

# R&S®Forum Application for Remote Control of Rohde & Schwarz Instruments

## Application Note

This application note describes how to use R&S Forum to remotely control Rohde & Schwarz Test and Measurement instruments by the means of Python scripts or interactive console communication.

The Application Note **does not focus** on Python language. It provides several ready-to-use examples in the attachment. To discover full capabilities of Python, please refer to the large online community discussing Python-related topics.

If you are new to the subject of instrument remote control, we recommend reading the following tutorial, where you can find additional R&S Forum examples:

[R&S Instrument Drivers and Remote Control](#)

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### Note:

Please find the most up-to-date Application Note on our homepage:

[www.rohde-schwarz.com/appnote/1MA196](http://www.rohde-schwarz.com/appnote/1MA196)

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# 1 Introduction

R&S Forum is a free tool based on Python scripting language specially designed for remote control of Test and Measurement instruments. For instrument communication, it uses Python package called PyVISA.

R&S Forum key features are:

- Console for interactive communication with your instrument.
- Full power of Python scripting language for writing simple or complex scripts.
- Quick assignment with which instrument should a script or a macro be executed.
- Scripts can be executed in debug, normal or high speed mode.
- Automatic logging of the entire remote-control communication.
- Dedicated interactive window similar to RsVisaTester or NI VISA Test Panel.
- SCPI Commands Tree - all supported SCPI commands can be read from your instrument

## 2 Installation

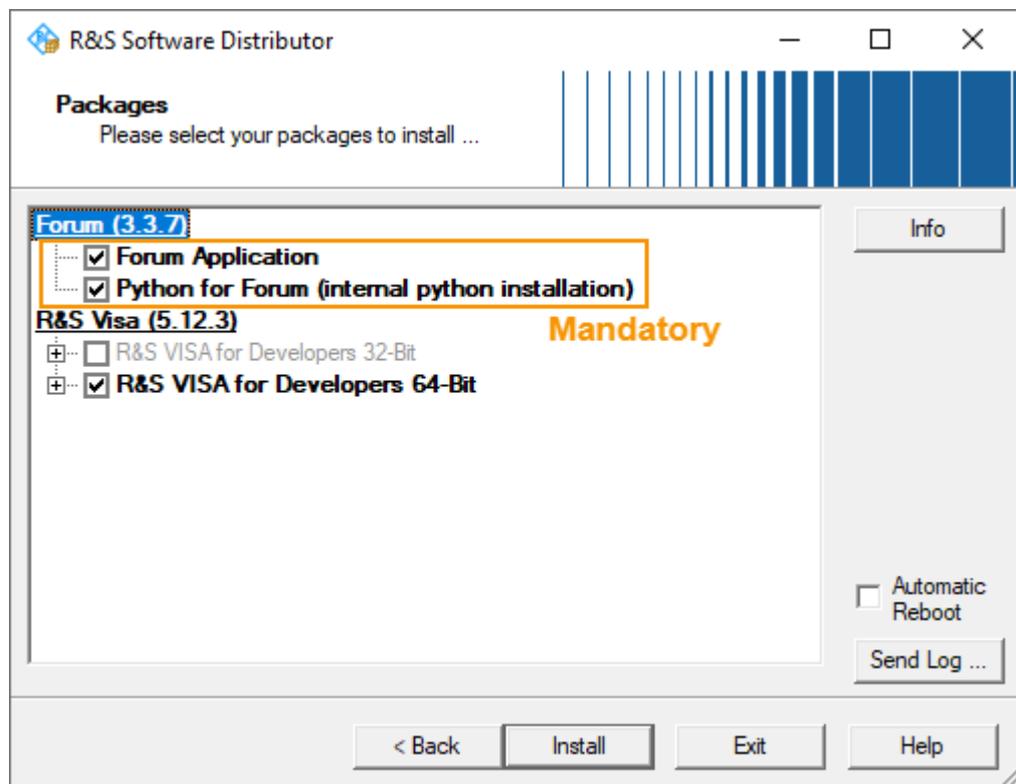
R&S Forum installs its own Python interpreter including all necessary packages. It does not interfere with your already installed Python interpreters.

