# Using R&S® Instruments within Agilent® ADS® Software

# Application Note

**Products:**

- R&S®SMU200A
- R&S®SMJ100A
- R&S®AMU200A
- R&S®AFQ100A
- R&S®AFQ100B
- R&S®SMBV100A
- R&S®SMATE
- R&S®ZVA
- R&S®ZVB
- R&S®ZVT
- R&S®ZVL
- R&S®FSW
- R&S®FSQ
- R&S®FSG
- R&S®FSU
- R&S®FSP
- R&S®FSV
- R&S®FSL
- R&S®FMU36

This Application Note presents means to integrate R&S® Test and Measurement instruments into the Agilent® ADS® Design System.
Methods to include R&S® Instruments are presented, accompanied by a free-of-charge software solution which is provided with this application note. It makes it very easy to include R&S® Instruments into your ADS® environment and your design flow.
Versions for both WINDOWS XP®/ WINDOWS 7®and LINUX® operating systems are available.

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Application Note

ROHDE&SCHWARZ

# Table of Contents

# 1 Overview

This application note presents possibilities for including the R&S Test and Measurement Instruments into the Agilent ADS Design System.

The Agilent ADS Design System is a powerful electronic design automation software system. It offers complete design integration to designers of products such as cellular phones, wireless networks, and radar or satellite communications systems. Both analog and digital simulation can be combined, leading to a complete simulation solution from the bit source up to the output RF power of a complete transmitter system and also back again into the receiver for all known digital communication standards.

By using real-world instruments in combination with such a design system, the design flow can be much more efficient, for example

- generate the baseband signal for a new digital communication standard and feed this signals from ADS into a real-world ARB and RF signal generator to create this signal and examine e.g. an RF amplifier
- check the influence of digital filters, coding, … on the real world signal
- record a real-world signal from e.g. an transmitter and check the parameters in comparison to the original signal - also in the presence of a simulated signal with noise, fading, …
- integrate the parameters of a real-world Device Under Test (S-parameters of an amplifier, …) into your design by using a Vector Network Analyzer for characterization

These are only a few ideas how about integrating test equipment into your design flow. With this application note, ways for integrating Rohde & Schwarz test equipment into ADS will be preset. This integration will be available for both analog and digital simulations, and signal sources as well as signal sinks can be included into your design.

The main key features of this solution are:
- One-button-solution (as easy to operate as the ADS simulator).
- Components for analog and digital simulation.
- Direct integration into ADS (including R&S specific palettes, menus, schematic symbols).
- Complete instrument configuration within the ADS Design Environment.
- Multiple Instrument Components (1 component support all instruments for the desired measurement task)
- Automatic generation of files in well-known ADS formats (TIM, SIG, S2P, …) during the simulation.
- Support of all interfaces to the instruments (IEEE, LAN, …) for all integrated components.
- Protocol and log file generation for all operations.

# 2 Software Features / Principle of Operation

The following instrument classes are provided as components for your ADS design system:

| Task | Supported Instruments | Component provided by the RS Solution | Type of Network supported |
|---|---|---|---|
| Read S parameters vs frequency from Measurement Instrument into ADS Simulation | ZVR/ZVC/ZVM<br>ZVA / ZVB / ZVT<br>ZVL | RS_S1P_Model<br>RS_S2P_Model<br>RS_S3P_Model<br>RS_S4P_Model | Analog |
| Read S parameters vs frequency and power from Measurement Instrument into ADS Simulation | ZVA / ZVB / ZVT | ZVx_P2D_Model | Analog |
| Read IQ vs time data from Measurement Instrument into ADS Simulation | FSIQ+B70<br>FSG / FMU36 / FSP / FSU / FSUP / FSQ / FSW / FSV / FSL | FSx_IQ_Source | Analog & digital |
| Send IQ vs time data from ADS Simulation to a ARB Signal Generator | SMJ100A+B9/B10/B11, SMU200A +B9/B10/B11, SMATE+B10/B11, SMBV+B10/B50/B51,<br>SMIQ+B60,<br>AMIQ, AMU200A +B9/B10/B11, AFQ100A+B10/B11 | ARB_IQ_Sink 1) | digital |

1) As SMU, SMJ, SMATE and SMBV are fully compatible for IQ modulation, SMJ, SMATE and SMBV are referred to as SMU in general in the following descriptions.

To understand the description and the basic principle of operation, some words on the basic design. The provided solution consists of 2 parts:

1. The RS ADS Interface (RSADSIF) which is an executable installed on your local PC. It provides the link to the RS Instruments via various bus systems (IEEE, LAN, …) and takes care on the data transfer. Instrument scanning, operation logging and data format conversion are done within this software.

2. The RS ADS Design Kit (RSADSDK) which is installed as Design Kit within ADS. This Design Kit provides the components for RS instruments within the ADS schematic, generates the menu items in the Schematic Window and realizes the export of instruments settings to the RS ADS Interface.

To use the Rohde & Schwarz ADS Integration, both components are required to be installed.

# 3 Connecting the Computer and the Instrument

The following chapter describes the connection to establish between the PC and the measurement instruments in order to connect to the instruments

**Connecting the Instruments**

Instruments can be connected via several bus systems:

- GPIB / IEEE bus
- Network Interface (TCP/IP)
- USB Bus

# 4 Installing the R&S Software

Installing the RS ADS Interface is divided into 2 steps:

1. Installing the RS ADS Interface itself
2. Installing the RS ADS Design Kit for the integration into ADS

The RS ADS Interface can be installed under Microsoft Windows and LINUX.

## 4.1 Installing the R&S ADS Interface under Microsoft Windows

The software has to be installed on the PC. To do this, run RSADSIF_<Version Number>.exe and follow the instructions on the screen. All necessary settings (installation path, program folder location, …) can be set during the installation. The software will install:

- the software itself including a release history and an uninstall routine
- the Design Kit files for ADS version 2009Update 1 and later versions

During installation, the program files are copied to the directory of your choice and a new folder ("RS ADS Interface" by default) is installed in your Start – Program menu.

