

R&S® AFQ100A, R&S® AFQ100B

I/Q Modulation Generator

Supplement

The following description relates to the Operating Manuals, version 03 of R&S®AFQ100A, and version 01 of R&S®AFQ100B.

It encloses the following topics:

- LXI features, see [Chapter 1, "LXI \(R&S AFQ100B only\)"](#), on page 2.
- Note to the triggering when setting up several connected R&S AFQs, see [Chapter 3, "Setting Up Several Connected R&S AFQs"](#), on page 19
- Tight@VNC instead of Ultra@VNC, see [Chapter 2.1, "Remote Access via Tight@VNC"](#), on page 12
- Standard password for remote desktop connection, see ["Remote Access Password"](#) on page 12
- TRIGGER KEY functions, see [Chapter 2.3, "Activating Remote Desktop with the Trigger Key"](#), on page 18
- Using R&S VISA for remote control over LAN, see [Chapter 2.2, "Remote Control over LAN using VXI-11 Protocol"](#), on page 13



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1 LXI (R&S AFQ100B only)

Refers to "Configuring the R&S AFQ for Network Operation" in the Operating Manual.

1.1 LXI Configuration

LAN eXtensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB.

Like GPIB, LXI determines and standardizes the way the instrument behaves in a LAN. The LXI implementation by the Rohde & Schwarz Signal Generators allows you to change certain LAN settings, to reset the LAN connection as well as to easily identify the instrument.



For information about the LXI standard refer to the LXI website at <http://www.lxistandard.org>. See also "News from Rohde & Schwarz, article 2006/II - 190".

The R&S AFQ complies with LXI and provides an integrated "LXI Status" dialog for LXI status indication and reset of the LAN configuration (LAN Configuration Initialize, LCI). To access the LXI Status dialog, press the SETUP key and select "Remote > LXI Status".

For further information, see [Chapter 1.2, "LXI Status"](#), on page 10.



Firmware update

After a firmware update, shut-down and re-start the instrument in order to enable the full LXI functionality.

Default state of the network settings

According to the LXI standard, an LCI must set the following parameters to a default state.

Parameter	Value
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled
ICMP Ping	Enabled
Password for LAN configuration	LxiWebIfc

The LCI for the R&S AFQ also resets the following parameters:

Parameter	Value
Hostname	<Instrument-specific host name>
Description	Vector Signal Generator
Negotiation	Auto Detect
VXI-11 Discovery	Enabled

The LAN settings are configured using the instrument's .

1.1.1 LXI Browser Settings

The instrument's LXI browser interface works correctly with all W3C compliant browsers.

Typing the instrument's host name (LAN device name) or IP address in the address field of the browser on your PC opens the "Instrument Home Page" (welcome page).

To access the instrument via the web browser:

- ▶ Type in the instrument's host name or IP address in the address field of the browser on your PC, for example *http://10.111.10.205*.

Tip: The specific IP address (host address / instrument name) is used by the controller programs to identify and control the instrument. It is automatically assigned by the DHCP server the first time the instrument is registered on the network. The host name is usually composed of the instrument name and the serial number: *<instrument name><serial number>*, e.g. *RSAFQ100B1000011*.

Note: Do not add the missing zeros in the IP address, while opening the instrument home page.

The instrument home page (welcome page) opens.

The screenshot shows the LXI Instrument Properties page. The navigation menu on the left includes: Home, Lan Configuration, Status, Utilities, Instrument Control (with sub-items: Web Control, File Download, File Upload), Diagnostics (with sub-items: Device Screenshot, SCPI Remote Trace, SCPI Command Shell), and Help (with sub-items: Glossary, www.rohde-schwarz.com). The main content area displays the following information:

Instrument Model	R&S AFQ100B
Manufacturer	Rohde & Schwarz GmbH & Co. KG
Serial Number	100011
Description	Rohde & Schwarz Baseband Signal Generator AFQ100B 100011
LXI Version	1.4 LXI Core 2011
LXI Extended Features	
DNS Host Name(s)	instrument
MAC Address	00:25:64:C3:31:82
IP Address	10.111.10.205
Firmware Revision	02.15.231.65
Current Time	Wednesday, 2015/12/02, 11:54:06
Current Time source	Operating System
VISA resource string	TCPIP::10.111.10.205::inst0::INSTR TCPIP::10.111.10.205::hislip0::INSTR
Device Indicator	<input type="button" value="ACTIVE (press to toggle)"/> ●

At the bottom, there is a "Status" section showing "No error" and a copyright notice: "© 2015 ROHDE&SCHWARZ. All rights reserved."

The "Instrument Home Page" displays the device information required by the LXI standard including the VISA resource string in read-only format.