Supported Win OS: Windows 10

Supported Mac OS: OS X Mavericks 10.9, El Capitan 10.11, HighSiera 10.13, Catalina 10.15

For this application note, we use Windows 10 64-bit and R&S Forum version 3.3.7

To install R&S Forum, download and start the `Forum_Setup_xxx.exe` file that is available on the application note's website:



The Setup installs the following components:

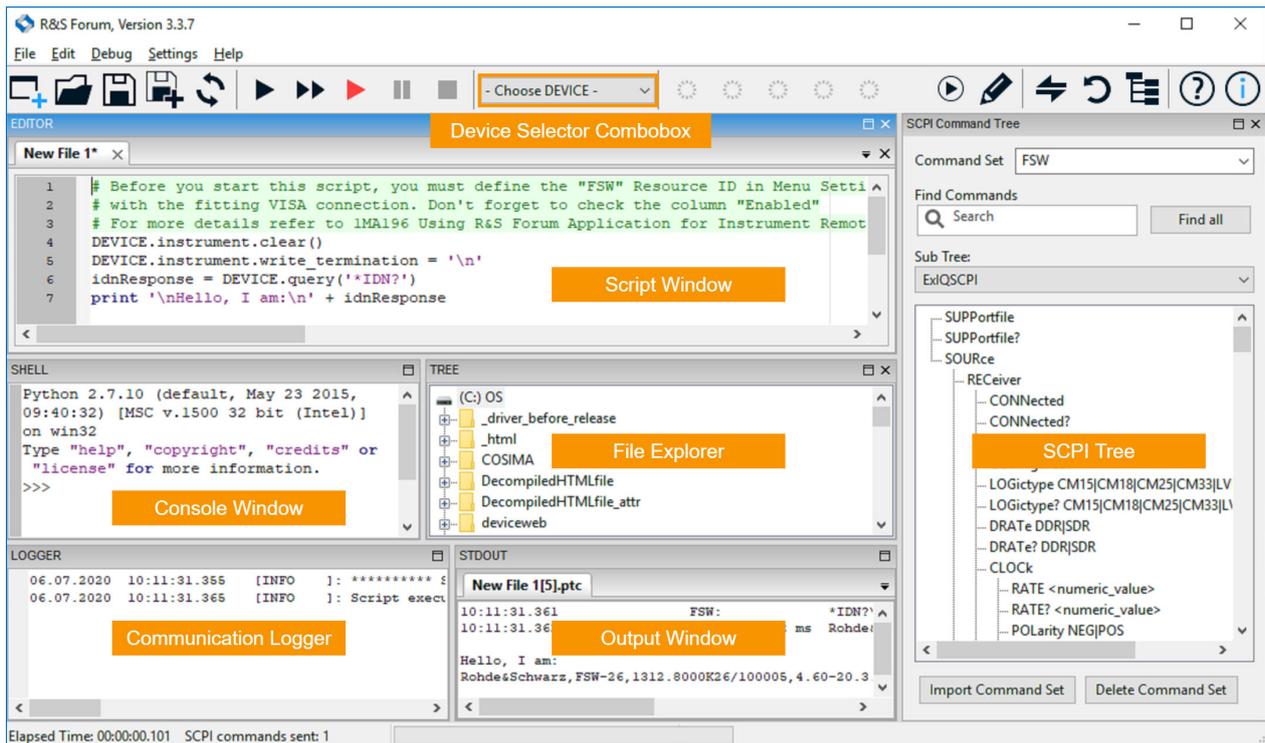
- R&S Forum application
- Python 2.7.10
- Python PyVISA package 1.8
- R&S VISA - on 64-bit OS, the 64-bit package contains both 32-bit and 64-bit DLLs. R&S Forum allows you to select the VISA implementation. See [Chapter 10.2, "R&S Forum, VISA and GPIB Interface"](#), on page 14

## 3 R&S Forum Main Window

Start R&S Forum: Windows Start Menu -> R&S Forum



You can rearrange all the windows based on your preference. To get back to the standard layout, use the shortcut **CTRL+L**.