**IMPORTANT NOTE**

Installing the RS ADS Interface Software is only possible in folders following the 8-character-rule, so spaces and long directory names are not allowed. This is due to limitations of the ADS Design System.

If RS ADS Interface software is installed in such a directory, the interface **WILL NOT WORK**!
After the installation is completed, click "RS ADS Interface" from the new program folder entry to run the software.

**Design Kit**

Install the design kit according to chapter 4.3 and verify the installation according to chapter 4.4.

## 4.2 Installing the R&S ADS Interface under Linux

**Install files**
Copy the following files into your install directory (e.g. /usr/local/RSADSIF):
RS_2006A.zip, RSADSIF.exe, libQtCore.so.4, libQtGui.so.4 and libQtScript.so.4
Create an empty folder called “log” inside your install directory.
**Important**: Make sure all files and directories are existent and named correctly (**case sensitive!**) and don’t omit the .exe, even if not necessary under Linux.

**Environment Variable**
Add your program directory to the environment variable “RSADSIF” e.g. by adding the following to your /etc/profile:

*RSADSIF=/usr/local/RSADSIF/*

*export PATH … … … RSADSIF*

**Design Kit**

Install the design kit according to chapter 4.3 and verify the installation according to chapter 4.4.

## 4.3 Installing the RS ADS Design Kit

1. From the ADS Main window, choose *DesignKit* > *Install Design Kits*. The Install ADS Design Kit dialog box appears.

2. Click *Unzip Design Kit Now*… . The Unzip ADS Design Kit dialog box appears.

3. To specify the path and file name of the file you want to unzip, click *Browse next* to the Unzip File field. The Unzip From File Browse dialog box appears.

4. Select the Design *Kit ZIP file RS_2006A.zip (running ADS 2009 or lower) or RSDK2011 (running ADS 2011)* within your RS ADS Interface folder as installed before and click OK. Select the ZIP file that matches your ADS Installation Version.
   (For ADS2008/2009, the same files as for version 2006 can be used.)
   Please note that spaces are not allowed in the full path name.

5. To specify the new location for the files you want to unzip, click *Browse next* to the To Directory field. The Unzip To Directory Browse dialog box appears.

6. Select the location you want to install the Design Kit. If your company does not already have a specified location to store design kits, create a new directory to install the files.

7. Click *OK* to unzip your design kit. An Information Message dialog reporting that the design kit was successfully unzipped may appear after the unzip operation is complete.
   You will find a new folder "RS_2006A" (RSDK2011 in case of ADS 2011) within the selected installation folder containing all Design Kit files.

8. All sections within the box "2. Define Design Kit" are filled automatically when the previous steps are finished successfully.

9. Within the box "3. Install Design Kit", you may select at which level you want to install the design kit:
   *SITE LEVEL:* Used to provide design kit capability for users in a networked environment.
   *USER LEVEL*: Used to provide design kit capability for an individual user so you can manage your own design kits.
   *STARTUP LEVEL*: Used to help you manage multiple design kits at different locations.
   *PROJECT LEVEL*: Used to manage design kits within an ADS project.

For the RS ADS Interface, *SITE LEVEL* or *USER LEVEL* is recommended.

10. After selecting a level, click *OK* in the Install ADS Design Kit dialog to install and enable the design kit. An Information Message dialog stating that the design kit was successfully enabled appears. Click *OK* to clear the Information Message dialog. Your design kit is now ready for use.

Details on the installation and usage of Design Kits into ADS can be found in the ADS manual "Design Kit Installation and Setup" which can be found on the Internet [13] or on your ADS Installation CD-ROM's or PC Installation.

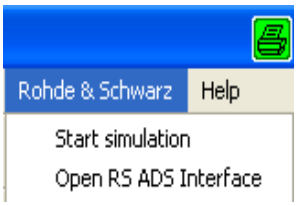
Please restart ADS in order to complete the Design Kit installation.

## 4.4 Checking for successful installation

After a successful installation and a restart of your ADS design environment, you will find

**1. New Menu Entries**

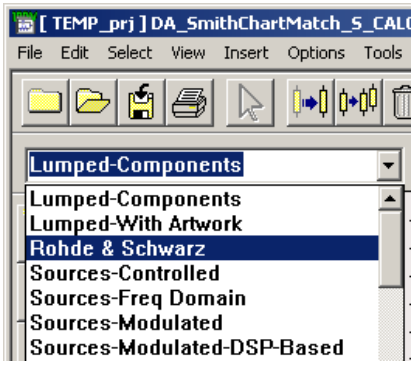
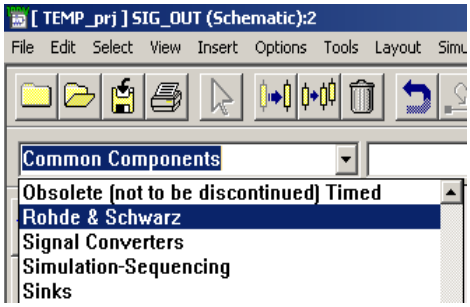
The following new menu entry will appear in your ADS schematic menu:




Use "*Start simulation*" to start your simulation in combination with a data import and export from the R&S instruments.
Use "*Open RS ADS Interface*" for configuration of the instrument connection and interface customization.

