that it cannot fall over.

If the product has foldable feet, always fold the feet completely in or out to ensure stability. The feet can collapse if they are not folded out completely or if the product is moved without lifting it. The foldable feet are designed to carry the weight of the product, but not an extra load.



If stacking is possible, keep in mind that a stack of products can fall over and cause injury.

If you mount products in a rack, ensure that the rack has sufficient load capacity and stability. Observe the specifications of the rack manufacturer. Always install the products from the bottom shelf to the top shelf so that the rack stands securely. Secure the product so that it cannot fall off the rack.

### Connecting to power

The product is an overvoltage category II product. Connect the product to a fixed installation used to supply energy-consuming equipment such as household appliances and similar loads. Keep in mind that electrically powered products have risks, such as electric shock, fire, personal injury or even death. Replace parts that are relevant to safety only by original parts, e.g. power cables or fuses.

Take the following measures for your safety:





- Before switching on the product, ensure that the voltage and frequency indicated on the product match the available power source. If the power adapter does not adjust automatically, set the correct value and check the rating of the fuse.
- Only use the power cable delivered with the product. It complies with country-specific safety requirements. Only insert the plug into an outlet with protective conductor terminal.
- Only use intact cables and route them carefully so that they cannot be damaged. Check the power cables regularly to ensure that they are undamaged. Also ensure that nobody can trip over loose cables.
- If you connect the product to an external power supply, use the one delivered with the product or recommended in the product documentation. The external power supply must conform to the country-specific regulations.
- Only connect the product to a power source with a fuse protection of maximum 20 A.
- Ensure that you can disconnect the product from the power source at any time. Pull the power plug to disconnect the product. The power plug must be easily accessible. If the product is integrated into a system that does not meet these requirements, provide an easily accessible circuit breaker at the system level.

## Cleaning the product

Use a dry, lint-free cloth to clean the product. When cleaning, keep in mind that the casing is not waterproof. Do not use liquid cleaning agents.

## Meaning of safety labels

Safety labels on the product warn against potential hazards.



	<p>Potential hazard</p> <p>Read the product documentation to avoid personal injury or product damage.</p>
	<p>Electrical hazard</p> <p>Indicates live parts. Risk of electric shock, fire, personal injury or even death.</p>
	<p>Hot surface</p> <p>Do not touch. Risk of skin burns. Risk of fire.</p>
	<p>Protective conductor terminal</p> <p>Connect this terminal to a grounded external conductor or to protective ground. This connection protects you against electric shock if an electric problem occurs.</p>

## 1.2 Labels on the product

Labels on the casing inform about:

- Personal safety, see "[Meaning of safety labels](#)" on page 10
- Product and environment safety, see [Table 1-1](#)
- Identification of the calibration unit model and supporting operating frequency range

**Table 1-1: Labels regarding product and environment safety**

	<p>Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its service life. For more information, see the product user manual, chapter "Disposal".</p>
	<p>Take care when handling electrostatic sensitive devices.</p>

## 1.3 Warning messages in the documentation

A warning message points out a risk or danger that you need to be aware of. The signal word indicates the severity of the safety hazard and how likely it will occur if you do not follow the safety precautions.

### **WARNING**

Potentially hazardous situation. Could result in death or serious injury if not avoided.

### **CAUTION**

Potentially hazardous situation. Could result in minor or moderate injury if not avoided.

### **NOTICE**

Potential risks of damage. Could result in damage to the supported product or to other property.

## 1.4 Korea certification class B



이 기기는 가정용(B급) 전자파 적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

## 2 Introduction

The R&S ZN-Z84 is designed as an external switch matrix for the Rohde & Schwarz vector network analyzers R&S ZNA, R&S ZNB, R&S ZNBT and R&S ZND.

### 2.1 Option concept

Depending on the installed options, the R&S ZN-Z84 offers 2 or 4-vector network analyzer (VNA) ports and up to 24 test ports, each of them operating within a frequency range of 10 MHz to 8.5 GHz.

The **Base Unit** (order no. 1319.4500.02) implements a 2x6 switch matrix that allows to connect its two VNA ports to any pair of test ports. It offers extension paths for 2 or 4 VNA ports:

**Table 2-1: Extension path for 2 matrix VNA ports**

Option	Extension	Order No.
R&S ZN-Z84-B22	Test ports 7 to 12	1319.4969.22
R&S ZN-Z84-B32	Test ports 13 to 18	1319.4969.32
R&S ZN-Z84-B42	Test ports 19 to 24	1319.4969.42

**Table 2-2: Extension path for 4 matrix VNA ports**

Option	Extension	Order No.
R&S ZN-Z84-B24	VNA ports 3 and 4 Test ports 7 to 12	1319.4969.24
R&S ZN-Z84-B34	Test ports 13 to 18	1319.4969.34
R&S ZN-Z84-B44	Test ports 19 to 24	1319.4969.44

For technical details, see the R&S ZN-Z84 data sheet.

## 2.2 About this manual

The user manual is included on the CD-ROM supplied with the delivery. Beyond the "getting started" chapters, it contains descriptions of all instrument functions and of the remote control of the instrument. In addition, it contains notes on preventative maintenance for the R&S ZN-Z84 and on troubleshooting based on the warnings and error messages that the instrument emits. Finally it contains a description of the ZN-Z8x user tool, which can also be found on the CD-ROM.

The most recent version is available on the [Internet](#).

## 3 Preparing for use

The R&S ZN-Z84 is designed as a base unit (2x6 switch matrix) that can be equipped with up to three optional port extensions. The following description applies to all variants; differences are pointed out explicitly where relevant.

The section below describes how to put the switch matrix R&S ZN-Z84 into operation, how to establish external connections and integrate the R&S ZN-Z84 into a network.

### 3.1 Lifting and carrying

See "[Lifting and carrying the product](#)" on page 8.

### 3.2 Unpacking and checking

1. Unpack the product carefully.
2. Retain the original packing material. Use it when transporting or shipping the product later.
3. Using the delivery notes, check the equipment for completeness.
4. Check the equipment for damage.

If the delivery is incomplete or equipment is damaged, contact Rohde & Schwarz.

### 3.3 Choosing the operating site

Specific operating conditions ensure proper operation and avoid damage to the product and connected devices. For information on environmental conditions such as ambient temperature and humidity, see the data sheet.

See also "[Choosing the operating site](#)" on page 8.

## Electromagnetic compatibility classes

The electromagnetic compatibility (EMC) class indicates where you can operate the product. The EMC class of the product is given in the data sheet.

- Class B equipment is suitable for use in:
  - Residential environments
  - Environments that are directly connected to a low-voltage supply network that supplies residential buildings
- Class A equipment is intended for use in industrial environments. It can cause radio disturbances in residential environments due to possible conducted and radiated disturbances. It is therefore not suitable for class B environments. If class A equipment causes radio disturbances, take appropriate measures to eliminate them.

## 3.4 Setting up the product

See also:

- ["Setting up the product"](#) on page 8
- ["Intended use"](#) on page 7

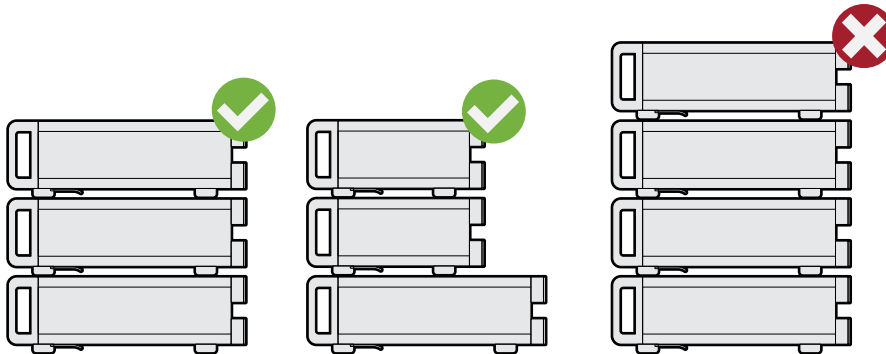
### 3.4.1 Placing the product on a bench top

#### To place the product on a bench top

1. Place the product on a stable, flat and level surface. Ensure that the surface can support the weight of the product. For information on the weight, see the data sheet.
2. **CAUTION!** Foldable feet can collapse. See ["Setting up the product"](#) on page 8.  
Always fold the feet completely in or out. With folded-out feet, do not place anything on top or underneath the product.
3. **WARNING!** A stack of products can fall over and cause injury. Never stack more than three products on top of each other. Instead, mount them in a rack.  
Stack as follows:
  - If the products have foldable feet, fold them in completely.

## Setting up the product

- It is best if all products have the same dimensions (width and length). If the products have different dimensions, stack according to size and place the smallest product on top.
- Do not exceed the permissible total load placed on the product at the bottom of the stack:
  - 50 kg when stacking products of identical dimensions (left figure).
  - 25 kg when stacking smaller products on top (middle figure).



Left = Stacked correctly, same dimensions  
 Middle = Stacked correctly, different dimensions  
 Right = Stacked incorrectly, too many products

#### 4. **NOTICE!** Overheating can damage the product.

Prevent overheating as follows:

- Keep a minimum distance of 10 cm between the fan openings of the product and any object in the vicinity to provide sufficient airflow and ventilation.
- Do not place the product next to heat-generating equipment such as radiators or other products.

### 3.4.2 Mounting the product in a rack

#### To prepare the rack

1. Observe the requirements and instructions in "[Setting up the product](#)" on page 8.
2. **NOTICE!** Insufficient airflow can cause overheating and damage the product. Design and implement an efficient ventilation concept for the rack.



**To mount the product in a rack**

1. Use an adapter kit to prepare the product for rack mounting.
  - a) Order the 19" rack adapter kit designed for the product. For the order number, see data sheet.
  - b) Mount the adapter kit. Follow the assembly instructions provided with the adapter kit.
2. Grab the product by the handles and push it onto the shelf until the rack brackets fit closely to the rack.
3. Tighten all screws on the rack brackets to secure the product in the rack.

**To unmount the product from a rack**

1. Loosen the screws at the rack brackets.
2. Remove the product from the rack.
3. If placing the product on a bench top again, unmount the adapter kit from the product. Follow the instructions provided with the adapter kit.

## 3.5 Considerations for test setup

**Cable selection and electromagnetic interference (EMI)**

Electromagnetic interference (EMI) can affect the measurement results.

To suppress electromagnetic radiation during operation:

- Use high-quality shielded cables, for example, double-shielded RF and LAN cables.
- Always terminate open cable ends.
- Ensure that connected external devices comply with EMC regulations.
- Use  $\leq 3$  m for the USB cable length or the USB cable delivered with the calibration unit, if possible.

**Signal input and output levels**

Information on signal levels is provided in the data sheet. Keep the signal levels within the specified ranges to avoid damage to the product and connected devices.

### Preventing electrostatic discharge (ESD)

Electrostatic discharge is most likely to occur when you connect or disconnect a DUT.

- ▶ **NOTICE!** Electrostatic discharge can damage the electronic components of the product and the device under test (DUT).

Ground yourself to prevent electrostatic discharge damage:

- a) Use a wrist strap and cord to connect yourself to ground.
- b) Use a conductive floor mat and heel strap combination.

## 3.6 Connecting to power

For safety information, see "[Connecting to power](#)" on page 9.