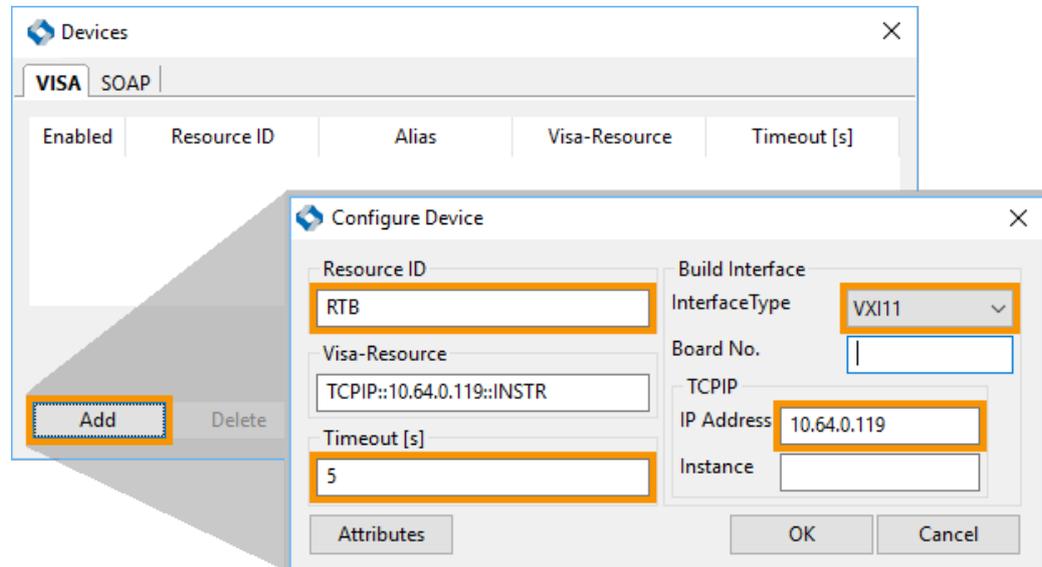
Windows description:

- **Script Window:** Window containing R&S Forum scripts.
- **File Explorer:** Use it to browse for scripts.
- **Communication Logger:** Information about different events, e.g. script start time, stop time, or command execution duration.
- **Console Window:** Python Console for interactive execution.
- **Output Window:** Python Standard output window.
- **SCPI Tree:** SCPI commands read from the instrument

**Device Selector Combobox** is a control used in Script Window, Console Window, and Macros for specifying target instrument if you use a general `DEVICE` keyword (see Tip at the end of [Chapter 5, "Console Window"](#), on page 8).