### 2. New Component Entries

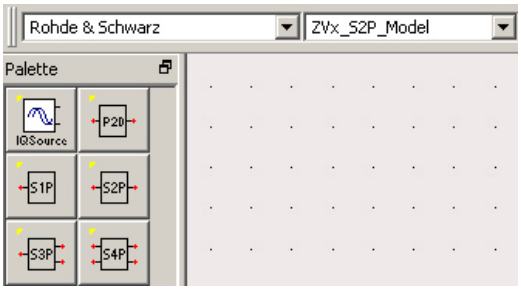
The following new Component Parameter List entry in your RF Design Environment:

| Analog/RF Network | Digital Signal Processing Network |
|---|---|
|  |  |





After selecting the Parameter List entry, the Rohde & Schwarz Palette will be displayed:

| Analog/RF Network | Digital Signal Processing Network |
|---|---|
|  |  |





### Adding Instruments

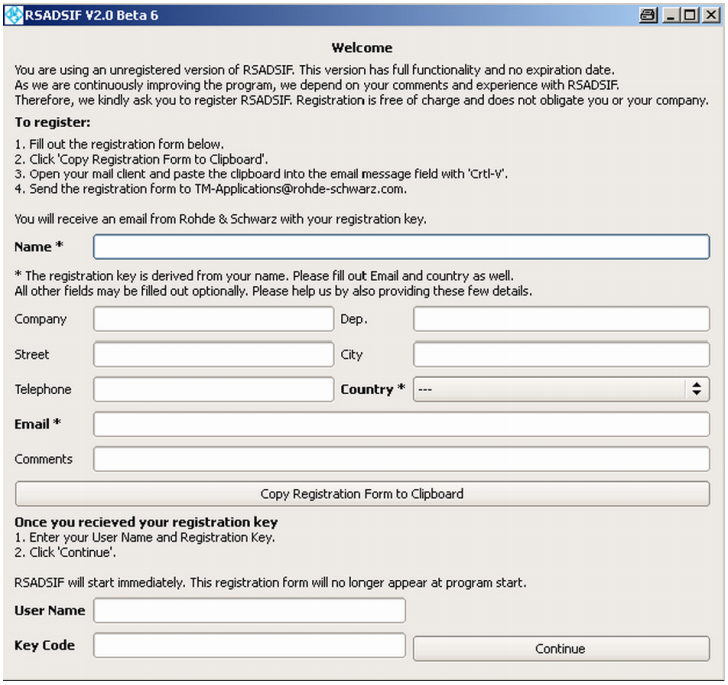
In order to use other instruments connected to the IEEE bus / LAN interface / …, you have to enter the VISA Resource Identifiers of these instruments.
This can be done like described in the next chapter 5.2.

# 5 Operating the RSADSIF Software

## 5.1 Registration:

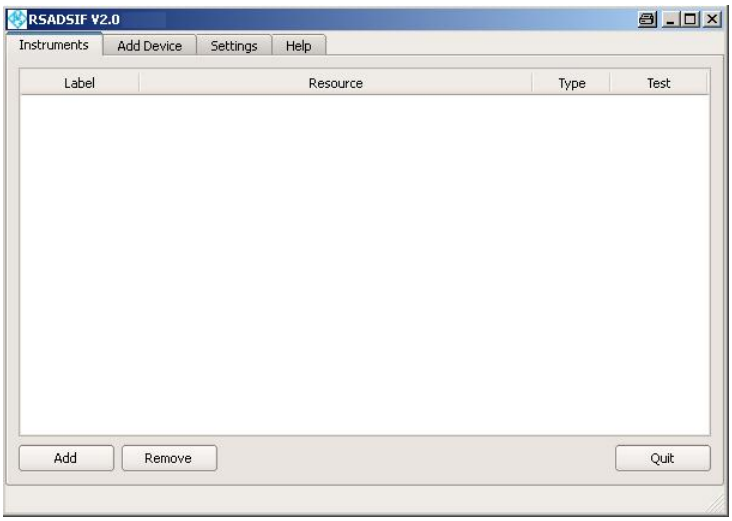
When RSADSIF starts, the Registration form appears. Please register the installation; it is free and does not result in any further commitments for you or your company.

- If RSADSIF has not been registered, you can still start the program by clicking the Continue button.
- If you complete the Registration form, a keycode will be sent to you. Enter the code into the Registration form and click the Continue button.



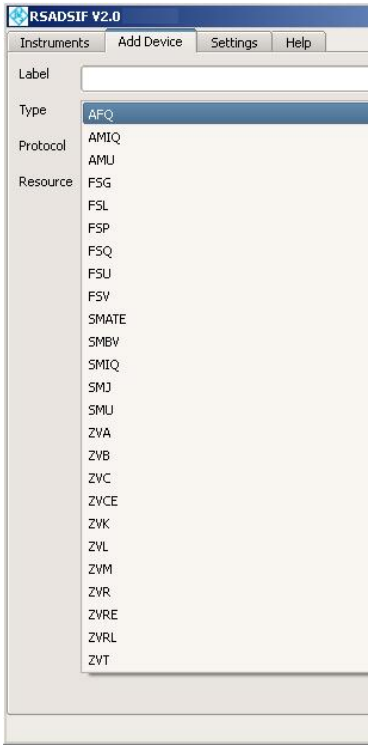

After inserting a valid keycode the registration is complete, the registration form does not appear any more.