The navigation pane of the browser interface contains the following elements:

- "LXI"
 - "Home" opens the instrument home page.
The home page displays the device information required by the LXI standard, including the VISA resource string in read-only format.
 - "Device Indicator" activates or deactivates the LXI status indication.
When activated, the LXI LEDs flash, both in the browser dialog and in the LXI dialog of the connected instrument. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates that no LAN cable is connected.
 - "Lan Configuration" allows you to configure LAN parameters and to initiate a ping, see [Chapter 1.1.2.3, "Ping Parameter"](#), on page 7.
 - "Status" displays information about the LXI status of the instrument.
 - "Utilities" provides access to the LXI event log functionality required by the LXI standard.
- "Instrument Control"
 - "Web Control" provides remote access to the instrument, see [Chapter 1.1.2.4, "Web Control"](#), on page 8.
- "Diagnostics"
 - "SCPI Remote Trace" records messages exchanged via the remote control interface, see [Chapter 1.1.2.5, "SCPI Remote Trace"](#), on page 9.
- "Help"
 - "Glossary" explains terms related to the LXI standard.
 - www.rohde-schwarz.com opens the Rohde & Schwarz home page.

- ▶ Press the "Inactive (press to toggle)" button to activate the connection.

ACTIVE (press to toggle)



A green flashing status LED indicates the active connection. If the LAN connection fails, the LED turns red.

The status of the LAN connection is also indicated by the "LAN Status indicator" in the "LXI Status" dialog.

The "Device Indicator" setting is not password-protected.

For further information, see section [Chapter 1.2, "LXI Status"](#), on page 10.

The navigation pane of the browser interface contains the following control elements:

- "LAN Configuration" opens the LAN Configuration page.
- "LXI Glossary" opens a document with a glossary of terms related to the LXI standard.
- "Status" displays information about the LXI status of the instrument.

1.1.2 LAN Configuration

The "LAN Configuration" web page provides access to the parameters required for identifying the R&S AFQ in the network, and allows modification.



Password protection

Changing the LAN configuration is password-protected. The default password is *Lxi-WebIfc* (notice upper and lower case characters). This password cannot be changed in the current firmware version.

It comprises the following navigation entries.

- [IP Configuration](#)..... 5
- [Advanced LAN Configuration](#).....6
- [Ping Parameter](#)..... 7
- [Web Control](#)..... 8
- [SCPI Remote Trace](#)..... 9

1.1.2.1 IP Configuration

The "IP Configuration" page displays all mandatory LAN parameters.

The screenshot shows the LXI configuration web interface. The left sidebar contains navigation menus for LXI, Lan Configuration, Instrument Control, Diagnostics, and Help. The main content area is titled "LAN Parameters" and contains the following fields:

Hostname	<input type="text" value="rsafq100b1000011"/>	Attention! Changing the hostname reboots the device!
DNS Hostname(s)	<input type="text" value="rsafq100b1000011.rsint"/>	
Domain	<input type="text" value="rsint.net"/>	
Description	<input type="text" value="AFQ (02.15.x.x) 000000"/>	
IP Address Mode	<input type="text" value="DHCP + Auto IP Address"/>	
IP Address	<input type="text" value="10.111.10.205"/>	
Subnet Mask	<input type="text" value="255.255.0.0"/>	
Default Gateway	<input type="text" value="10.111.0.1"/>	
Obtain DNS Server Address automatically	<input checked="" type="checkbox"/>	
DNS Server(s)	<input type="text" value="10.0.2.166"/>	<input type="text" value="10.0.23.159"/>
Register Device at DNS Server dynamically	<input checked="" type="checkbox"/>	
HISLIP Port	<input type="text" value="4880"/>	

At the bottom of the form is a "Submit" button and a password field with the label "(Password required)".

Below the form, the "Status" section shows "No error".

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The "IP Address Mode" selects a configuration mode for the IP address of the R&S AFQ. With static configuration, the entered IP address, subnet mask, and default gateway are used. With dynamic configuration, DHCP or dynamic link local addressing (automatic IP) are used to obtain the instrument IP address.

1.1.2.2 Advanced LAN Configuration

The "Advanced LAN Configuration" menu provides LAN settings that are not declared mandatory by the LXI standard.

The screenshot shows the LXI configuration web interface. The left sidebar contains navigation menus for LXI, Lan Configuration, Instrument Control, Diagnostics, and Help. The main content area is titled "LAN Parameters" and contains the following fields:

mDNS and DNS-SD	<input type="text" value="mDNS & DNS-SD"/>	
ICMP Ping enabled	<input checked="" type="checkbox"/>	
VX1-11 Discovery	<input checked="" type="checkbox"/>	

At the bottom of the form is a "Submit" button and a password field with the label "(Password required)".