1. Plug the AC power cable into the AC power connector on the rear panel of the product. Only use the AC power cable delivered with the product.
2. Plug the AC power cable into a power outlet with ground contact.  
The required ratings are listed next to the AC power connector and in the data sheet.
3. If necessary, also ground the product using the grounding terminal  $\perp$ .

When the instrument is connected to the AC supply, it automatically adjusts to the AC supply voltage (see the labeling for the voltage range). It is not necessary to manually adjust the instrument to a specific voltage or to change the fuse.

## 3.7 Connecting external devices

The R&S ZN-Z84 is equipped with different interfaces for establishing a remote control connection, typically from a VNA of the R&S ZNA, R&S ZNB, R&S ZNBT and R&S ZND family.

### 3.7.1 USB

If necessary, connect the USB connecting cable to the USB type B (slave) port on the rear panel. With direct connection to a master device, a connecting cable A-B (plug type A onto plug type B) must be used.

### 3.7.2 LAN

The connection to the LAN is made using a commercially available RJ-45 cable via the LAN interface on the back of the instrument.

► **NOTICE!** Possible disturbance of network operation.

Switch off the instrument before connecting or removing the network cable to ensure reliable detection of the network connection and avoid faults during operation of the instrument.

The network interface works with a 100 Mbit/s IEEE 802.3u Ethernet. The TCP/IP network protocol and the associated network services are preconfigured. To exchange data in a local area network (LAN), it must be possible to address each connected computer or instrument via a unique IP address or a hostname.

By default, every R&S ZN-Z84 is assigned a hostname `ZN-Z84X<serial number>`.

#### 3.7.2.1 Networks with DHCP

The R&S ZN-Z84 is preconfigured to use the dynamic host configuration protocol (DHCP). In such networks, the R&S ZN-Z84 is automatically assigned a free IP address.

#### 3.7.2.2 Static IP configuration


With static IP configuration, the static IP configuration data are usually provided by the network administrator. They can be activated on the R&S ZN-Z84 using remote control.

### 3.7.2.3 Point-to-Point connections

Establishing a simple network – a LAN connection between an R&S ZN-Z84 and a computer without integration into a larger network – requires assignment of an IP address for the R&S ZN-Z84 and the computer. Private IP addresses 192.168.xxx.yyy are available for this connection. The values for xxx and yyy range from 1 to 254; the subnet mask length is 24 or higher. The IP address for the gateway must also be specified, but it is not of significance in this case.

### 3.7.3 Direct control

The "direct control" (a.k.a. "device control") interface allows you to establish a direct connection between the measurement bus of an R&S ZNB or R&S ZNBT and the FPGA controlling the routes of a switch matrix R&S ZN-Z8x. As direct control bypasses the matrix's microcontroller, it significantly reduces the switching times compared to management via USB or LAN.



 The R&S ZNB (R&S ZNBT) must be equipped with the device control option R&S ZNB-B12 (R&S ZNBT-B12).

The FPGA is put on the measurement bus by connecting the matrix's "Direct Control IN" interface to the analyzer's "DIRECT CTRL" interface; cascading of Direct Control connections is possible via "Direct Control OUT" (see [Table 4-1](#)).

A suitable connection cable is provided with option R&S ZN-B121 (order no. 1323.9290.00).

## 3.8 Switching on or off

**Table 3-1: Overview of power states**

Status	LED	Position of power switch
Off	Off	[0]
Standby	 orange	[1]
Ready	 green	[1]

### To switch on the product

The product is off but connected to power.

1. Set the switch on the power supply to position [I]



The LED of the [standby] key is orange. See [Table 3-1](#).

2. Press the [standby] key.

The LED changes to green.

When the instrument receives power from the AC supply, it immediately starts loading the firmware (mini display: "ZNZ84 FPGA loading...") and performs a self-test.

When the firmware is successfully loaded, the instrument is ready for operation and can be remotely controlled via USB or LAN and Direct Control.

### To shut down the product

The product is in the ready state.

- ▶ Press the [standby] key.

The operating system shuts down. The LED changes to orange.

### To disconnect from power

The product is in the standby state.

1. **NOTICE!** Risk of data loss. If you disconnect the product from power when it is in the ready state, you can lose settings and data. Shut it down first.

Set the switch on the power supply to position [0].

The LED of the standby key is switched off.

2. Disconnect the product from the power source.

## 3.9 Function check

The R&S ZN-Z84 automatically monitors the most important instrument functions when it is turned on.

## 4 Instrument tour

This chapter shows all function keys, control elements and connections on the front and rear panel of the R&S ZN-Z84.

### 4.1 Front panel

The front panel of the switch matrix provides the administrative area on the left-hand side, and, to its right, the matrix VNA port area (including a USB type B connector) and the matrix test port area. Brief explanations on the controls and connectors can be found on the next pages.

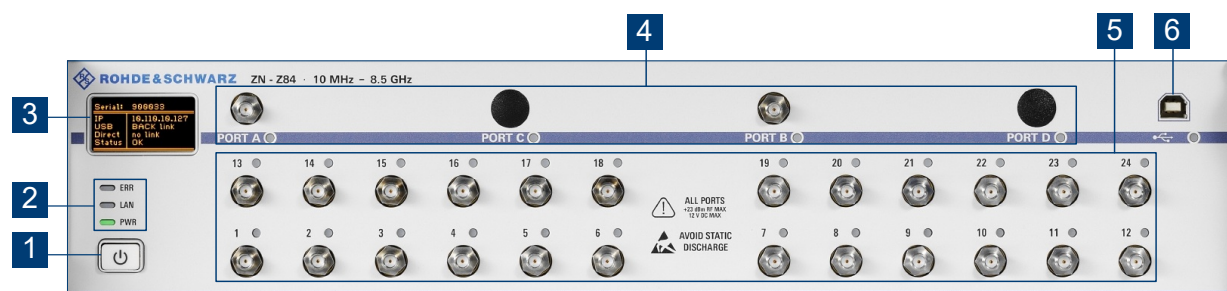


Figure 4-1: Front panel of the R&S ZN-Z84

- 1 = Standby key
- 2 = Status LEDs
- 3 = Mini display
- 4 = Matrix VNA ports
- 5 = Matrix test ports
- 6 = USB connector

#### 4.1.1 Standby key



The key serves two main purposes:

- Toggle between standby and ready state; see ["To switch on the product"](#) on page 21.

When the instrument is powered up, it comes up in ready state.

- Shut down the instrument; see ["To shut down the product"](#) on page 21.

### 4.1.2 Status LEDs



Above the standby toggle switch, some LEDs indicate various status information:

- [ERR]: operation state; if an error occurs, the LED lights up red
- [LAN]: LAN error occurred
- [PWR]: power state (ready/standby); see ["To switch on the product"](#) on page 21.

### 4.1.3 Mini display

```
Serial: 900033
IP      192.168.1.2
USB     BACK link
Direct  no link
Status  OK
```

The miniature display in the upper left-hand corner of the R&S ZN-Z84 provides the following instrument information:

- Serial number `Serial`
- IP address `IP` (see [Chapter 3.7.2, "LAN"](#), on page 19)
- USB link state `USB: FRONT link, REAR link or no link` (see [Chapter 3.7.1, "USB"](#), on page 19)
- Direct Control state `D.C.: link or no link` (see [Chapter 3.7.3, "Direct control"](#), on page 20)
- Operational status `STAT: OK or Error <error code>` (see [SYSTEM: ERRor?](#) on page 45 )

### 4.1.4 Matrix VNA ports

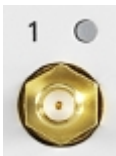


SMA female connectors, 50  $\Omega$ , labeled A, C, B, D (from left to right). A colored LED indicates whether the related port is currently used.

- With the R&S ZN-Z84 base unit and the (optional) 2-VNA-port extensions R&S ZN-Z84-B22, -B32 and -B42, only connectors A and B are available.
- With the optional 4-VNA-port extension R&S ZN-Z84-B24, connectors C and D are added.

See the [Introduction](#) for the possible extension paths.

### 4.1.5 Matrix test ports



Numbered female SMA connectors (50  $\Omega$ ), serving as outputs for the RF stimulus signal and as inputs for the measured RF signals from the DUT (response signals).

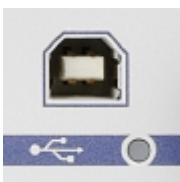
- Without port extension, the R&S ZN-Z84 base unit offers ports 1 to 6.
- Optional extensions R&S ZN-Z84-B22/B24, -B32/B34 and -B42/B44 add test ports 7 to 12, 13 to 18 and 19 to 24, respectively.

Use a suitable torque wrench when fastening the RF cables on the connectors.


If the related port is in use, the color of the LED indicates the connected VNA port. The LED colors can be set using the [ZN-Z8x user tool](#) which can be found on the complementary CD.

See also "[Signal input and output levels](#)" on page 17 for maximum input levels of the R&S ZN-Z84.

### 4.1.6 USB connector



Two type B (slave) high-speed USB connectors are provided on the R&S ZN-Z84: one at the front panel and one at the back panel. They can be used (exclusively) to control the R&S ZN-Z84 from the VNA.

-  The front USB connector is linked by using an internal USB-Hub. For optimum switching speed, it is recommended to use the back panel connector.
- The length of passive connecting USB cables should not exceed 1 m. See also the notice on EMI Suppression below (see [Chapter 3.5, "Considerations for test setup"](#), on page 17).



## 4.2 Rear panel

This section shows all interfaces on the back of the R&S ZN-Z84.

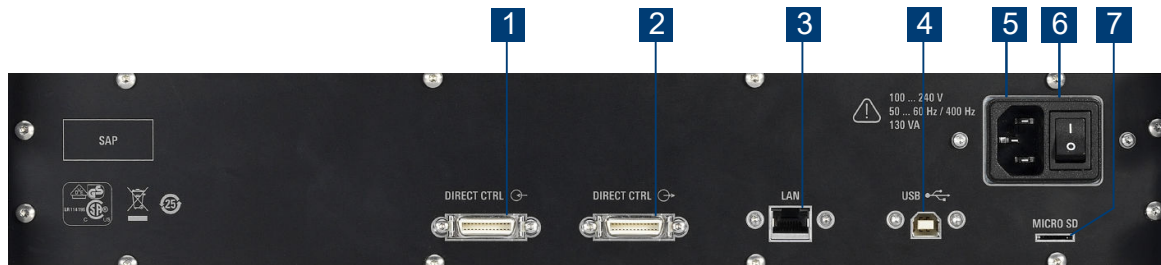


Figure 4-2: R&S ZN-Z84 rear view

Table 4-1: Rear panel elements

Index	Label	Description
1	DIRECT CTRL	DIG-IQ connectors: Direct Control (Prog Bus) interface, incoming (from R&S ZNB/ZNBT) and outgoing (to other Direct Control devices).
2	DIRECT CTRL	Allows a direct connection between the R&S ZNB/ZNBT measurement bus and the FPGA controlling the matrix switches, bypassing the microcontroller. Direct control significantly reduces the switching times compared to management via USB or LAN. <b>Note:</b> requires the Device Control hardware option "B12" on the R&S ZNB/ZNBT.
3	LAN	RJ-45 connector to integrate the instrument to a Local Area Network, primarily for remote control purposes.
4	USB	Type B (slave) high-speed USB connector to control the R&S ZN-Z84 from the VNA. See also <a href="#">Chapter 4.1.6, "USB connector"</a> , on page 24.
5		AC power connector
6	IO	Power switch
7	MICRO SD	Micro SD card slot

See the R&S ZN-Z84 data sheet for interface specification details.