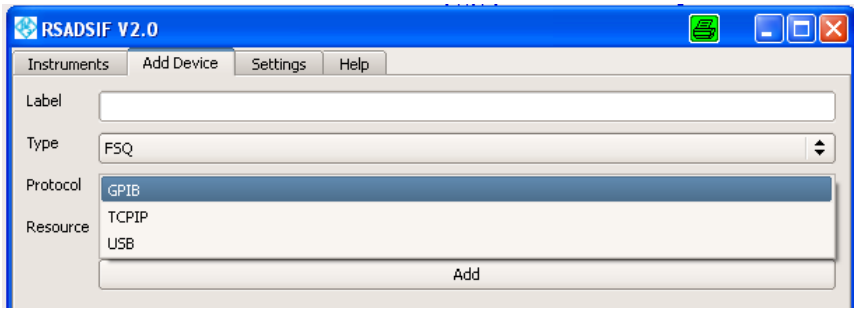
## 5.2 Operating



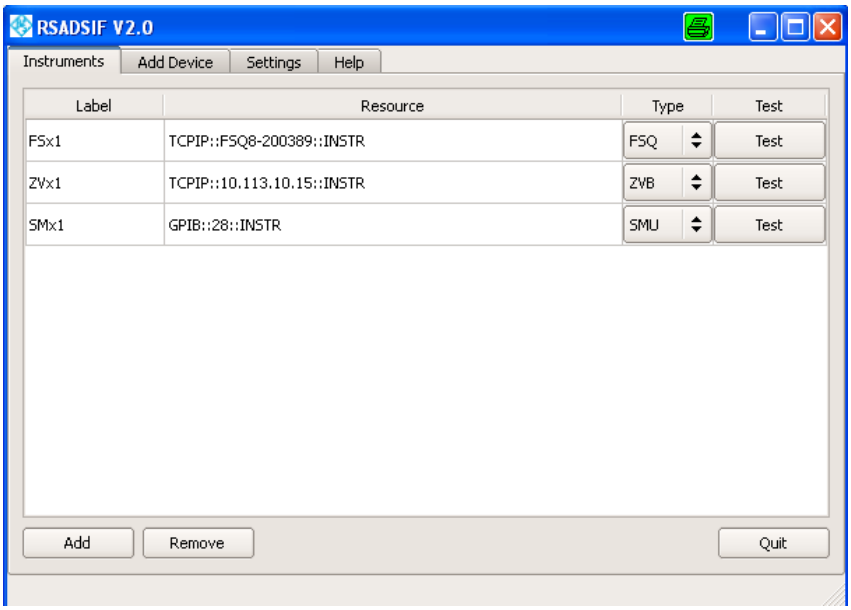

The RS ADS Interface software supports the usage of any interface to connect to the instrument (IEEE bus, LAN interface, USB).

Use the tab Add Device to add instruments to your setup:
Choose a label, an instrument type, the protocol and the resource:



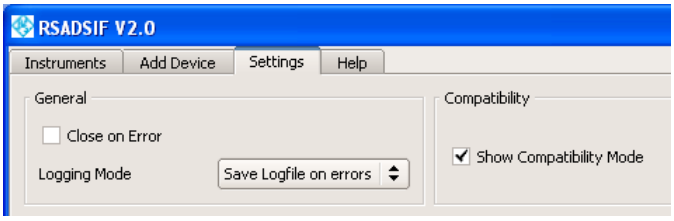



Examples for connecting instruments via LAN and GPIB:

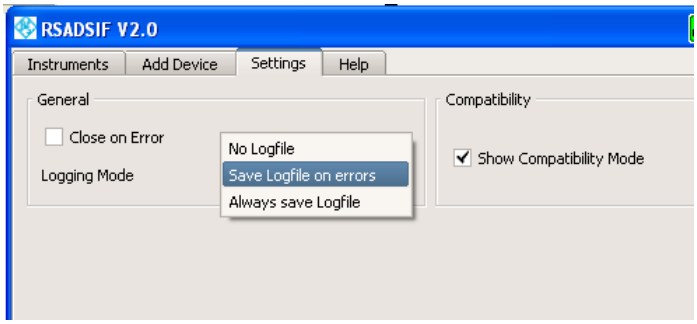



Using "Remove", the selected entry can be deleted.
"Rename" will change the selected resource entry.

**Settings:**
Under Settings you can select "Close on Error", if and under what conditions a log file is created, and "Show compatibility Mode". In the latter case you can include instruments which are not available under "Type" but compatible to an instrument listed there.



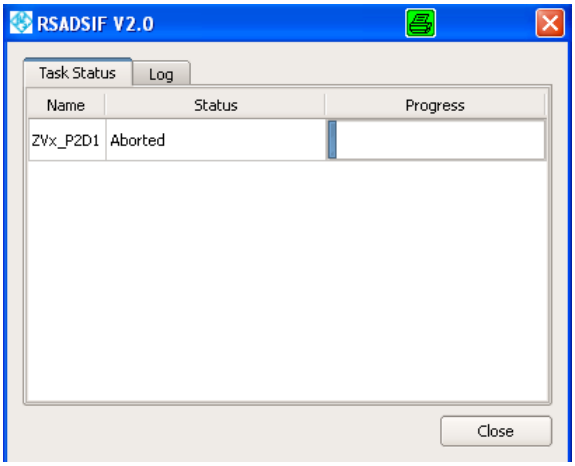

.




The path for saving a logfile is: Path: C:\WINNT\RS\RSADSIF\LOG

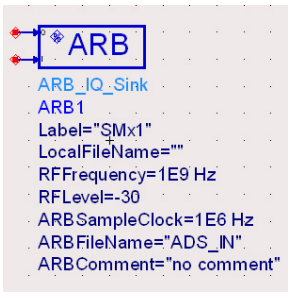
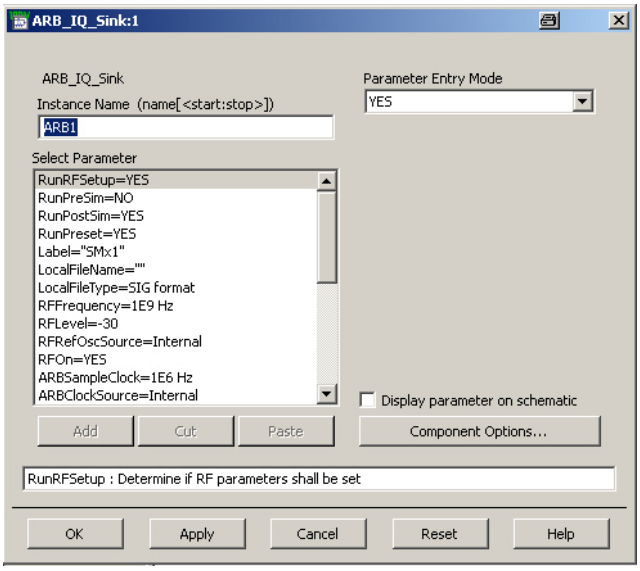
**While running the simulation**