Below the form, the "Status" section shows "No error".

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The following advanced parameters are available:

- "mDNS and DNS-SD": The additional protocols "multicast DNS" and "DNS service discovery" are used for device communication in zero configuration networks, working without DNS and DHCP.
- "ICMP Ping enabled": Must be enabled to use the ping utility. If you disable this setting, the instrument does not answer ping requests. The setting does not affect the LXI ping client. You can ping other hosts from the instrument, even if the setting is disabled.
- "VXI-11 Discovery": Must be enabled to detect the instrument in the LAN. If you disable this setting, the instrument cannot be detected by the VXI-11 discovery protocol mechanism. The setting does not affect other detection mechanisms. Setting up a VXI-11 connection via the IP address or the host name is independent of this setting.

1.1.2.3 Ping Parameter

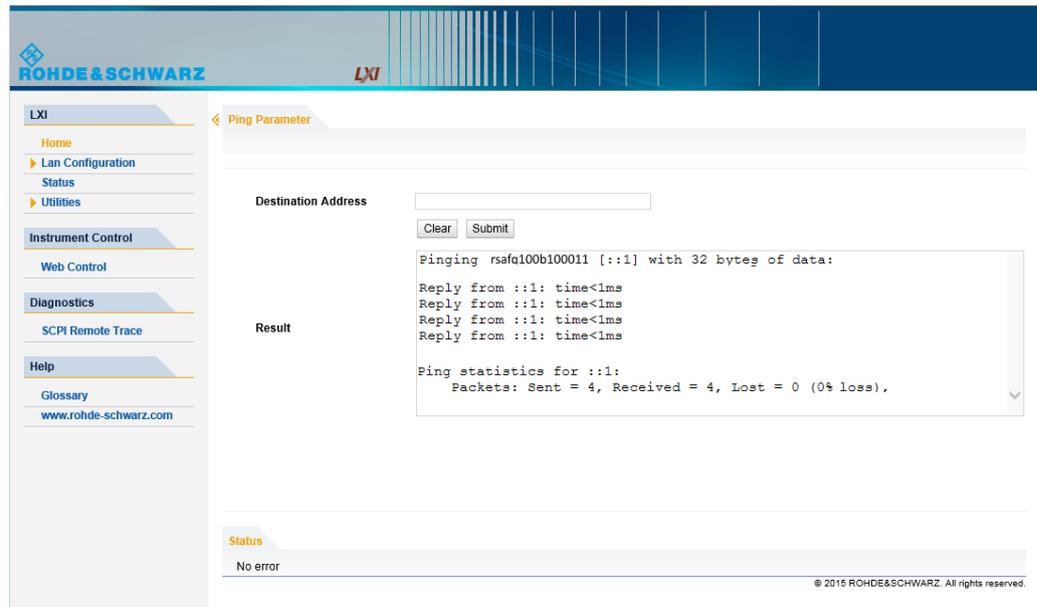
The "Ping Client" page provides the ping utility to verify the connection between the LXI-compliant instrument and another device.

The ping is initiated from the instrument. Using the `ICMP` echo request and echo reply packets, the function checks whether the communication with a device via LAN works. Ping is useful for the diagnosis of IP network or router failures.

The ping utility is not password-protected.

To initiate a ping from the instrument to the device:

1. Enable "ICMP Ping" on the "Advanced LAN Configuration" page (enabled after an LCI).
2. Select the "Ping Client" page.
3. In the "Destination Address" field, enter the IP address of the device to be pinged (without the ping command and without any further parameters), e.g. `10.111.10.203`.
4. Select "Submit".



1.1.2.4 Web Control

The web control functionality provides remote operation via VNC using a Web browser (with HTML5). This mode does not require additional installation or activation. The VNC protocol allows simultaneous operation from several remote devices. The instrument remains locally operable.

The GUI of the R&S AFQ is visible. To perform the settings, you can operate the instrument as with the manual control. The instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available.

Starting a Remote Control via the LXI web browser

This section assumes that the instrument and the controller PC are connected in the LAN.

1. Start a web browser that supports html5 (W3C compliant).
2. Enter the IP address of the R&S AFQ in the browser's address bar.
The R&S AFQ's welcome page is displayed.
3. In the navigation pane, select "Instrument Control" > "Web Control".
Remote access to the instrument requires the password. The default password is *instrument*.
4. Enter the password and confirm with the ENTER key.
After the connection is established, the current screen of the R&S AFQ is displayed in the browser window.

- Use the mouse cursor and keyboard to access the functionality of the instrument as you would directly perform the settings on the instruments front panel.