## 5 Instrument functions

The single function of a switch matrix R&S ZN-Z84 is to dynamically establish RF connections between its VNA ports (statically connected to the RF ports of the VNA) and its test ports (statically connected to the DUT), applying a passive load match to currently unconnected ports.

Typically these connections are requested by the connected VNA that ultimately wants to:

- Send a stimulus signal (the *a* wave) to a particular DUT port and to receive the response signal from the stimulated and other DUT ports (the *b* waves)
- And then quickly change to different stimulus/response ports.

Hence the switch matrix is completely remote-controlled; it does not provide any means for manual control.

For each possible expansion stage, the connection paths of the R&S ZN-Z84 are shown in simplified form in the circuit diagrams below.

### 5.1 Matrix building blocks

The switch matrix is composed of interconnected 2x6 and 1x4 switch modules that are in turn made up of RF semiconductor switches  $S_{P<n>T}$ ,  $n=3,4$ . The latter allows you (or the controlling VNA) to switch bidirectional connections between their single "input port" to any of their  $n$  "output ports".

#### 5.1.1 Switch module 2x6

At the "south", the 2x6 switch modules implement the test ports. At the "north", they are either directly connected to the VNA ports (in R&S ZN-Z84 Base Units without extensions) or to one or two 1x4 switch modules.

To prevent reflections caused by misadjustment, 50  $\Omega$  terminating resistors are connected to unused outputs.

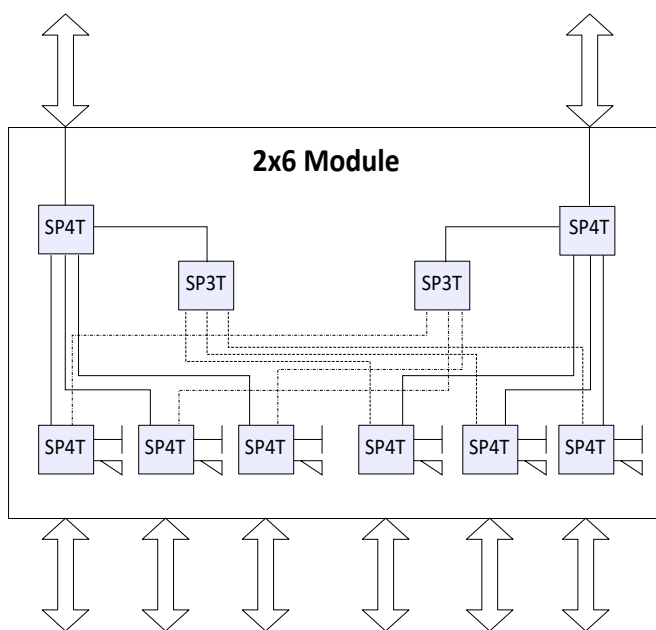
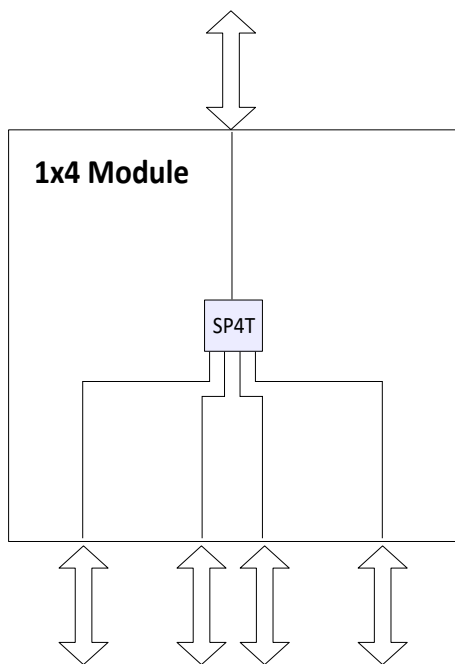


Figure 5-1: Switch module 2x6

### 5.1.2 Switch module 1x4

At the "north", the 1x4 switch modules are connected to the VNA ports. At the "south", they are connected to each of the available 2x6 modules.



## 5.2 Extensions with 2 matrix VNA ports

For the 2-VNA-port variants, the switching paths for the VNA ports are completely symmetrical. The 2 matrix VNA ports can be switched to any pair of test ports at the same time ("full crossbar").

### 5.2.1 Switch matrix 2x6

For the R&S ZN-Z84 Base Unit without extension, the switching functionality is provided by a single 2x6 module:

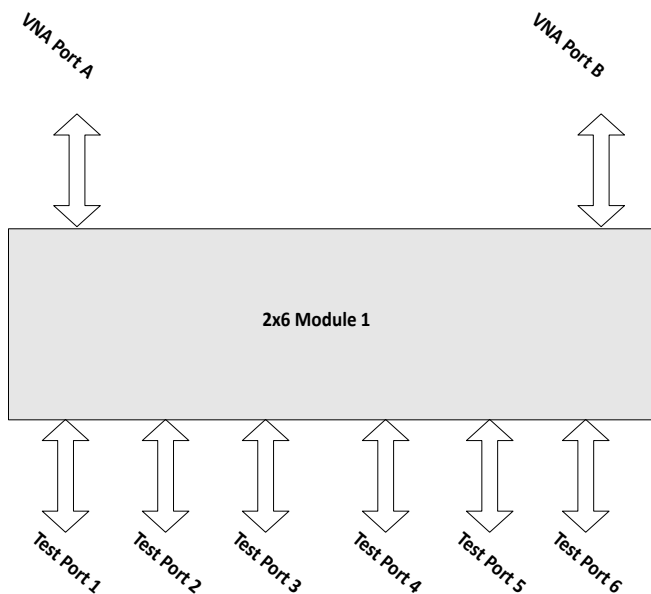


Figure 5-2: Switch Matrix 2x6

### 5.2.2 Switch matrix 2x12

For test ports 7 to 12 (with option R&S ZN-Z84-B22), a second 2x6 module is installed. To support "full crossbar" switching

- Each of the matrix VNA ports is connected to a dedicated 1x4 module
- Each of the 1x4 modules is connected to both 2x6 modules

## Extensions with 2 matrix VNA ports

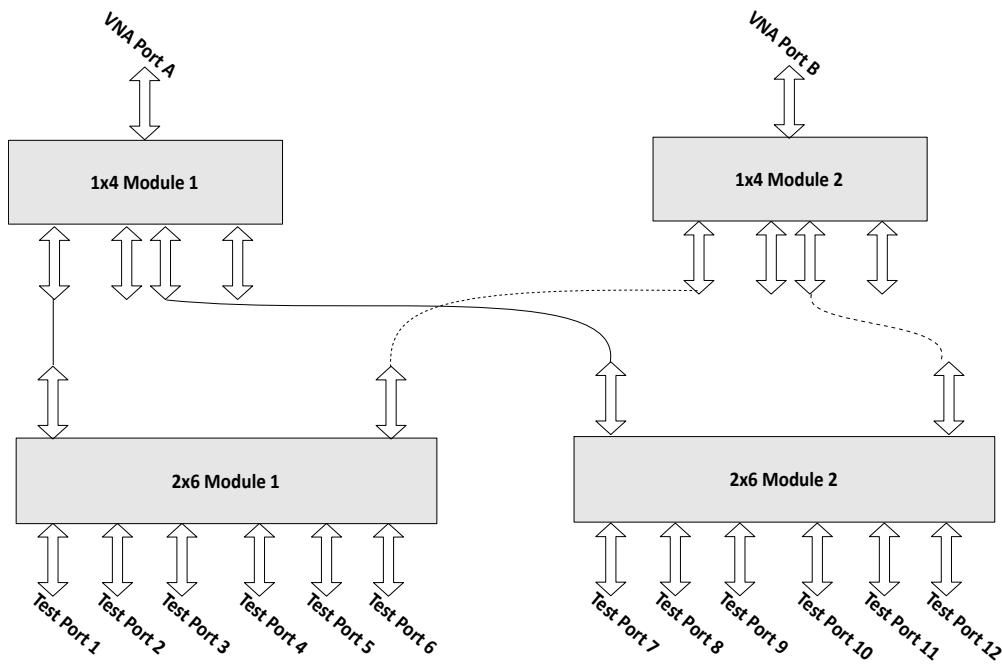


Figure 5-3: Switch Matrix 2x12

### 5.2.3 Switch matrix 2x18

For test ports 13 to 18 (with additional option R&S ZN-Z84-B32), a third 2x6 module is installed. Again, to support "full crossbar" switching each of the two 1x4 modules is connected to any of the three 2x6 modules:

## Extensions with 2 matrix VNA ports

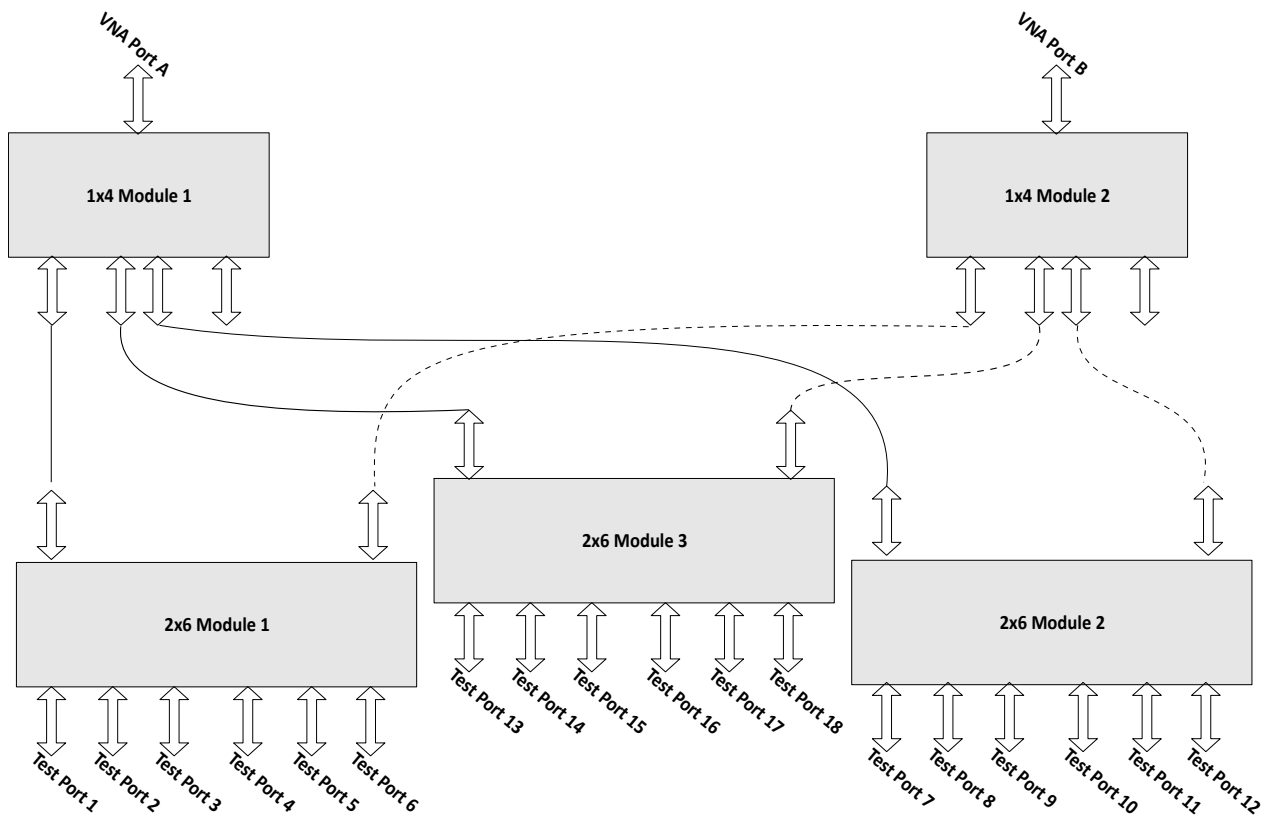


Figure 5-4: Switch matrix 2x18

### 5.2.4 Switch matrix 2x24

Same extension logic for test ports 19 to 24 (with additional option R&S ZN-Z84-B42): 2x6 module 4 provides the additional test ports and is connected to both 1x4 modules.