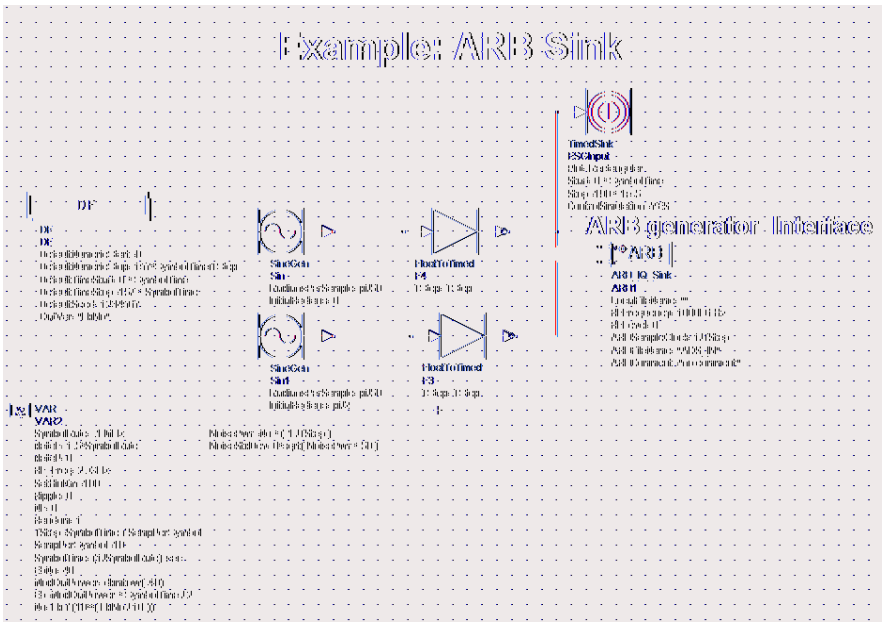
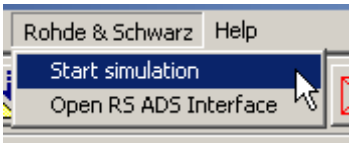
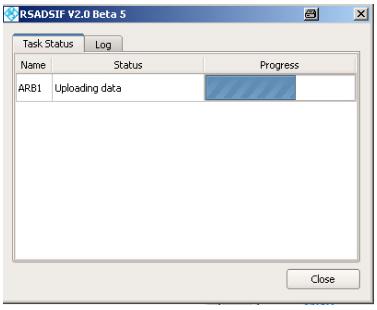
If RS ADS Interface is started during the ADS Simulation process, a small window will pop up which will inform you on all actions and errors:

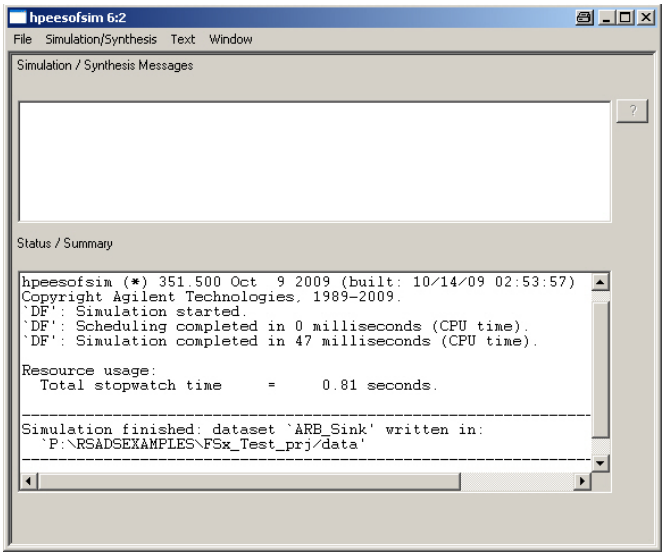


# 6 Design Examples

## 6.1 Writing simulated data to an Arbitrary Generator

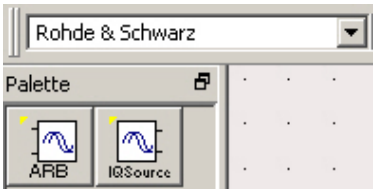
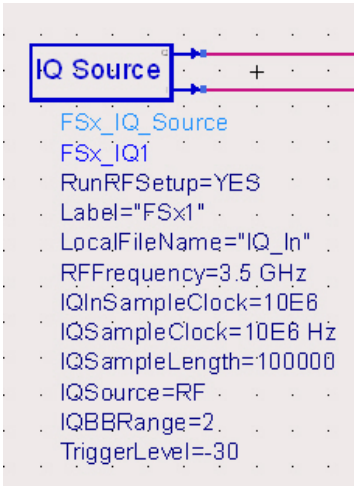
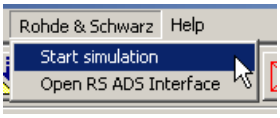
| Writing simulated data to an Arbitrary Generator | |
|---|---|
| 1) | Start your ADS design environment. |
| 2) | Create a new project and create a new design. |
| 3) | From the Component Palette List, choose "Rohde & Schwarz": |
| |  |
| 4) | Choose the ARB_IQ_Sink and place the model onto your layout: |
| |  |
| 5) | Configure all parameters as required by double-clicking to the ARB symbol: |
| |  |

| | |
|---|---|
| 6) | Close the box and complete your design: |
| |  |
| 7) | Start the simulation using the menu entry<br>"Rohde & Schwarz > Start simulation": |
| |  |
| 8) | Wait until the simulation has finished: |
| |  |