1.1.2.5 SCPI Remote Trace

The remote trace functionality allows you to trace input and output strings at the remote control interface of the R&S AFQ.

A recorded trace (message log) can be evaluated directly in the dialog. Use the highlighting and navigation functions provided in the lower toolbar to locate error messages and messages containing arbitrary search strings. You can also export the message log to a *.CSV file and evaluate the file using a suitable program.

To trace and display messages:

- In the navigation pane, select "Diagnostics" > "SCPI Remote Trace".
- In the toolbar bar of the "SCPI Remote Trace" page, select "live mode" > "on" and "logging" > "on".
"live mode > on" displays all commands and responses, and "logging > on" also traces messages.
- If you now control the instrument with SCPI commands, using an appropriate tool, the SCPI remote trace records the information sent and received.

The screenshot shows the LXI SCPI Remote Trace interface. The left sidebar contains navigation options: Home, Lan Configuration, Status, Utilities, Instrument Control, Web Control, Diagnostics (with SCPI Remote Trace selected), and Help. The main area displays the SCPI Remote Trace page with a toolbar for live mode, logging, filter, log file, refresh, download, clear, and details. Below the toolbar is a table of recorded messages:

rec	MT	message
0	>	!idn?
0	<	Rohde&Schwarz, <instrument,12345,67890>
0	>	!opt?
0	<	0
0	>	Freq?
0	<	1000000000
0	>	LEV -20
0	>	LEV?
0	<	-20

Below the table, a status bar indicates "20 live records received". The footer contains the copyright notice: "© 2015 ROHDE&SCHWARZ. All rights reserved."

The function records all sent commands, received responses and messages, and stores them in an internal database. If "live mode" is disabled, you can display the recent traces upon request, using the "refresh" button. You can also store the log in a file.

Note: The diagnostics functionality will be extended in later releases, e.g. to download or upload SCPI command files from / to the instrument.

Toolbars

The toolbar at the top of the dialog provides basic settings and functions.



- "Live mode" / "logging": If logging is switched on, messages are traced. They are stored in an internal database and can be displayed upon request, using the refresh button (live mode off) or they can be displayed automatically (live mode on).
- "Filter": applies a filter to columns and/or rows when working (live mode off)
- "Refresh": reads the message log from the internal database and displays it
- "Download": stores the SCPI trace log to a *.CSV file
- "Clear": deletes all message log entries in the database and on the screen
- "Details": displays details of the selected message, for example an SCPI command in hex format (also possible by double-clicking a message)

Columns

The following columns are available if no column filter is applied:

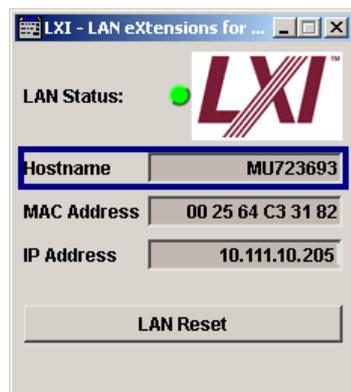
- "Rec": record number of the message within the message log
- I: number of the subinstrument
- "MT": indicates the type of the message. Possible values and related message contents are:
 - > = incoming command
 - < = outgoing response to a query
 - E = error message, highlighted by red color
 - T = execution time, i.e. time required by the instrument to process the command internally
- "message": indicates the type of the message. Possible values and related message contents are:
 - > = incoming command
 - < = outgoing response to a query
 - E = error message, denoted in red
 - T = execution time, i.e. time required by the instrument to process the command internally

1.2 LXI Status

Refers to "General Instrument Settings > Setup Key" in the Operating Manual.

The "LXI - LAN eXtensions for Instruments - Status..." dialog displays the settings and status of the LAN and allows to reset the LAN connection.

For more information about LXI, see [Chapter 1.1, "LXI Configuration"](#), on page 2.



LAN Status

The LED indicates the LXI status.

The LAN Status is also indicated with the LED "LAN Status" on the front panel of the instrument.

"green"	normal operation
"green (flashing)"	device identification
"red"	LAN fault

LAN Reset

Initiates the network configuration reset mechanism for the instrument and resets the hostname, MAC address, and IP address.

Alternatively, the LAN RESET button on the front panel of the instrument can be used. To initiate the network configuration reset, press the button longer than 4 sec and wait for the signal tone.

See ["Default state of the network settings"](#) on page 2 for information on the reset parameters.

To open the "Instrument Home Page" (welcome page), type the instrument's computer name (host name) or IP address in the address field of the browser on your PC, e.g. `http://10.111.10.205`.

Note: A LAN reset may require an instrument reboot.