## Extensions with 4 matrix VNA ports

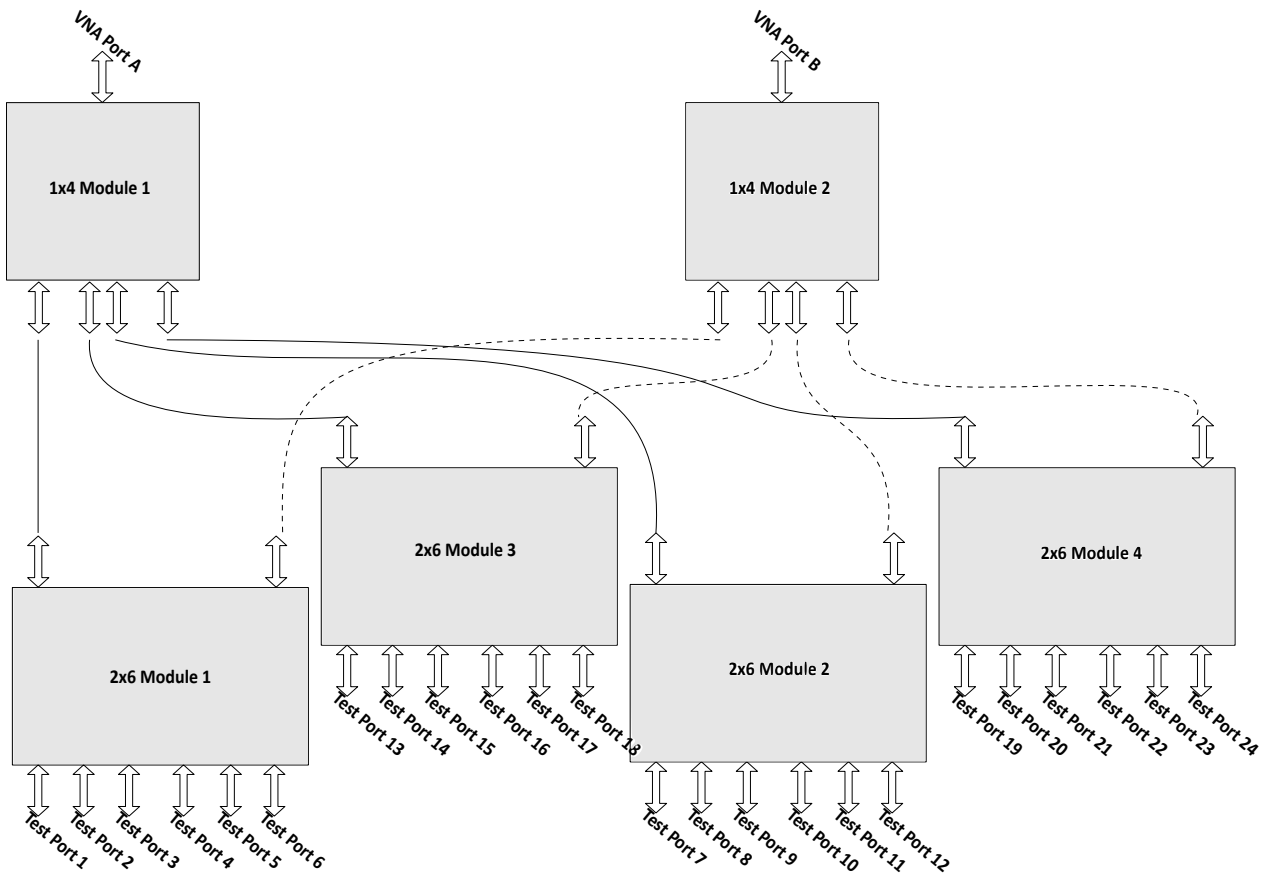


Figure 5-5: Switch matrix 2x24

### 5.3 Extensions with 4 matrix VNA ports

The 4-VNA-port variants are implemented as two separate 2xN submatrices:

- VNA ports A and C with test ports 1-6 and 13-18
- VNA ports B and D with test ports 7-12 and 19-24 (if available)

#### 5.3.1 Switch matrix 4x12

Option R&S ZN-Z84-B24 adds the two additional physical VNA ports and a second 2x6 module for test ports 7 to 12 that is directly connected to the VNA ports:

## Extensions with 4 matrix VNA ports

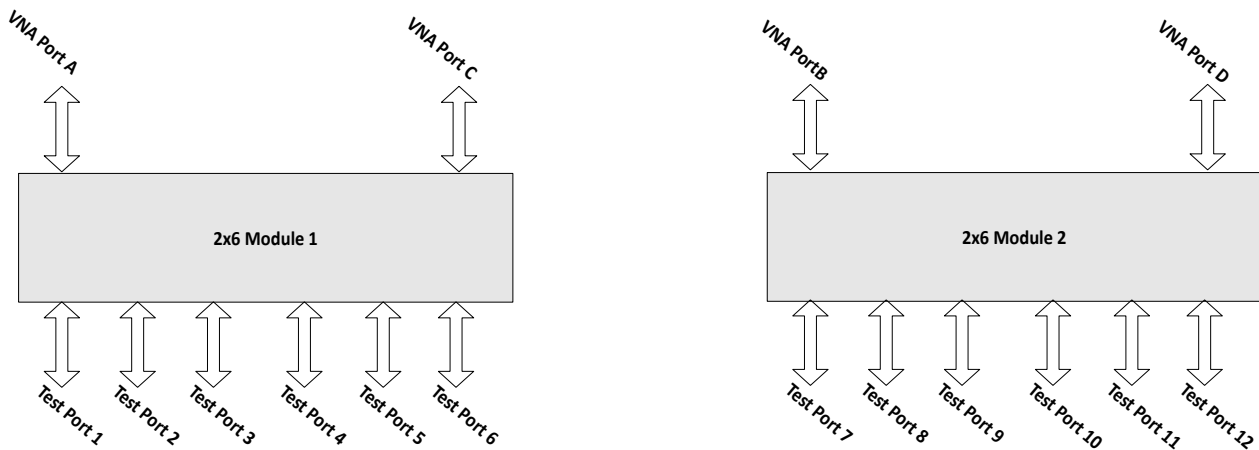


Figure 5-6: Switch matrix 4x12

### 5.3.2 Switch matrix 4x18

For test ports 13 to 18 (with additional option R&S ZN-Z84-B34), a third 2x6 module is installed. This 2x6 module no. 3 is connected to the 1x4 modules of matrix VNA ports A and D:



## Extensions with 4 matrix VNA ports

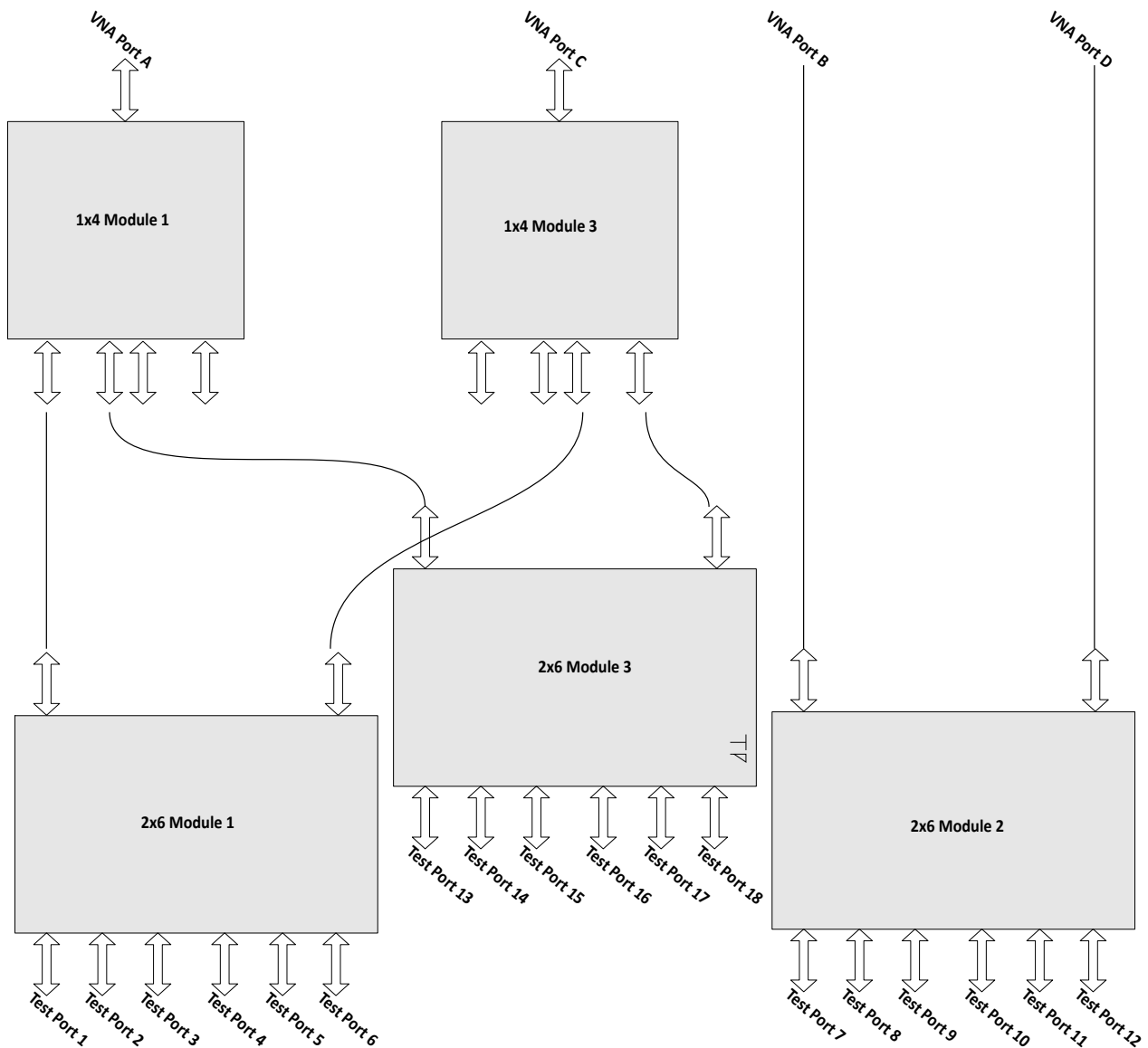


Figure 5-7: Switch matrix 4x18

### 5.3.3 Switch matrix 4x24

The additional option R&S ZN-Z84-B44 comprises:

- 2x6 module no. 4 that provides test ports 19-24
- Two additional 1x4 modules that are connected to VNA ports B and D and to the 2x6 modules providing test ports 7-12 and 19-24

Extensions with 4 matrix VNA ports

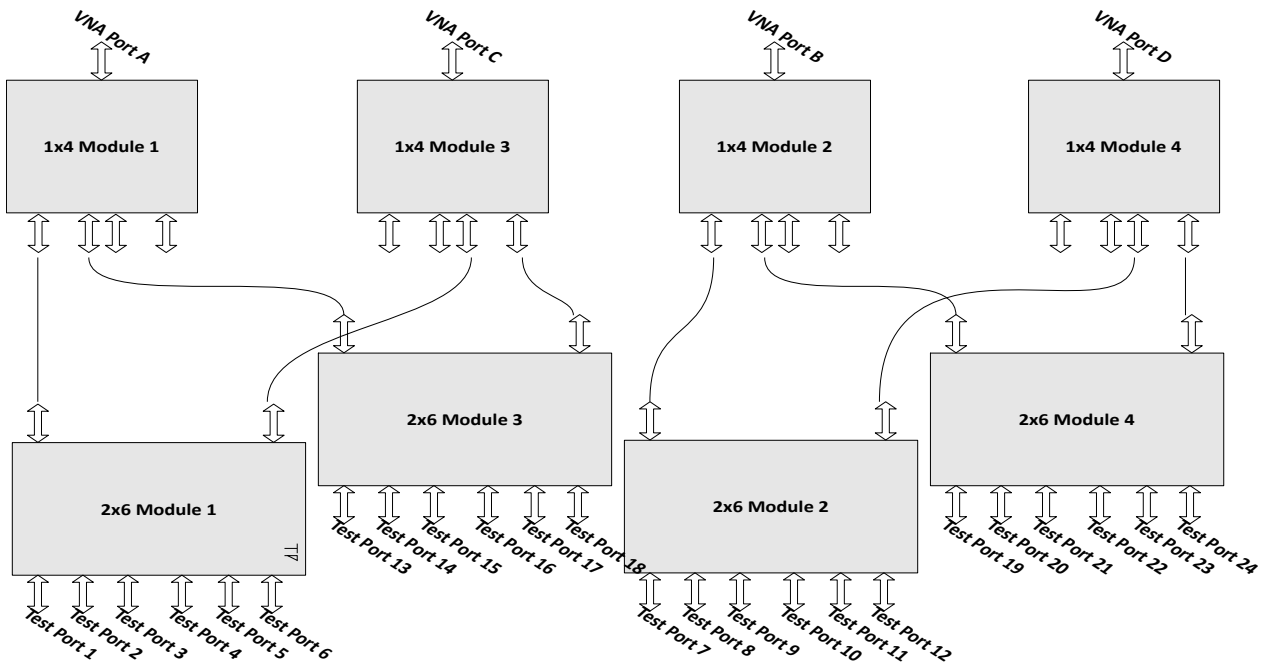


Figure 5-8: Switch matrix 4x24

## 6 Application

From the perspective of the VNA, the purpose of a switch matrix is to extend the number of test ports, i.e. to convert an N-port network analyzer into an N'-port network analyzer ( $N' > N$ ) without modifying the instrument itself. The increased number of test ports can reduce or even eliminate the manual reconnections of the DUT, resulting in a higher measurement speed, reliability and repeatability.

The firmware of the R&S ZNA, R&S ZNB, R&S ZNBT and R&S ZND is able to control switch matrices from Rohde&Schwarz directly. It is fast and easy to set up and operate a switch matrix via the graphical user interface. For example, an R&S ZNB in combination with an R&S ZN-Z84 can seamlessly work as a multi-port network analyzer with up to 24 ports.

However, an N-port analyzer is always limited to measuring N signals simultaneously, i.e. during stimulation by the active test port, even though the DUT is fully connected to the switch matrix, it may not be possible to measure all  $b$  waves simultaneously. For example, consider a DUT with 6 unbalanced ports, connected to a 2-port analyzer via the R&S ZN-Z84 base unit without extension. For each stimulus port, 5 sweeps are required to measure the resulting  $b$  waves,  $6 \cdot 5 = 30$  sweeps in total. For "real" 6-port analyzers, a single sweep per driving port is sufficient.

Furthermore, in the example above, at least  $6 \cdot 5 / 2$  successive matrix switching procedures are required (one for each port pair). This involves command processing and physical switching and hence might take some time to complete. To optimize the measurement setup with respect to speed and resources, the characteristics of the available switch matrices have to be considered.



- The **Direct control** access to the R&S ZN-Z84 eliminates the protocol and command processing overhead of the standard remote control interfaces and hence significantly reduces the total switching time.
- While it is allowed to connect multiple matrices to a single analyzer of the R&S ZNx family, matrix cascading at RF layer is **not** supported.

## 6.1 Matrix setup and operation at the R&S ZNx

Setting up a switch matrix at the R&S ZNA, R&S ZNB, R&S ZNBT or R&S ZND firmware typically involves the following steps:

1. Establish the physical connection via the appropriate management interface (USB, LAN or Direct Control)
2. Register the matrix (as managed object)
3. Define the RF configuration:
  - a) Configure the matrix-VNA-connections according to the existing (or planned) physical connections between VNA test ports and matrix VNA ports
  - b) Assign the matrix test ports and the remaining VNA ports (i.e. those VNA ports that are not connected to a matrix VNA port) to DUT test ports

After this initial setup, the analyzer takes control of the attached matrices: it configures the test ports and dynamically establishes the required matrix through-connections according to the current measurement task.

## 6.2 RF connections and matrix connectivity

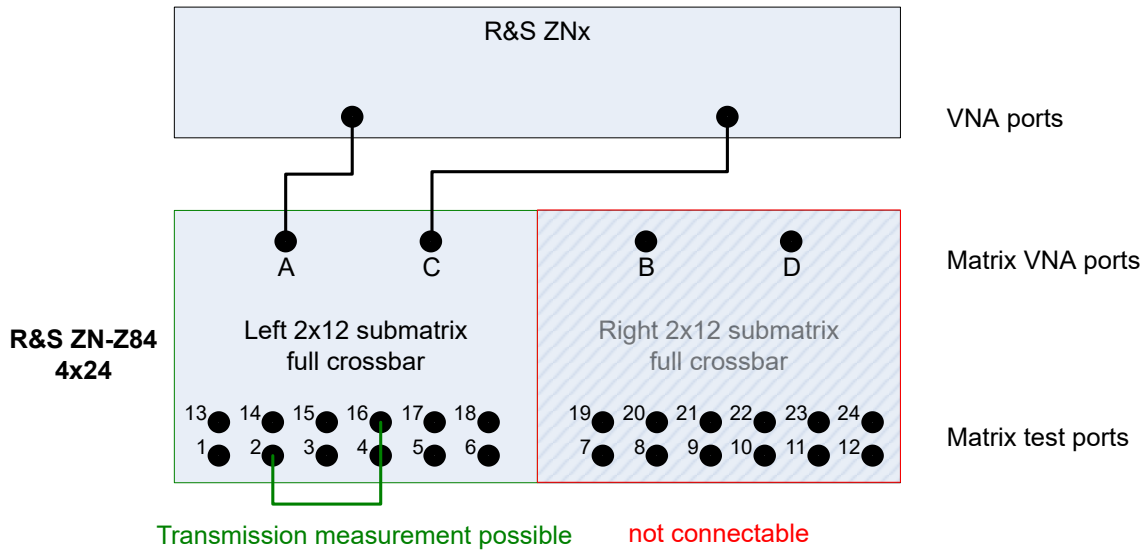
Depending on the expansion stage of the R&S ZN-Z84 and the RF connections between VNA and matrix

- Certain matrix test ports may not be available for measurements
- Certain transmission measurements may not be possible

**Example:**

Consider a fully equipped R&S ZN-Z84, where the matrix VNA ports of the left submatrix cannot be connected to the test ports of the right submatrix and vice versa.

If none of the two VNA ports of a submatrix is connected, obviously no connection between the VNA and the submatrix's test ports can be established and hence neither reflection nor transmission measurements are possible.



**Figure 6-1: Unconnected right submatrix**

## Multiple paths: precision versus speed

**Example:**

Connecting one of two submatrix VNA ports enables reflection measurements for the corresponding matrix test ports. However, as long as a second connection between the VNA and this submatrix is missing, "intra-submatrix" transmission measurements are still impossible.

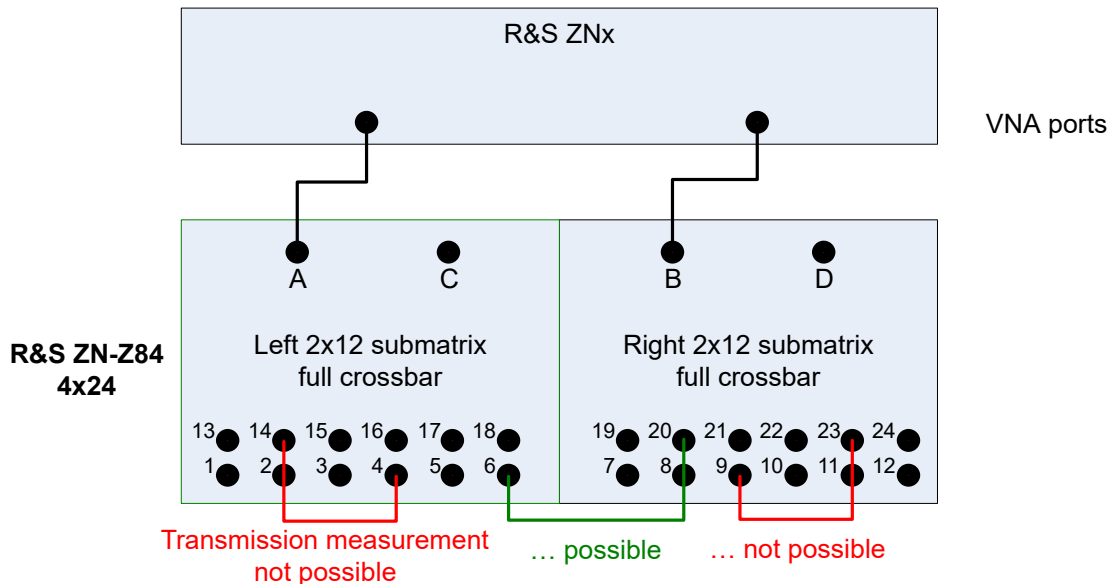


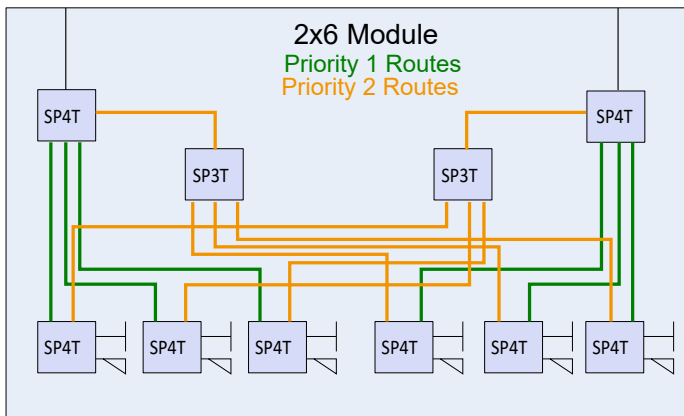
Figure 6-2: Partially connected submatrices

### 6.3 Multiple paths: precision versus speed

On the other hand, the switch matrix offers multiple routes to a given matrix test port and hence measurements may be performed using different physical paths (where a *path* consists of the traversed VNA connections and matrix routes).