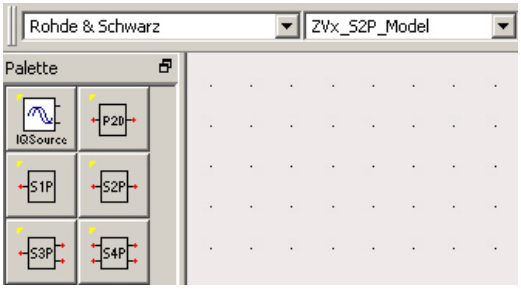
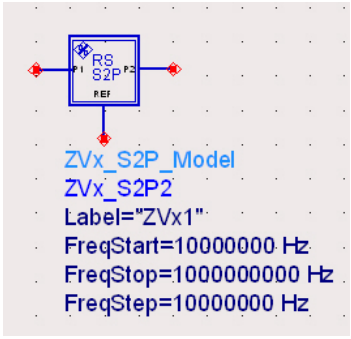


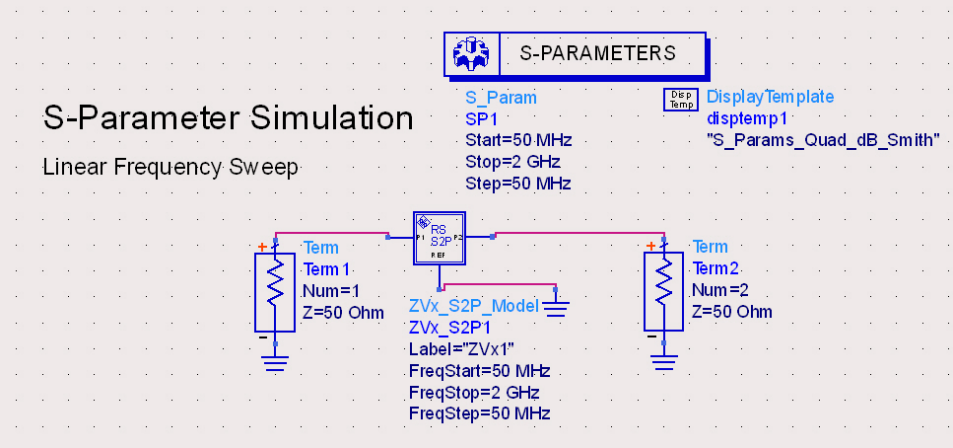
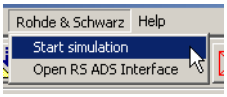

| | |
|---|---|
| 9) | Evaluate your simulations results. |

## 6.2 Reading IQ Data from an R&S®FSx

| Reading IQ Data | |
|---|---|
| 1) | Start your ADS design environment. |
| 2) | Create a new project and create a new design. |
| 3) | From the Component Palette List, choose *"Rohde & Schwarz"*: |
| |  |
| 4) | Choose the A/D component and place the model onto your layout: |
| |  |
| 5) | Configure all parameters as required by double-clicking on the component |
| 6) | Close the box and complete your design: |
| 7) | Start the simulation using the menu entry<br>*"Rohde & Schwarz > Start simulation"*: |
| |  |
| 8) | Wait until the simulation has finished and the R&S ADS-Interface dialog box closes. |
| 9) | Evaluate your simulations results. |
| | |

## 6.3 Reading S-Parameters from an ZVx with the ZVx_S2P_Model

| Reading S-Parameters with the S2P Model | |
|---|---|
| 1) | Start your ADS design environment. |
| 2) | Create a new project and create a new design. |
| 3) | From the Component Palette List, choose "Rohde & Schwarz": |
| |  |
| 4) | Choose the RS_S2P_Model component and place the model on your layout: |
| |  |
| 5) | Configure all parameters as required by double-clicking on the component. |
| 6) | Close the box and complete your design: |

| | |
|---|---|
| |  |
| 7) | Start the simulation using the menu entry *"Rohde & Schwarz > Start simulation":* |
| |  |
| 8) | Wait until the simulation has finished and the R&S ADS Interface dialog box closes. |
| 9) | Evaluate your simulations results. |

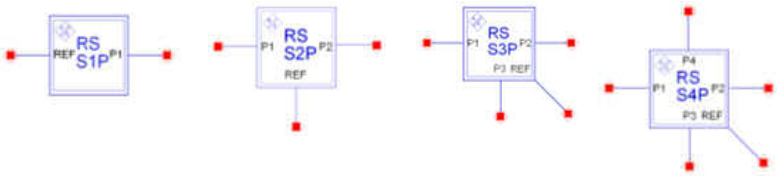
# 7 Model Source Instruments

This chapter describes the model source instruments. These are components which generate a "behavior model" for a specific real-world component.

This behavior model can be a S parameter file with sweeped frequency and - if decided - also sweep power.

## 7.1 RS_SnP_Model

### Symbol and Description




The component will control a Vector Network Analyzer and create a S parameter file for a 1-Port / 2-Port / 3-Port / 4-Port DUT.