## 4 Adding New Instrument

Go to the Menu item `Settings -> Instruments` and use `Add`

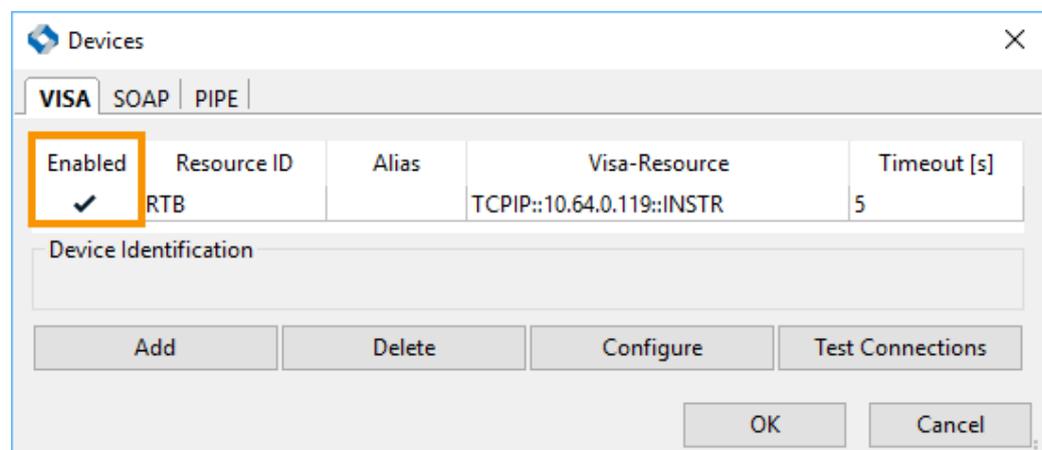


Edit the highlighted fields, **Visa-Resource** field is composed automatically. Keep the following editing order:

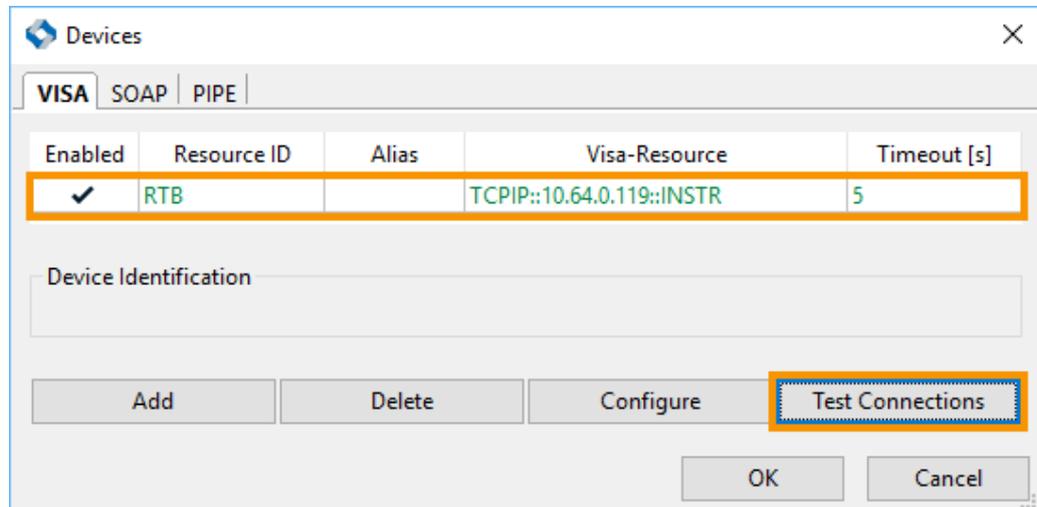
1. **Resource ID** - name with which you refer to the instrument later.
2. **InterfaceType** - interface type. In our case, we use LAN VXI-11 connection.
3. **IP Address** - IP address of your instrument.
4. **Timeout [s]** - initial timeout value for VISA read operations. You can change this value later in your script.



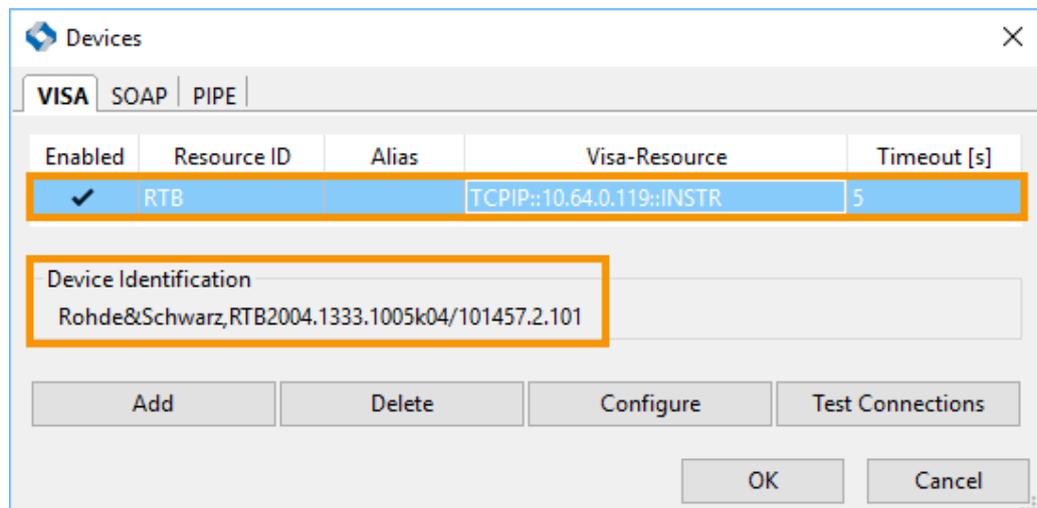
**IMPORTANT!** - Make sure that you check the column `Enabled`. Otherwise, R&S Forum ignores the instrument configuration:



Hitting the `Test Connections` button verifies connections to **ALL ENABLED** instruments. The verification consists of opening a VISA session, querying the identification string with a SCPI query `*IDN?`, and closing the session. Green color of a row indicates successful connection.



Select the individual row to see the instrument's response to the `*IDN?` query:



After this step, R&S Forum is ready to communicate with your instrument.



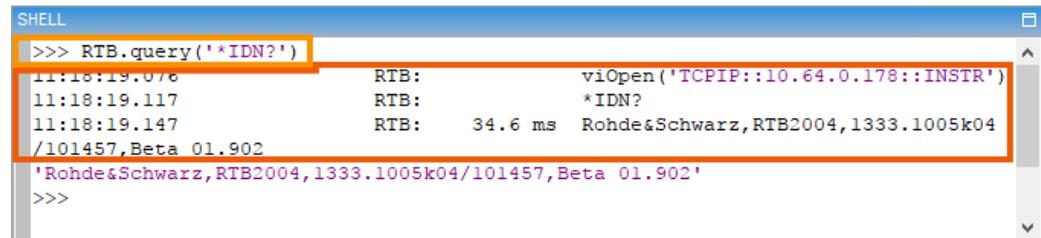
From now on, you always refer to your instrument with its `Resource ID`, or its optional `Alias` name. In the background, R&S Forum constructs a VISA instrument object with its name, in our case `RTB`. For this reason, the `Resource ID` must be unique.

## 5 Console Window

The Console Window (SHELL) is used for immediate commands execution. Use it for quick testing of SCPI commands in cases where writing a script is not necessary. You can later use all the Console code in your scripts.

Example of the querying our RTB's identification string:

```
RTB.query('*IDN?')
```



```
SHELL
>>> RTB.query('*IDN?')
11:18:19.076 RTB: viOpen('TCPIP::10.64.0.178::INSTR')
11:18:19.117 RTB: *IDN?
11:18:19.147 RTB: 34.6 ms Rohde&Schwarz, RTB2004, 1333.1005k04
/101457, Beta 01.902
'Rohde&Schwarz, RTB2004, 1333.1005k04/101457, Beta 01.902'
>>>
```

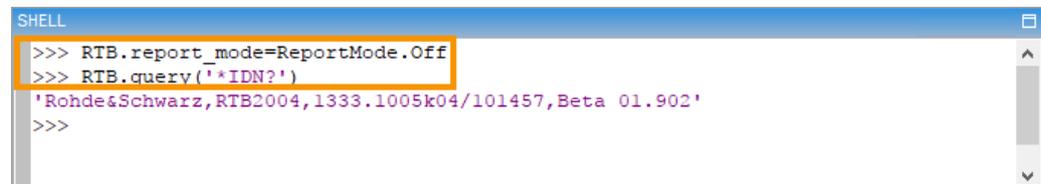
R&S Forum by default has instrument's property `ReportMode = ON`. Therefore, in addition to the SCPI response you see all the VISA actions reported as well (red rectangle). To switch this feature off, change its property value:

```
RTB.report_mode=ReportMode.Off
```

To do the same just for a single command, use the additional parameter in the `query()` method:

```
RTB.query('*IDN?', report_mode=ReportMode.Off)
```

The result in both cases is the same:



```
SHELL
>>> RTB.report_mode=ReportMode.Off
>>> RTB.query('*IDN?')
'Rohde&Schwarz, RTB2004, 1333.1005k04/101457, Beta 01.902'
>>>
```



Use Arrow keys UP / DOWN to bring up previously used lines.