2 Remote Control

Refers to "Putting into Operation > Manual Remote Control via an External Controller" in the Operating Manual.



As an alternative to remote control using programmed commands, the R&S AFQ can also be manually controlled from a remote location via remote access, or remote desktop.

These operating modes are fundamentally different, even though they are often seen as interchangeable:

- **Remote Desktop**
In this mode, a Windows desktop connection from the remote computer (external controller) and the R&S AFQ is established and you can set your application as with manual operation.
- **Remote Access**
In this mode, the instrument is accessed from an external controller via a LAN connection, using a standard Web browser and the common cross-platform technology VNC (Virtual Network Computing). While the instrument is in operation, the user interface of the instrument is displayed on the remote computer, and VNC provides access to all of the applications files and network resources of the instrument.
The remote computer requires the VNC client, either as a stand-alone program or as a plug-in for a browser.
- **Remote Control**
In this mode, all settings are configured from a remote PC using remote control commands. The GUI of the instrument is not displayed. Remote control commands can be executed either individually, or you can also create programs for repeating applications, that are performed faster than with manual operation and are always reproducible.

2.1 Remote Access via Tight@VNC

Refers to "Configuration for Manual Remote Control" in the Operating Manual.

Instead of the remote access via Ultra@VNC, the R&S AFQ allows you to remotely control the instrument via the program Tight@VNC, an open source desktop software application. It uses extended VNC RFB protocol, and additionally features e.g. listening mode or password protection.

The software and additional information is available at the <http://tightvnc.com/> website.

For the setting up and operating, you can proceed similarly as described to Ultra@VNC in the manual.

Remote Access Password

The default password for remotely accessing the R&S AFQ is *instrument*.

1. To change the password, click the VNC icon in the windows task bar and select "Properties".



In the properties dialog, you can set your own password.

2. Enter the new password and confirm with "OK"

2.2 Remote Control over LAN using VXI-11 Protocol

Refers to "Remote Control Basics" > "Switchover to Remote Control" > "Remote Control over LAN Interface". "Remote Control over LAN using VXI-11 Protocol" substitutes the description of "Setting up Control of the R&S AFQ in the 'Measurement & Automation Control' Program" in the user manual.



Rohde & Schwarz provides the standardized I/O software library R&S VISA for communication via TCP/IP (LAN: HiSlip, VXI-11 and raw socket) or USB (USBTMC) interfaces.

R&S VISA is available for download at the Rohde & Schwarz website <http://www.rohde-schwarz.com/rsvisa>.

In this example, the R&S VISA software library is used to set up a LAN remote control link and remotely control the R&S AFQ. R&S VISA is running on a controller PC with Windows operating system. When the connection is set up you can send commands to the instrument, and receive the responses.

The remote control connection requires a VISA installation but no additional hardware on the controller PC. The LAN I/O channel is selected at initialization time using the VISA resource string (also referred to as "address string"). A VISA alias (short name) is used to replace the complete resource string. The host address is either the R&S AFQ's hostname or IP address. See "Remote Control Basics" > "Switchover to Remote Control" > "Remote Control via LAN Interface" in the user manual of the R&S AFQ.



In this example, it is assumed that:

- A LAN remote control link between the controller and the R&S AFQ is already set up.
- The R&S VISA program is installed on the remote PC, see "<http://www.rohde-schwarz.com/rsvisa> > RS VISA Release Notes".

Configuring the controller

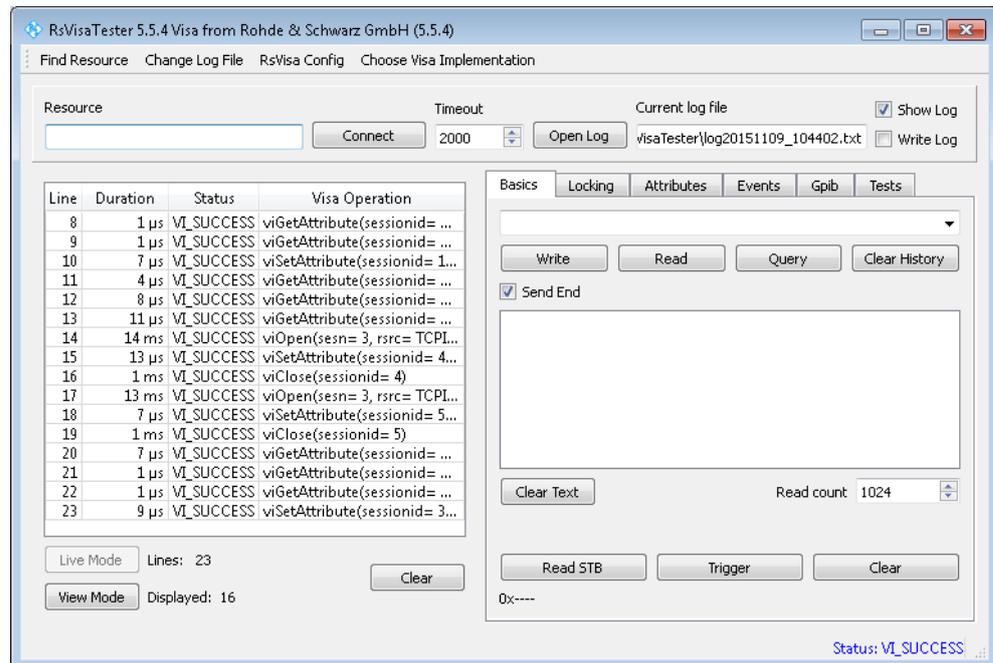
To remote control the R&S AFQ, we use the R&S VISA Tester application.