These paths have different characteristics - in particular if the corresponding matrix routes differ in the number of switches being traversed.

## Multiple paths: precision versus speed



**Figure 6-3: Routes and priorities**

The R&S ZNx firmware prioritizes the available routes according to the number of switches that they traverse:

- To obtain highest measurement *precision*, the driving VNA port should always use the "best possible" (highest priority) route. On the other hand, this may cause additional matrix switching procedures and hence may result in a reduced measurement speed.
- If the focus is on measurement *speed*, the number of matrix switching procedures should be minimized, disregarding a possible loss in measurement precision.

As for "slow" management connections the trade-off between precision and speed cannot be resolved, the R&S ZNx firmware allows to select which optimization should be performed.

To see the difference between the two optimizations, again consider a DUT with 6 unbalanced ports, connected to a 2-port analyzer via the R&S ZN-Z84 base unit without extension. If all S-parameters shall be measured, at least  $6 \cdot 5/2$  successive matrix switching procedures are required (one for each pair of test ports) and the *speed* optimization would choose one of these minimum solutions. In contrast, the *precision* optimization always selects the priority 1 route for the driving port, which results in  $6 \cdot 5$  successive matrix switches (one per *directed* port pair).



Always choose the *precision* optimization if R&S ZNx and R&S ZN-Z84 are connected using [Direct control](#). The switching speed of the matrix in this case is in the same range as the source switch of the VNA.

# 7 Operation

The switch matrix R&S ZN-Z84 is completely remote-controlled; it does not provide any means for manual control.

The RF port LEDs indicate the currently switched routes between matrix VNA ports and matrix test ports. The PWR LED on the front panel indicates the standby state of the instrument. The front panel USB is equipped with an LED that is lit while a connection is active.

The R&S ZN-Z84 is equipped with a 128x64 monochrome OLED-Display that displays the following information:

- Serial number of the instrument (for identification purposes)
- IP address
- USB and Direct Control link states
- Operational state of the instrument. This can be either
  - OK if the instrument is error-free or
  - ERROR <error code> with the error code of the last occurred error.

The following sections describe the steps and commands required for remote control of the switch matrix R&S ZN-Z84.

In [Chapter 7.1, "Basic information on remote control"](#), on page 40, you find information on setting up the switch matrix for remote control and on the available interfaces and protocols. You also find a brief description of the status register. The remote control commands are explained in detail in [Chapter 7.2, "Remote control – commands"](#), on page 44.

## 7.1 Basic information on remote control

This chapter contains basic information on remote control of the switch matrix R&S ZN-Z84. It contains instructions for setting up the instrument for remote control and a brief description of the status register.



## 7.1.1 Interfaces and protocols


The instrument has different interfaces for remote control. The following table provides an overview:

**Table 7-1: Remote control interfaces and protocols**

Interface	Comments
USB	On the back of the instrument, there is a type B USB interface (slave) for communication with the master device. For details see <a href="#">Chapter 7.1.1.2, "USB interface"</a> , on page 42.
Local Area Network (LAN)	The LAN port is located at the backplane of the instrument. The LAN interface supports a RAW TCP/IP protocol at port 2101. All LAN parameters can be set using SCPI commands or via USB using the <a href="#">ZN-Z8x user tool</a> which can be found on the complementary CD. For details see <a href="#">Chapter 7.1.1.3, "LAN interface"</a> , on page 43

### Standard commands for programmable instruments (SCPI)

For remote control of the instrument, commands in line with the SCPI standard are used. The syntax of commands that are not included in that standard still follows the SCPI rules. The instrument supports SCPI version 1999 (Standard Commands for Programmable Instruments). The SCPI standard is built on the foundation of the IEEE 488.2 standard, and it aims to standardize instrument-specific commands, error handling and status register. For further information on SCPI concepts and definitions, please refer to the book "Automatic Measurement Control – A tutorial on SCPI and IEEE 488.2" by John M. Pieper, R&S order number 0002.3536.00.

 This description of the remote control functionality assumes that you are familiar with programming and understand how to operate the controller. You find detailed information on syntax and on the interface commands in the SCPI descriptions mentioned above.

#### 7.1.1.1 Commands and responses

**Commands** are messages that the controller sends to the instrument. They operate the instrument functions and request information. The commands are divided into types based on two criteria:

- Based on the effect that they have on the instrument

## Basic information on remote control

- **Setting commands** control instrument settings, such as resetting the instrument, or entering setting values.
- **Query commands** make output data for the remote control, for example for identifying the instrument or for querying a setting's value. Queries have a question mark ? at the end of the setting command.
- Based on how they are defined in the IEEE 488.2 and SCPI standards:
  - **Common commands** are precisely defined regarding their function and syntax in the IEEE 488.2 standard. These commands are identical for all instruments, and they refer to functions such as the management of the standardized status register, resetting and self-testing.
  - **Instrument-dependent commands** are for functions that depend on the characteristics of the specific instrument, such as frequency setting. Many of these commands have also been standardized by the SCPI Consortium. Such commands are labeled "SCPI compliant" in the command reference. Commands without the SCPI label are instrument-dependent, however, their syntax follows the SCPI rules, as allowed by the standard.

**Responses** are messages that the instrument transmits to the controller after a query command. Responses contain measurement results, instrument settings or status information on the instrument.

You find detailed descriptions of the commands for controlling the R&S ZN-Z84 in [Chapter 7.2, "Remote control – commands"](#), on page 44.

### 7.1.1.2 USB interface

For remote control via the USB bus, connect the controller (master) to the R&S ZN-Z84's type B USB interface.

Instrument control requires the generic `USBBULK.dll` and the instrument-specific `znz8x_dll.dll`. These libraries are part of the R&S ZNx firmware and are also installed with the [ZN-Z8x user tool](#) that can be found on the complementary CD.

#### USB address

To establish a USB connection, you need:

- The **vendor ID** `0x0AAD` (for Rohde & Schwarz)
- The R&S ZN-Z84's **product ID** `0x011B` and

## Basic information on remote control

- The instrument's 6-digit serial number (see mini display or label on the back of the instrument)

### 7.1.1.3 LAN interface

The instrument is equipped with a LAN interface to enable integration into a local area network (LAN). This interface consists of a connector, a network card, and protocols.

For remote control via the network, the controller and the instrument must be connected via the LAN interface to a common network that uses the TCP/IP network protocol. They are connected using commercially available RJ-45 cables. The TCP/IP network protocol and the network services associated with it are preconfigured on the instrument.

To establish the connection, you need the instrument's IP address or computer name.

### Socket communication

An alternative way for remote control of the software is to establish simple network communication using sockets (also referred as "Raw Ethernet communication").

The simplest way to establish a socket communication to the switch matrix is to connect to the built-in Telnet server. A Telnet client is part of every operating system and supports communication with the server on a command-by-command basis. For better utilization and to enable automation by additional programs, user-defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the instrument's host name and the number of the port configured for remote control. All switch matrices use port number 2101 for this purpose. The port is configured for communication on a command-to-command basis and for remote control by a program.

### 7.1.2 Status reporting system

The status reporting system stores all information on the instrument's current status and on the errors that have arisen. This information is stored in the status reg-

ister and in an error output queue that can be queried using the `SYSTem:ERRor?` command.

## 7.2 Remote control – commands

This chapter describes all the commands that are relevant for remote control of the switch matrix R&S ZN-Z84. The "List of Commands" at the end of the manual contains all commands in alphabetic order.



### Tips and tricks for operation ...

- **The use of upper and lower case letters** designates the long and short forms of a command: `SET:LAN:SNMask` = `SET:LAN:SNM`
- **Text parameters** are separated from the header by a space. They follow the strict syntax rules for keywords.
- Results are returned as ASCII strings terminated with `<CR><LF>` (ASCII 13 followed by ASCII 10)
- Optional [Handshake](#) (enabled by default)

### 7.2.1 Handshake

If Handshake is active, on successful execution of a command that otherwise does not return a result, a confirmation `0, "OK"<CR><LF>` is returned.

<a href="#">HANDshake?</a> .....	44
<a href="#">HANDshake:ON</a> .....	45
<a href="#">HANDshake:OFF</a> .....	45

---

#### HANDshake?

Queries whether Handshake is ON (default) or OFF.

#### Return values:

`<Boolean>`                      Either 0 (OFF) or 1 (ON)  
                                          \*RST:                      1 (ON)

**Usage:**                              Query only

**HANDshake:ON**  
**HANDshake:OFF**

Enables/disables the Handshake logic.

A successful command execution is answered by the handshake confirmation 0, "OK"<CR><LF>.

**Usage:** Event

**7.2.2 General functions**

*RST.....	45
SYSTem:CLEAr.....	45
SYSTem:ERRor?.....	45

**\*RST**

Sets the instrument to a defined default state:

- **Handshake** is turned ON
- All existing **Routes** are disconnected

**Usage:** Event

**SYSTem:CLEAr**

Clears the error memory.

**Usage:** Event

**SYSTem:ERRor?**

Queries the R&S ZN-Z84 for a list of errors.