| Parameters | | | | |
|---|---|---|---|---|
| **Name** | **Description** | **Default** | **Unit** | **Type** |
| *RunRFSetup* | Set RF parameters: YES, NO | YES | -- | bool |
| *RunPreSim* | Measurement is done before the simulation: YES, NO | YES | -- | bool |
| *RunPostSim* | Measurement is done after the simulation: YES, NO | NO | -- | bool |
| *RunPreset* | Preset the instrument: YES, NO | YES | -- | bool |
| *Label* | Instrument's label | "ZVx1" | -- | string |
| *FreqStart* | Starting frequency for frequency sweep | 10 MHz | Hz | real |
| *FreqStop* | Stop frequency for frequency sweep | 1 GHz | Hz | real |
| *FreqStep* | Frequency steps for frequency sweep 1) | 10 MHz | Hz | real |
| *RFLevel* | RF Output Level | 0 | dBm | real |
| *IFFilter* | IF filter bandwidth | 10 | kHz | real |

| Pins and Files | | |
|---|---|---|
| **Name** | **Description** | **Signal Type** |
| Pin "REF" | Reference Port | S parameter |
| Pin "P1"…"P4" | Ports of the DUT | S parameter |
| File Format | SnP file format | --- |

| Footnotes | |
|---|---|
| 1) | The sweep direction is taken from *LevelStart* and *LevelStop*, the sign of *LevelStep* is ignored and will be assigned to match the sweep direction derived from *LevelStart* and *LevelStop*.<br>The resulting maximum number of sweep points for the ZVR / ZVC is limited to 2001 for 1-port measurement and 501 for 2-port measurement. |

| Notes | |
|---|---|
| 1) | *RunPreSim* and *RunPostSim* determine if the communication with the instrument shall be done before and/or after the simulation of the circuit.<br>If you do not want the simulator to control the component, select *NO* for both values. |
| 2) | If *RunPreset* is selected, the instrument will be reset and all channel assignments will be executed before other settings are performed on the instrument.<br>If *RunPreset* is not selected, the necessary channels are queried automatically from the instrument.<br>S parameters distributed on several channels can not be used for this measurement. |
| 3) | If *RunRFSetup* or *RunPreset* is selected, the settings for *FreqStart, FreqStop*, and *FreqStep* will be executed. |
| 4) | The data from the instrument are always stored as S1P / S2P / S3P / S4P files with the name "RS_SxP.sxp" (x=1..4) in the "\data" directory of the current project. |

## 7.2 ZVx_P2D_Model

### Symbol and Description


The component will control a Vector Network Analyzer and create an S parameter file for a 2-Port DUT. Additionally, the power at the ports will be sweeped according to the settings.

| Parameters | | | | |
|---|---|---|---|---|
| **Name** | **Description** | **Default** | **Unit** | **Type** |
| *RunRFSetup* | Set RF parameters: YES, NO | YES | -- | bool |
| *RunPreSim* | Measurement is done before the simulation: YES, NO | YES | -- | bool |
| *RunPostSim* | Measurement is done after the simulation: YES, NO | NO | -- | bool |
| *RunPreset* | Preset the instrument: YES, NO | YES | -- | bool |
| *Label* | Instrument's label | "ZVx1" | -- | strimg |
| *FreqStart* | Starting frequency for frequency sweep | 10 MHz | Hz | real |
| *FreqStop* | Stop frequency for frequency sweep | 1 GHz | Hz | real |
| *FreqStep* | Frequency steps for frequency sweep 1) | 10 MHz | Hz | real |
| *LevelStart* | Starting level for level sweep | -30 dBm | dBm | real |
| *LevelStop* | Stop level for level sweep | -10 dBm | dBm | real |
| *LevelStep* | Level steps for level sweep 1) | 1 dB | dB | real |

| Pins and Files | | |
|---|---|---|
| **Name** | **Description** | **Signal Type** |
| Pin "IN" | Port 1 of the DUT | S parameter |
| Pin "OUT" | Port 2 of the DUT | S parameter |
| File Formats | S2D file format | --- |

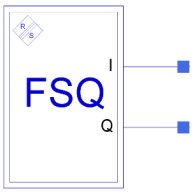
| Notes | |
|---|---|
| 1) | *RunPreSim* and *RunPostSim* determine if the communication with the instrument shall be done before and/or after the simulation of the circuit.<br>If you do not want the simulator to control the component, select *NO* for both values. |
| 2) | If *RunPreset* is selected, the instrument will be reset and all channel assignments, … will be executed before other settings are performed on the instrument.<br>If *RunPreset* is not selected, the necessary channels are queried automatically from the instrument.<br>S parameters distributed on several channels can not be used for this measurement. |
| 3) | If *RunRFSetup* or *RunPreset* is selected, the settings for *FreqStart, FreqStop*, and *FreqStep* will be executed. |
| 4) | The data from the instrument are always stored as P2D files with the name "ZVx_P2D.p2d" in the "\data" directory of the current project. |

**Required Licences:**
This component requires the license "Design Environment" (ads_schematic) for placing the component and "RF Systems Models" (mdl_systemlib) for simulation.

# 8 Source Instruments

## 8.1 FSx_IQ_Source

### Symbol and Description




The FSx_IQ_Source model downloads data from any of the R&S FSIQ / FSP / FSUP / FSU / FSQ / FSG / FMU36 / FSW / FSV/FSL Spectrum and Signal Analyzers into ADS. It outputs IQ data as recorded from the detector.