The instrument is preconfigured for networks using DHCP (dynamic host configuration protocol). If this configuration is used, enter the computer name in the position of the IP address.

To enable the external controller to communicate with the R&S AFQ via TCP/IP protocol, set up a remote control link as follows:

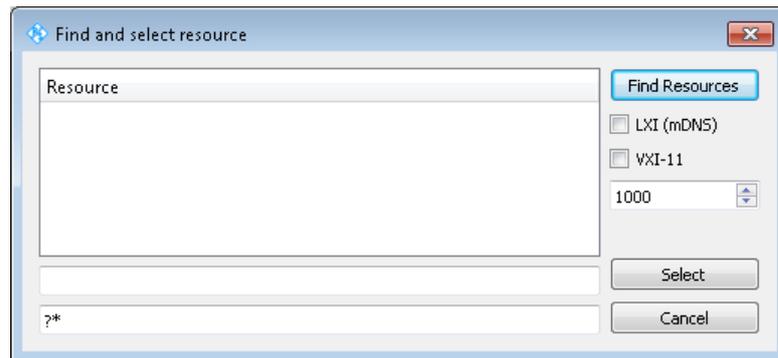
1. Make sure that the controller and the instrument are connected in the network (network cable) and switched on.
2. On the controller, start "R&S VISA > Tester 32bit" or "R&S VISA > Tester 64bit", respectively.



3. In the menu bar, select "Choose VISA Implementation > Rohde & Schwarz Visa".



4. Select "Rohde & Schwarz Visa" and confirm with "OK".
5. In the menu bar, select "Find Resource" to search for the instrument in the LAN.

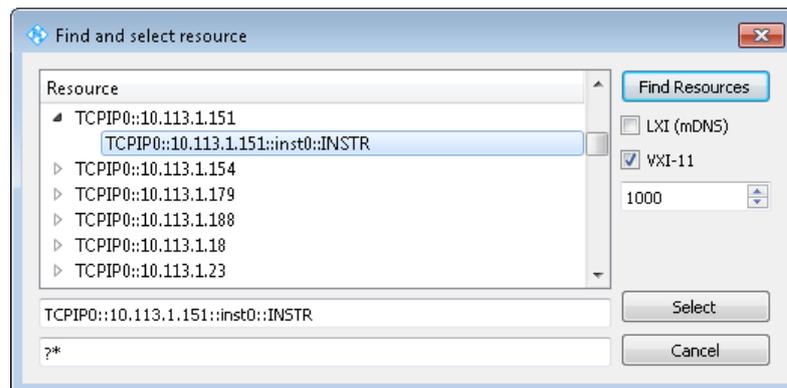


6. Select "VXI-11" and "Find Resources".

R&S VISA scans the network for connected instruments and lists all detected instruments in the "Resource" list.

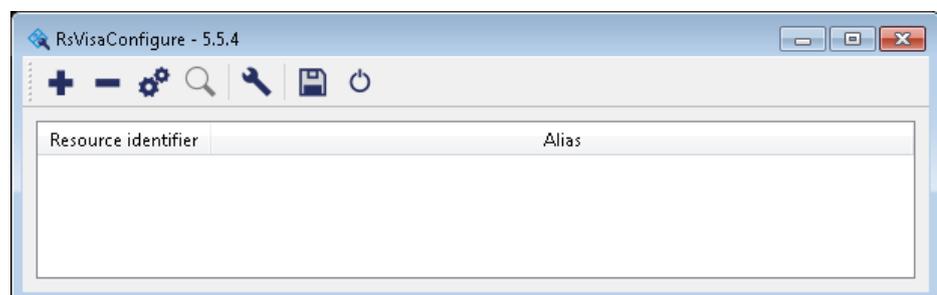
Note: The search may take some time, particularly in large networks.