**Return values:**

<ErrCodes> A list of error numbers (see table below)

**Usage:** Query only

Table 7-2: R&amp;S ZN-Z84 error codes

Error code	Error string	Description
0	ZNZ84_STATUS_OK	
1	ZNZ84_STATUS_UNKNOWN_OPT	unknown extension module
2	ZNZ84_STATUS_OPT_ERROR	extension module does not match available option codes
3	ZNZ84_STATUS_FPGA_ERROR	cannot read from FPGA registers
4	ZNZ84_STATUS_SD_CARD_ERROR	SD card corrupted (selftest failed)
5	ZNZ84_STATUS_NOR_FLASH_ERROR	NOR flashes corrupted (selftest failed)
6	ZNZ84_STATUS_CONFIG_FILE_ERROR	config.ini corrupted (inconsistent config.ini file)
7	ZNZ84_STATUS_FPGA_FALLBACK_LOADED	productive FPGA corrupted, fallback loaded
8	ZNZ84STATUS_FPGA_IRQ_ACTIVE	FPGA triggered a system monitor IRQ
9	ZNZ84_STATUS_FPGA_TIMEOUT_LOADING	FPGA loading timeout, e.g. old FPGA not triggering PROGBUS_FPGA_LOADED_GPIO
10	ZNZ84_STATUS_FPGA_INCOMPATIBLE_VERSION	FPGA version is not compatible with $\mu$ C version
11	ZNZ84_STATUS_MATRIX_FILE_ERROR	matrix.ini corrupted (inconsistent matrix.ini file)
20	ZNZ84_STATUS_FPGA_TEMPALARM	temperature alarm FPGA
21	ZNZ84_STATUS_VCC_AUX9_OUT_OF_RANGE	Voltage difference between -12 V and +6 V is out of range
22	ZNZ84_STATUS_VCC_AUX10_OUT_OF_RANGE	Voltage difference between -12 V and +5 V (2x6 Modules 1 and 2) is out of range
23	ZNZ84_STATUS_VCC_AUX11_OUT_OF_RANGE	Voltage difference between -12 V and +5 V (2x6 Modules 3 and 4) is out of range

## Remote control – commands

Error code	Error string	Description
24	ZNZ84_STA-TUS_VCC_AUX14_OUT-RANGE	Voltage difference between -9V7 and +3V3 (2x6 Modules 1 and 2) is out of range
25	ZNZ84_STA-TUS_VCC_AUX15_OUT-RANGE	Voltage difference between -9V7 and +2V5 (2x6 Modules 3 and 4) is out of range
26	ZNZ84_STA-TUS_VCC_AUX6_OUT-RANGE	Voltage difference between +1V0 and Ground is out of range
27	ZNZ84_STA-TUS_VCC_INT_OUTRANGE	Internal FPGA voltage of +1.2 V is out of range
28	ZNZ84_STA-TUS_VCC_AUX_OUTRANGE	AUX. FPGA voltage of +2.5 V is out of range

### 7.2.3 Identification

*IDN?.....	47
*OPT?.....	48
*SERial?.....	48

#### \*IDN?

**IDENTIFICATION QUERY** queries the instrument identification string.

#### Return values:

<ID\_Str> ROHDE&SCHWARZ,ZN-Z84-<opt>,<serial>,<fw version>, where  
 <opt> is the option characterizing the expansion stage, i.e. the highest required option; for instance, 02 for the Base Unit configuration (order no. 1319.4500.02) or 34 for the 4x18 expansion (highest order no. 1319.4969.34).  
 <serial> is the 6-digit serial number (see [Mini display](#) or SAP label on the rear panel).  
 <fw version> is the installed firmware version in "xx.yy" dotted decimal notation (xx: major version; yy: minor version).

**Usage:** Query only

**Manual operation:** See "[Identification String](#)" on page 61

**\*OPT?**

**OPTION IDENTIFICATION QUERY** queries the options contained in the instrument and returns a list of the installed options.

**Return values:**

<options>                   "/"-separated list of options, e.g. Installed Options: Basic/B22/B32 for the 2x18 extension.

**Usage:**                    Query only

**Manual operation:**    See "[Installed Options](#)" on page 61

**\*SERial?**

Returns the serial number of the instrument.


**Return values:**

<Value>                    6-digit serial number, see mini display and SAP label on the back panel

**Usage:**                    Query only

**7.2.4 LAN interface**

The following commands get/set the properties of the LAN interface.

 Modified LAN settings are not applied until `SET:LAN:INIT` is executed. To make the changes permanent, use `WRITE:MXINI`.

<code>SET:LAN:HOST:NAME</code> .....	49
<code>SHOW:LAN:HOST:NAME?</code> .....	49
<code>SHOW:LAN:MAC:ADDRESS?</code> .....	49
<code>SHOW:LAN:DHCP?</code> .....	49
<code>SET:LAN:DHCP:ON</code> .....	49
<code>SET:LAN:DHCP:OFF</code> .....	49
<code>SET:LAN:GW</code> .....	50
<code>SHOW:LAN:GW?</code> .....	50
<code>SET:LAN:IP</code> .....	50
<code>SHOW:LAN:IP?</code> .....	50



## Remote control – commands

SET:LAN:SNMask.....	50
SHOW:LAN:SNMask?.....	50
SET:LAN:INIT.....	51

**SET:LAN:HOST:NAME** <HostName>

**SHOW:LAN:HOST:NAME?**

Queries/sets the hostname of the switch matrix R&S ZN-Z84.

If the switch matrix uses DHCP and the DHCP server supports DHCP Option 12, the switch matrix can also be reached via this hostname.

**Parameters:**

<HostName>            The LAN hostname string (max. 20 characters).  
                               The default hostname is ZNZ84X<serial>.

**Manual operation:**    See "[Hostname](#)" on page 63

**SHOW:LAN:MAC:ADDRESS?**

Queries the LAN MAC address of the switch matrix R&S ZN-Z84.

**Return values:**

<MACAddress>        The LAN MAC address in the format  
                               xx-xx-xx-xx-xx-xx, e.g. 00-90-b8-1c-95-b9.

**Usage:**                Query only

**SHOW:LAN:DHCP?**

Queries whether DHCP is enabled.

**Return values:**

<DHCP>                1: DHCP enabled  
                               0: DHCP disabled (static IP configuration)

**Usage:**                Query only

**Manual operation:**    See "[IP Setting](#)" on page 63

**SET:LAN:DHCP:ON**

**SET:LAN:DHCP:OFF**

Enables/disables dynamic host configuration.

**Usage:** Event

**Manual operation:** See ["IP Setting"](#) on page 63

---

**SET:LAN:GW** <GWIP>

**SHOW:LAN:GW?**

Sets/queries the LAN default gateway.

Setting is only possible with static IP configuration ([SET:LAN:DHCP:OFF](#)). Otherwise the R&S ZN-Z84 answers with a "Deactivate DHCP first!"

**Note** that modified LAN settings are not applied until [SET:LAN:INIT](#) on page 51 is executed.

**Parameters:**

<GWIP> The IP address of the default gateway in dotted decimal format, e.g. 192.168.1.2.

**Manual operation:** See ["IP Address / Subnet Mask / Standard Gateway"](#) on page 63

---

**SET:LAN:IP** <IpAddr>

**SHOW:LAN:IP?**

Sets/queries the LAN IP address.

Setting is only possible with static IP configuration ([SET:LAN:DHCP:OFF](#)). Otherwise the R&S ZN-Z84 answers with a "Deactivate DHCP first!"

**Note** that modified LAN settings are not applied until [SET:LAN:INIT](#) on page 51 is executed.

**Parameters:**

<IpAddr> The LAN IP address in dotted decimal format, e.g. 192.168.0.254.

**Manual operation:** See ["IP Address / Subnet Mask / Standard Gateway"](#) on page 63

---

**SET:LAN:SNMask** <SnMask>

**SHOW:LAN:SNMask?**

Sets/queries the LAN subnet mask.

## Remote control – commands

Setting is only possible with static IP configuration (`SET:LAN:DHCP:OFF`). Otherwise the R&S ZN-Z84 answers with a "Deactivate DHCP first!"

**Note** that modified LAN settings are not applied until `SET:LAN:INIT` on page 51 is executed.

**Parameters:**

`<SnMask>` The LAN subnet mask in dotted decimal format, e.g. 255.255.255.0.

**Manual operation:** See "IP Address / Subnet Mask / Standard Gateway" on page 63

**SET:LAN:INIT**

Activates the previously configured LAN settings (DHCP, IP address, subnet mask, default gateway).

Use the `WRITE:MXINI` command to persist the LAN settings.

**Usage:** Event

**Manual operation:** See "Apply LAN settings (nonpermanent)" on page 64

**7.2.5 Routes**

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**ROUTE**

Creates a set of RF routes (connections from matrix VNA ports to matrix test ports) or queries the existing routes.

**Note** that during route creation,

- Existing routes are deleted
- Unconnected matrix test ports are terminated with a 50 Ω match

If the new route set was successfully created, the SET command returns the created routes exactly as the query would do.

## Remote control – commands

If the new route set is invalid, either because it is empty, involves non-existing ports or contains multiple routes for the same ports, an 1, "ROUTE ERROR" is returned and the existing routes are preserved.

**Parameters:**

<Routes> Non-empty, comma-separated list of routes [A-D][0-24], where each route is determined by a matrix VNA port [A-D] and its connected matrix test port [0-24], for example ROUTE A1,B2 connects matrix VNA Port A with matrix test port 1 and matrix VNA Port B with matrix test port 2. Matrix test port 0 means that the related matrix VNA port is "not connected"; in queries, both unequipped and unconnected matrix VNA ports are indicated as being connected to matrix test port 0.

**Example:** In a 2xN switch matrix create a single route between matrix VNA port A and matrix test port 1:

```
ROUTE A1
```

A subsequent Route? returns A1,B0,C0,D0.

```
ROUTE A0
```

deletes all routes.

**Manual operation:** See "[Routes / Reset](#)" on page 62

**SHOW:ROUTes?**

Returns the list of all possible routes

**Return values:**

Routes Comma-separated list of all possible routes.  
E.g., in the 2x6 base matrix, the return value is A1,A2,A3,A4,A5,A6,B1,B2,B3,B4,B5,B6.

**Usage:** Query only

**Manual operation:** See "[Routes / Reset](#)" on page 62

**7.2.6 Other****SHOW:DIRectcon:STATus?**

Queries the status of the Direct Control interface.

**Return values:**

<StatusCode>            Either 0, "D.C. not linked" or 1, "D.C. linked"

**Usage:**                    Query only

---

**WRITE:MXINI**

Writes the current user settings (LAN), to the matrix flash. These settings are loaded during instrument startup.

**Usage:**                    Event

**Manual operation:**    See ["Write all settings to ZN-Z84 \(permanent\)"](#)  
on page 64

## 8 Maintenance, storage and disposal

The switch matrix R&S ZN-Z84 does not require maintenance at regular intervals. Maintenance work is essentially limited to cleaning the instrument.

### 8.1 Cleaning

How to clean the product is described in "[Cleaning the product](#)" on page 10.

Do not use any liquids for cleaning. Cleaning agents, solvents, acids and bases can damage the front panel labeling, plastic parts and display.

### 8.2 Service work

Replacing modules and ordering spare parts is described in the service manual. There you will also find all the ID numbers required for ordering spare parts.

In addition, the service manual contains information on troubleshooting, repairs and replacing modules.

### 8.3 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.

### 8.4 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 8-1: 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.

## 9 Transporting

### Lifting and carrying

See:

- ["Lifting and carrying the product"](#) on page 8

### Packing

Use the original packaging material. It consists of antistatic wrap for electrostatic protection and packing material designed for the product.

If you do not have the original packaging, use similar materials that provide the same level of protection. You can also contact your local Rohde & Schwarz service center for advice.

### Securing

When moving the product in a vehicle or using transporting equipment, make sure that the product is properly secured. Only use items intended for securing objects.

### Transport altitude

Unless otherwise specified in the data sheet, the maximum transport altitude without pressure compensation is 4500 m above sea level.



## 10 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](http://www.rohde-schwarz.com/support), or follow this QR code:



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

# Annex

## A ZN-Z8x user tool

The "ZN-Z8x user" tool offers the following functions:

- Connect to the R&S ZN-Z8x switch matrix via USB
  - Select a detected switch matrix
  - Read its identification parameters (extension type, serial number, firmware version)
- Create and delete routes manually
- Send SCPI commands and read the responses
- Read and modify LAN Settings
- Read and modify LED settings for the available RF ports
- Monitor system parameters:
  - FPGA temperature
  - Voltages at certain reference points

### A.1 Software installation

The "ZN-Z8x user" tool can be installed on any PC running Windows 7 or higher. In the current version, Windows XP is also supported.