Select the `RTB` instrument in the Main Window **Device Selector Combobox**. Then, instead of specifying an instrument, use a general R&S Forum keyword `DEVICE` :

```
DEVICE.query('*IDN?')
```

This way you can quickly switch between target instruments by changing the **Device Selector Combobox** value. The `DEVICE` keyword is available in:

- Console Window
- Scripts in the Script Window
- Macros

## 6 Script Window

Script Window (EDITOR) allows you to create, edit, save and load R&S Forum scripts. From Python scripts, we recommend . For R&S Forum scripts, we recommend using the file extension \*.i3e (derived from IEEE), to distinguish them from Python scripts.

### 6.1 Hello World Scripts

Referenced files - all packed into RS\_Forum\_Hello\_World\_Scripts.zip:

- RS\_Forum\_Hello\_World.i3e
- RS\_Forum\_Hello\_World\_SOCKET.i3e

Open the attached script RS\_Forum\_Hello\_World.i3e with the following content:

```
RTB.instrument.clear()
RTB.instrument.write_termination = '\n'
idnResponse = RTB.query('*IDN?')
print 'Hello, I am ' + idnResponse
```

Script execution controls are located on the Main Window ribbon:



Start the script in normal mode without debugging with the ► icon. The script queries IDN string from your instrument and prints it into the standard output window:

```
Hello, I am Rohde&Schwarz,RTB2004,1333.1005k04/101457,01.902
```



Always use `RTB.instrument.clear()` method at the beginning, it clears instrument's input / output buffers and prevents potential communication problems caused by previous actions.



The command `RTB.instrument.write_termination = '\n'` causes every SCPI command string sent to your instrument to be terminated by a LineFeed character. Never put the LineFeed directly into command strings, like for example:

```
idnResponse = RTB.query('*IDN?\n')
```

Besides better readability, the main reason is, that you can globally change it at one place if needed. VXI-11 or HiSLIP sessions do not require ending SCPI commands with the LineFeed. However, it is required in Raw Socket, Serial and sometimes in USB-TMC sessions. The script `RS_Forum_Hello_World_SOCKET.i3e`, shows an example of all the necessary settings for a raw socket session.

## 6.2 Advanced Scripts

Referenced files - all packed into `RS_Forum_Advanced_Scripts.zip`:

- `RS_Forum_Advanced_RTB_Example.i3e` - RTB script
- `RS_Forum_Advanced_SCOPE_Example.i3e` - RTO / RTE script
- `RS_Forum_Advanced_SPECAN_Example.i3e` - FSW / FSV script
- `RS_Forum_Advanced_RTB_PythonSyntax_Example.i3e` - Python Syntax examples
- `VisaDeviceExtended.py` - extension methods script

`VisaDeviceExtended.py` is an extension of the R&S Forum `VisaDevice` class to bring some frequently used methods: error checking, querying long strings, querying binary data and so on. The file must be placed in the same folder as the other `*.i3e` files. The example scripts are commented in detail to give you the option to reuse parts of them in your own scripts.

The script `RS_Forum_Advanced_RTB_PythonSyntax_Example.i3e` shows several common Python tasks you use in remote-control applications:

- Conditions
- Loops
- Conversions between strings, integers and floats.
- Querying instrument responses as strings or as lists.