7. Select the required instrument and confirm with "Select".



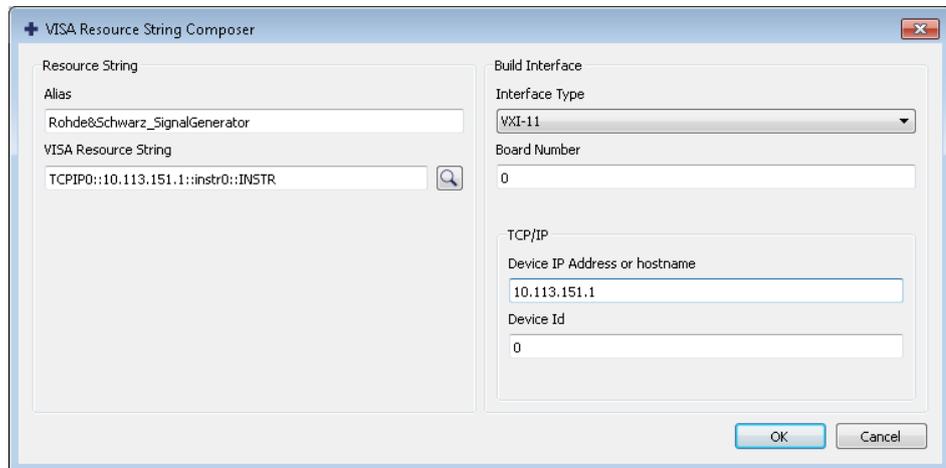
The "Find and select resource" dialog closes and R&S VISA indicates the instrument's IP address in the "Resource" field of the main application window.

8. As an alternative to the IP address, you can assign an alias name to the R&S AFQ:
 - a) In the menu bar, select "RsVisaConfig".

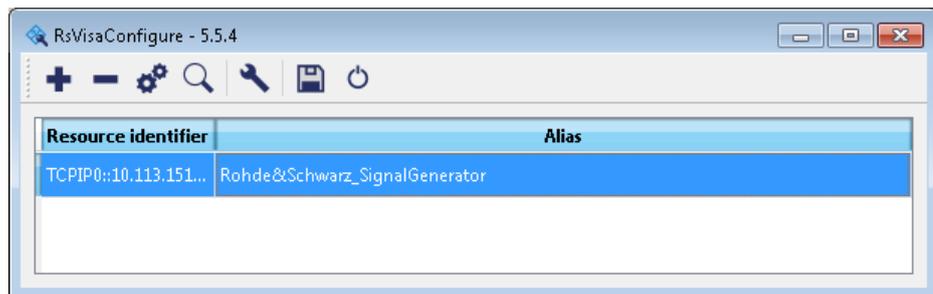


- b) In the toolbar, select "+" to access the "VISA Resource String Composer".

- c) Fill in the "Alias" name, the "VISA Resource String" and the "Device IP Address or host name" as shown in the figure, and confirm with "OK".



The "Alias" name is assigned to the instrument.



- d) Close the dialog.
The R&S AFQ is now registered in the program and can be addressed via the resource string or alias name.

9. In the main window, select "Connect".

R&S VISA establishes the connection to the R&S AFQ.

Now you can send settings to configure the instrument and receive its responses.

Note: If the connection cannot be set up, R&S VISA displays an error in the log view.

Check whether the controller and the instrument are connected to the network (network cable) and switched on. Correct spelling of the IP address or the computer name can also be checked. For further error location, inform the network administrator. In large networks, specification of additional addresses may be required for link setup, e.g. gateway and subnet mask, which are known to the network administrator.

For further information on the functions to read and write to an open session, as well as the utility applications the software provides, see the R&S VISA User Manual.

Starting a remote control over LAN (using VXI-11)