In addition to the requirements imposed by the operating system (e.g. see [Windows 7 system requirements](#)), you will need a spare USB port to establish a physical connection to the switch matrix.

Installation of the software is completely self-explanatory: run the `setup.exe` and follow the instructions of the installation wizard.

If not already available on the target PC, the wizard attempts to install the R&S ZN-Z USB BULK driver, which requires administrative privileges.

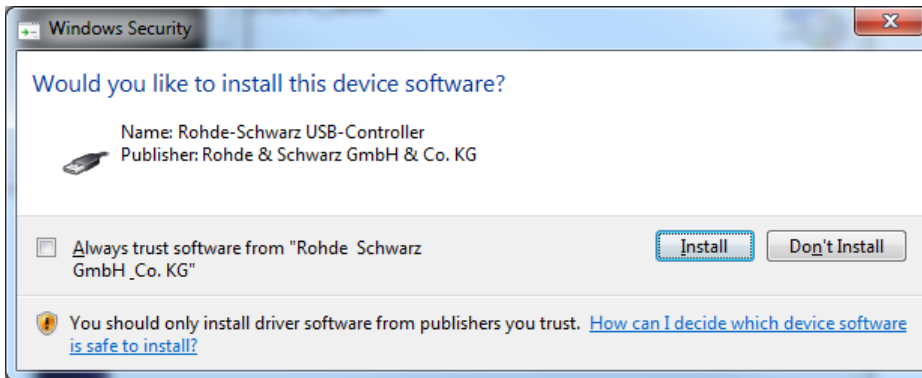
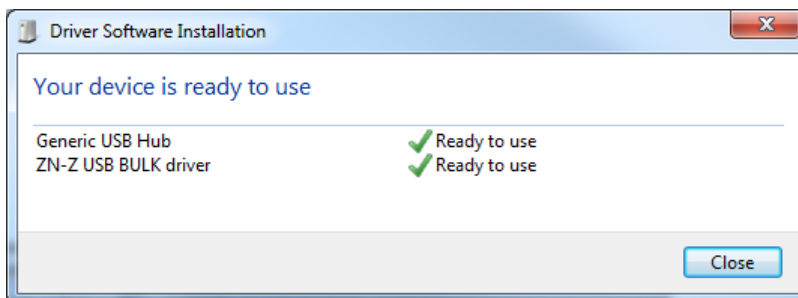


Figure A-1: USB device driver installation

## A.2 Getting started

1. Start the R&S ZN-Z84 as described in "To switch on the product" on page 21.
2. Connect the R&S ZN-Z84 via USB, as described in Chapter 3.7.1, "USB", on page 19.

When first connected to a particular USB port, the R&S ZN-Z84 is auto-detected by the operating system:



Note that the "Generic USB Hub" is only installed if the switch matrix is connected via its front USB port (see Chapter 4.1.6, "USB connector", on page 24).

3. Select "All Programs > Rohde-Schwarz > ZN-Z8x > ZN-Z8x user" from the Windows Start menu.

**Tip:** On an R&S ZNx, the ZN-Z8x user tool integrates into the "External Tools" softtool of the Vector Network Analyzer GUI ([APPLIC] hardkey or "System > External Tools" menu).

### Result

The "ZN-Z8x user" tool is started, and automatically connects to the detected switch matrix.

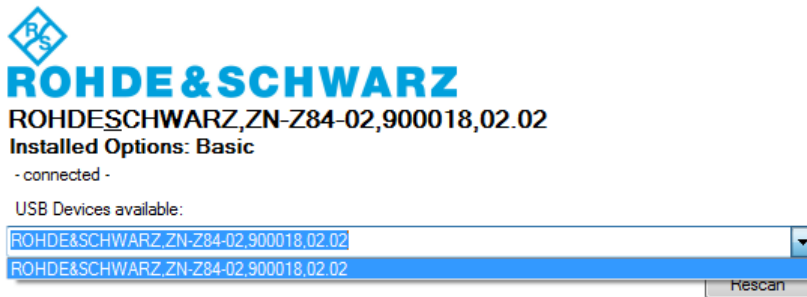


### A.3 Device panel

The panel above the tabs allows to select one of the available R&S ZN-Z8x and displays the basic properties of the selected device (extension type, serial number, firmware version).



After matrices have been connected or disconnected, the list of available devices must be updated manually using the "Rescan" button.



### Identification String

The line of text below the colored Rohde&Schwarz logo identifies a connected R&S ZN-Z84 by the following string:

ZN-Z84-<last two digits of highest option>, Serial: <serial number>, Version: <FW version>

Remote command:

\*IDN?

### Installed Options

This line of text lists the options that are installed on a connected R&S ZN-Z84.

Remote command:

\*OPT? on page 48

### USB Devices available / Rescan

Allows to select one of the detected switch matrices.



Use the "Rescan" button to refresh the list of detected switch matrices and to retrieve their properties.

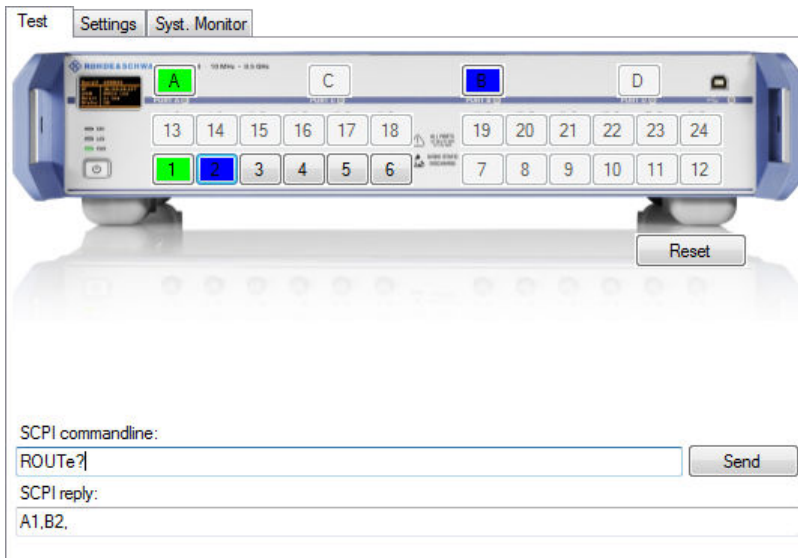
## A.4 Test tab

The Test tab allows to set up and delete matrix routes, to send SCPI commands to the switch matrix and to receive the command responses (if any).

The picture at the top of the tab visualizes the installed options: unequipped ports are greyed out and inactive.



Selecting a matrix in the **Device panel** automatically deletes the currently switched routes.



## Routes / Reset

Using the buttons overlaying the RF ports on the picture you can manually create and delete matrix routes. Existing routes are indicated in colors (see "[Color VNA Port A|B|C|D](#)" on page 64).

To create a route, first select one of the active VNA ports (A to D) and then one of the active test ports (1 to 24).

To delete a route, simply deselect (click) the corresponding test port or reuse one of its constituent ports in another route.

"Reset" deletes all existing routes.

Remote command:

`ROUTE`

`SHOW:ROUTEs?`

## A.5 Settings tab

The "Settings" tab allows to modify the LAN settings and the brightness and color of the RF port LEDs.

The screenshot shows the 'Settings' tab of the R&S ZN-Z84 user tool. It is divided into two main sections: 'LAN Settings' and 'Port-LED Settings'.

**LAN Settings:**

- IP Setting:** Radio buttons for 'DHCP' (selected) and 'Fixed IP'.
- IP Address:** Text input field containing '0.0.0.0'.
- Subnet Mask:** Text input field containing '255.255.255.0'.
- Standard Gateway:** Text input field containing '192.168.1.1'.
- Hostname:** Text input field containing 'ZNZ84X100055'.
- Buttons:** 'Apply LAN settings (nonpermanent)', 'Restore Factory Defaults (nonpermanent)', and 'Write all settings to ZN-Z8x (permanent)'.

**Port-LED Settings:**

- Brightness:** A horizontal slider control.
- Color VNA Port A:** A green button with 'change' text.
- Color VNA Port B:** A blue button with 'change' text.
- Color VNA Port C:** A red button with 'change' text.
- Color VNA Port D:** A yellow button with 'change' text.

## IP Setting

Select "DHCP" if the R&S ZN-Z84 receives its IP configuration via DHCP or "Fixed IP" if the IP configuration is assigned manually.

Use [Write all settings to ZN-Z84 \(permanent\)](#) to make the changes persistent.

Remote command:

```
SHOW:LAN:DHCP?
```

```
SET:LAN:DHCP:ON
```

```
SET:LAN:DHCP:OFF
```

## IP Address / Subnet Mask / Standard Gateway

Manual IP configuration (for "Fixed" [IP Setting](#)).

Use [Write all settings to ZN-Z84 \(permanent\)](#) to make the changes persistent.

Remote command:

```
SHOW:LAN:IP?
```

```
SET:LAN:IP
```

```
SHOW:LAN:SNMask?
```

```
SET:LAN:SNMask
```

```
SHOW:LAN:GW?
```

```
SET:LAN:GW
```

## Hostname

Gets/sets the R&S ZN-Z84's hostname (20 characters).

Remote command:

`SHOW:LAN:HOST:NAME?`

`SET:LAN:HOST:NAME`

### Apply LAN settings (nonpermanent)

Activates the (modified) LAN settings on the matrix.

Use the [Write all settings to ZN-Z84 \(permanent\)](#) function to make the changes persistent.

Remote command:

`SET:LAN:INIT` on page 51

### Brightness

Move the slider to modify the brightness of the RF port LEDs.

Use [Write all settings to ZN-Z84 \(permanent\)](#) to make the changes persistent.

### Color VNA Port A|B|C|D

Allows to set the colors for the available VNA ports.

If a route between a VNA port  $V$  and a test port  $T$  exists,  $T$  will be highlighted with  $V$ 's color.

Use [Write all settings to ZN-Z84 \(permanent\)](#) to make the color changes persistent.

### Restore Factory Defaults (nonpermanent)

Restores the LAN and LED settings to their default values and activates them.

Use [Write all settings to ZN-Z84 \(permanent\)](#) to make the changes persistent.

### Write all settings to ZN-Z84 (permanent)

Writes the current settings (LAN, RF port LEDs), to the matrix flash. These settings are loaded during instrument startup.

Remote command:

`WRITE:MXINI`

## A.6 System monitor tab

The "System Monitor" tab displays temperatures and voltages at certain reference points. In case of instrument malfunction provide by the requested values to the Rohde&Schwarz service.



Test	Settings	Syst. Monitor
Temperature (FPGA):	29,56 °C	
Max. Temperature (FPGA):	29,26 °C	
VCC int.	1,11 V	
VCC aux.	2,59 V	
VCC aux. 6	1,11 V	
VCC aux. 9	18,01 V	
VCC aux. 10	17,04 V	
VCC aux. 11	16,95 V	
VCC aux. 14	13,01 V	
VCC aux. 15	12,44 V	<input type="button" value="Update"/>

Use the "Update" button to retrieve the latest monitoring results from the selected R&S ZN-Z84.

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