Scripts in **Script Window** are executed in the same Python process as the **Console Window** commands. That means, all the objects and variables are accessible from both. For example, after finishing the `RS_Forum_Hello_World.i3e` script, you can verify content of the `idnResponse` variable in the **Console Window**:

```
>>> print idnResponse
Rohde&Schwarz,RTB2004,1333.1005k04/101457,Beta 01.902
```

## 7 Interactive Remote Control

Interactive Remote Control window is a new feature introduced in R&S Forum 3.3.0. It provides the same functionalities as RsVisaTester, NI Visa Test Panel, or R&S K2 Tool. Start it by clicking the Main Window ribbon instrument icon:



To communicate with your instrument, first select your device and hit **Connect/Disconnect** button:

## 8 SCPI Tree

SCPI Tree is a new feature introduced in R&S Forum 3.3.7. It allows you to read all the supported SCPI commands from your instrument. Open it by clicking the Main Window ribbon tree icon:



Start by importing new Scpi Tree:

Click the bottom button `Import Command Set`. The Import Window pops up:

- Enter a unique `Name of Command Set`
- Select radio button `Read Commands from Device`
- `Select Device`: The device must be enabled and present. Only HiSLIP and VXI-11 sessions are supported
- Click `Import`.



Reading and parsing all the SCPI commands might take several seconds, depending on the number of commands supported by the instrument.



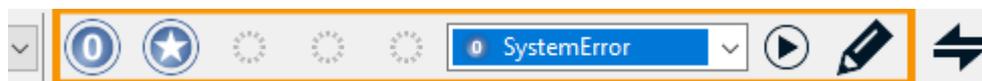
Some instruments support sub-trees (SCPI commands set only for a certain instrument Option). In that case, you can select them in the `Sub Tree` combobox.

After importing the SCPI Tree, you do not need an active connection to your instrument, the SCPI tree is available offline. With each command, you can perform the following actions (invoked by the right-click context menu):

- Copy to Clipboard as text
- Paste to Shell
- Paste to Editor

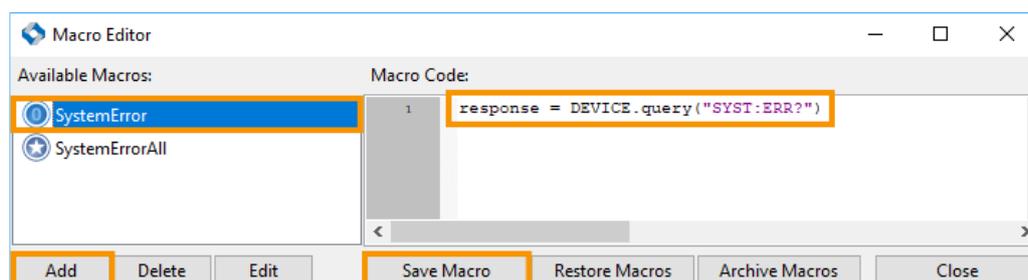
## 9 Macros

Macros are short scripts that you can invoke with one click. All the macro controls are placed on the Main Window ribbon:



Example of a simple macro performing SCPI query `SYST:ERR?` to check if an instrument reports an error in its error queue:

Use the macro edit icon  (CTRL+M) to open Macro Editor window:



For adding a new macro, press **Add**, enter its name, e.g. **SystemError**, and select its icon that will represent it on the Main Window ribbon (there is place for five script icons). You can also add a custom new icon from by pressing **Add Icon**. In the field **Macro Code**, enter the following script:

```
response = DEVICE.query("SYST:ERR?")
```

Save the Macro. To invoke it, first select a device in the Main Window **Device Selector Combobox**. Then, either click its icon or select its name from the roll-down box and hit **Execute**.