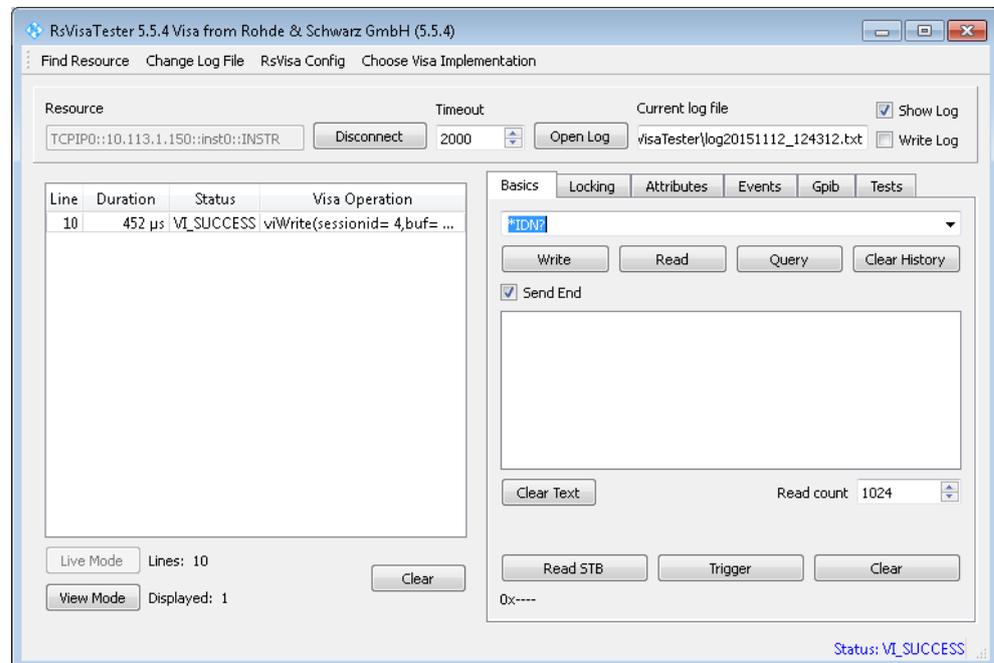
To set the instrument to remote control, you can use the addressed command `>R`, or send any command from the controller.

1. Start the R&S VISA Tester and establish the connection to the R&S AFQ, see ["Configuring the controller"](#) on page 13.
2. In the R&S VISA "Basics" tab, enter a SCPI command, e.g. `"*IDN?"` and confirm with "Query".

The instrument is switched to remote control when it receives a command from the controller.

Tip: Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

3. Select "Read" to obtain the instrument response.



Tip: If the "Show Log" checkbox is checked R&S VISA displays each VISA function call in the log-view on the left. If you check the "Write Log" checkbox the log-view entry is written to the log file as well. You can operate the log-view in two modes: the "Live Mode" shows only the most recent messages whereas the "View Mode" allows you to scroll the history.

4. To set, e.g. the frequency, enter `SOURCE:STAT 1` and select "Write".
To check the performed setting, select `SOURCE:STAT?"` "Read".
The instrument response is 1, i.e. the ARB generator is switched on.

While remote control is active, the REMOTE status LED on the front panel indicates that the instrument is in remote control mode. The operation via the front panel or via mouse and keyboard are locked, allowing a remote control program to be performed without interruption.

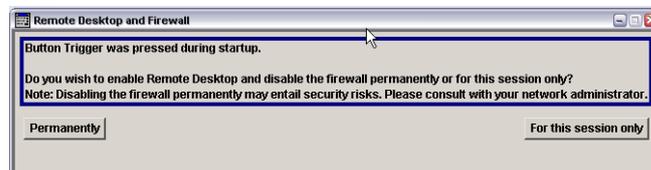
5. Although operation via front panel, mouse and keyboard is disabled, the dialog boxes can still be opened, for example to verify settings. The buttons and setting fields are grayed out and cannot be activated.
Additionally, you can disable the access to the dialogs with the command `SYST:KLOC ON` to protect the instrument against unauthorized readings.
6. To prevent unintentional return to manual operation, use the command `&LLO` (see section "VXI-11 Interface Messages" in the operating manual).
The instrument switches to "REM-LLO" state.
The automatic transition from local state to remote state by a subsequent remote command, and the command `*GTL` are disabled.
To return to manual mode is only possible via remote control.
7. To return to manual operation send the interface command `>L`.
Note: Before returning to manual control, command processing must be completed. Otherwise, the instrument switches back to remote control immediately.
Use the `>R` to disable the "REM-LLO" state.

2.3 Activating Remote Desktop with the Trigger Key

Refers to "Trigger Key" in the Operating Manual.

Apart from triggering and LAN reset, the trigger key also enables you to activate remote desktop operation:

- Pressing short triggers manually
- Pressing long executes an LXI (LAN) reset
- Pressing the trigger key during startup (while the LEDs are flashing) enables you to modify the firewall settings, and temporarily enables access to the instrument via remote desktop.
The start screen of the instrument software displays a dialog which allows you to enable remote desktop operation either permanently or for the current session only.



Refer also to chapter *Putting into Operation > Booting the R&S AFQ* in the Operating Manual.

3 Setting Up Several Connected R&S AFQs

Refers to "Setting Up Several Connected R&S AFQs for Precise Simultaneous Signal Output" in the Operating Manual.



When setting up several connected instruments, the master R&S AFQ must be triggered externally.