Below, is an example of a Macro Code called **SystemErrorAll** that reads all errors from instrument's error queue:

```
errors = []
while True:
    response = DEVICE.query("SYST:ERR?", report_mode=ReportMode.Off)
    if "no error" in response.lower():
        break
    errors.append(response)

print
if len(errors) == 0:
    print '{}: No errors detected'.format(DEVICE.name)
else:
    print '{}: {} errors detected:\n{}'.format(DEVICE.name,
        len(errors), '\n'.join(errors))
```

## 10 Tips & Tricks

### 10.1 Invisible GUI Fix

Sometimes, R&S Forum icon is displayed in the Windows task bar, but the Main Window GUI is not visible. If this happens, try to maximize the window. On Windows 7:

1. Move the mouse pointer over the task bar icon and wait until the mini image of the GUI appears.
2. Right - click on the image and select '**Maximize**'. If the '**Maximize**' selection is not available, use the Windows keyboard shortcut `ALT+SPACE` to bring up the window size context-menu and select '**Maximize**'.

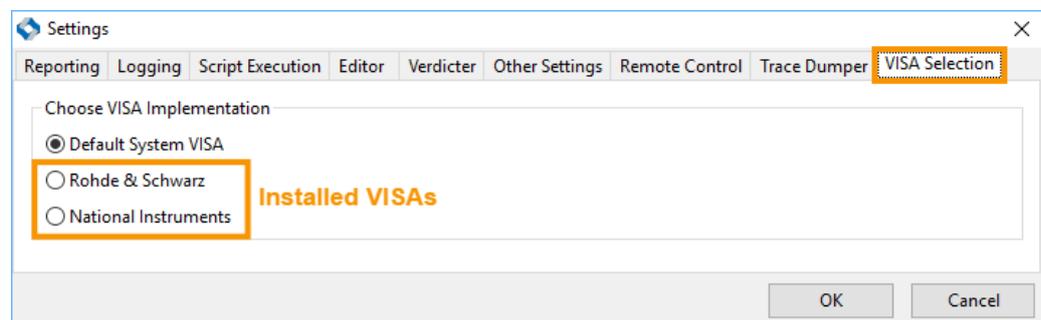
### 10.2 R&S Forum, VISA and GPIB Interface

Starting with R&S Forum version 3.3.0, usage of VISA has changed:

Before the version 3.3.0, R&S Forum always used R&S VISA if it was installed, even if other VISA was present and marked as system default one.

Starting with the version 3.3.0, R&S Forum uses system default VISA. **This change is important if you use GPIB interface.** R&S VISA does not support other manufacturer's GPIB controller hardware. If you use GPIB physical connections, you have to use the matching manufacturer's VISA. For example, a USB-GPIB adapter from National Instruments requires NI VISA + NI USB GPIB installation.

R&S Forum 3.3.3 introduces an option to select VISA implementation. Go to Main Window Menu **Settings -> Settings** (`CTRL+P`), and switch to the tab **VISA Selection**. The default setting is `Default System VISA`, but you can choose any of the installed VISAs explicitly:



If you have NI VISA installed, it is regarded as Default System VISA in all 32-bit applications, hence also in R&S Forum.

## 10.3 DEVICE.query() and DEVICE.ask() Methods

Both methods send a query to your instrument. The difference is only in parsing the response:

`DEVICE.query()` method returns literal response string.

`DEVICE.ask()` method splits response by **comma** characters and returns list of strings.

## 10.4 Simple Commands Syntax

Due to the compatibility with other Rohde & Schwarz tools, R&S Forum supports simple command/query syntax. The following two lines perform the same operation:

```
RTB.query('*IDN?')  
RTB: *IDN?
```

We recommend using the simple syntax only in the Console Window.

## 10.5 Script Editor Double-Click Behavior

Go to Main Window Menu **Settings** -> **Settings** (CTRL+P), switch to the tab **Editor**, where you can switch the editor's double-click behavior. You have a choice between:

- selecting the double-clicked line text (standard behavior)
- executing the double-clicked line

# 11 Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company has an extensive sales and service network with locations in more than 70 countries.

The electronics group ranks among the world market leaders in its established business fields. The company is headquartered in Munich, Germany. It also has regional headquarters in Singapore and Columbia, Maryland, USA, to manage its operations in these regions.

## Sustainable product design

- Environmental compatibility and eco-footprint
- Energy efficiency and low emissions
- Longevity and optimized total cost of ownership



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