| Parameters | | | | |
|---|---|---|---|---|
| **Name** | **Description** | **Default** | **Unit** | **Type** |
| RunRFSetup | RF parameters shall be set: YES, NO | YES | -- | bool |
| RunPreSim | Sampling is done before the simulation: YES, NO | YES | -- | bool |
| RunPostSim | Sampling is done after the simulation: YES, NO | NO | -- | bool |
| RunPreset | Instrument is presented: YES, NO | YES | -- | bool |
| LocalFileName | Name of the copy of the IQ data file (extension-free) 1) | 'IQ_In' | -- | string |
| LocalFileType | Type for file format to store on disc: none, TIM, SIG | SIG | -- | enum |
| RFFrequency | RF Frequency | 1 GHz | Hz | real |
| RFLevel | RF Level | -30 dBm | dBm | real |
| RFRefOscSource | Source for 10 MHz reference frequency: INT, EXT | INT | -- | enum |
| IQINSampleClock | Input sampling rate for Digital Baseband Input 8) | 1 MHz | Hz | real |
| IQSampleClock | Sampling rate for the data acquisition 2) | 1 MHz | Hz | real |
| IQSampleLength | Number of IQ samples to record 3) | 1024 | -- | int |
| IQPreTrigSamples | Number of measurement values to be recorded before the trigger point | 0 | 1 | int |
| IQFilter | Analog filters bandwidth in front of the A/D converter: 300 kHz, 1 MHz, 3 MHz, 10 MHz, 20 MHz, 50 MHz 4) | 3 MHz | -- | enum |
| IQAvgOn | Averaging for IQ data: ON, OFF 5) | OFF | -- | bool |
| IQAvgCount | Average count for IQ capture 5) | 1 | 1 | int |
| IQSource | Source for the IQ data: RF, BB, DIQ 6) | RF | -- | enum |
| IQBBDither | Baseband Dithering: ON, OFF 6) | OFF | -- | bool |
| IQBBLowPass | Baseband 36 MHz lowpass filter activated: ON, OFF 6) | OFF | -- | bool |
| IQBBBalanced | Baseband IQ mode balanced: YES, NO 6) | NO | -- | bool |
| IQBBImp | Baseband Impedance of the IQ inputs: 50 Ω, high 6) | 50 Ω | -- | enum |
| DIQRANGE | Voltage of a digital full scale value 8) | 2 V | V | real |
| TriggerMode | Mode for triggering: IMM, EXT, IFP, RFP 7) | IMM | -- | enum |
| TriggerLevel | Level for IFP and RFP trigger | -30 dBm | dBm | real |

| Pins and Files | | |
|---|---|---|
| **Name** | **Description** | **Signal Type** |
| Pin "I" | I data from the data acquisition | Scalar Floating Point |
| Pin "Q" | I data from the data acquisition | Scalar Floating Point |

| Footnotes | |
|---|---|
| 1) | If no filename is entered, no copy is generated on the local PC |
| 2) | The sampling rate can be set<br>• for FSQ / FMU36 / FSG in the range of 10 kHz to 81.6 MHz in 0.1 Hz steps<br>• for FSQ with option FSQ-B72 in the range of 20.4 MHz to 326.4 MHz in 0.1 Hz steps<br>• for FSU / FSUP / FSP to discrete values: 32 MHz / 2n, n = 0 .. 11, resulting in a range of 15.625 kHz to 32 MHz<br>• For FSV in the range of 100 Hz to 45 MHz in 0.1 Hz steps<br>• For FSV with R&S®FSV-B70 option in the range of 100 Hz to 128 MHz in in 0.1 Hz steps<br>• For the FSW in the range of 100 Hz to 200 MHz*)<br>*) standard 12.5 MHz<br>with R&S®FSW-B28 option 35 MHz<br>with R&S®FSW-B40 option 50 MHz<br>with R&S®FSW-B80 option 100 MHz<br>with R&S®FSW-B160 option 200 MHz<br>• For FSL in the range of 10 kHz to 65.8 MHz |
| 3) | The number of samples can be set<br>• for FSQ / FSU / FSUP / FMU36 / FSG continuous in a range of 1 to 16.776.704<br>• for FSP without option FSP-B70 in a range of 1 to 130.560<br>• for FSP with option FSP-B70 in a range of 1 to 523.776<br>• for FSV continuously in a range of 1 to 20.000.000<br>• for FSL continuously in a range of 1 to 512.000<br>• for the FSW max. 400 Msample I and Q |
| 4) | 20 MHz and 50 MHz filters are available with FSQ only.<br>For FSV/FSW the setting of the IQFilter bandwidth is omitted. |
| 5) | Only available for FSU and 32 MHz sampling rate and IQPreTriggerSamples >= 0. |
| 6) | Analog Baseband input only available with FSQ with option FSQ-B71 and FMU36.<br>Digital Baseband Input only available with FSQ or FSG with R&S FSQ-B17 Digital Baseband Interface or FSV with FSV-B17 Digital Baseband Interface or FSW with FSW-B17.<br>See also Application Note 1MA147 " Using the R&S®ExIQ Box with FSQ and Agilent ADS Software" where applicable. |
| 7) | RFP for FSP with option FSP-B6. |
| 8) | Only valid if IQSource is set to DIQ. For IQSource=RF or BB no effect. |

| Notes | |
|---|---|
| 1) | RunPreSim and RunPostSim determine if the communication with the instrument shall be done before and/or after the simulation of the circuit.<br>If you do not want the simulator to control the component, select NO for both values. |
| 2) | If RunPreset is selected, the command "SYST:PRES" (equivalent to pressing the PRESET key at the front panel) will be executed before other settings are performed on the instrument. |

| | |
|---|---|
| 3) | If RunRFSetup is selected, the settings for RFFrequency, RFLevel, RFRefOscSource and RFOn will be executed. |
| 4) | The data from the instrument are always stored as SIG files with the name "FSx_IQ_IN_I.SIG" and "FSx_IQ_IN_Q.SIG" in the "\data" directory of the current project.<br>If you want additional copies of the file in the SIG or TIM format, you can specify LocalFileName and LocalFileType for name and type.<br>The complete filenames will be <LocalFileName>_[I/Q].[SIG/TIM]. |
| 5) | IQSampleClock and IQSampleLength must be entered according to the valid value range as described in the table above. |
| 6) | IQPreTriggerSamples specified the number of samples between the trigger event and the start of the IQ data recording itself. |
| 7) | If IQScaleMode is set to VOLT, IQ input samples are assumed to be voltage values. An overrange of the values will result in an error.<br>If MAX is selected, IQ input samples will be scaled to fit the value range of the D/A converter with maximum dynamic range. |
| 8) | IQAvgOn and IQAvgCount switches the averaging of IQ samples within the FSU on or off.<br>If averaging is selected, IQ data are averaged inside the instrument with phase synchronized sampling according to the external trigger. |
| 9) | If an FSQ with option FSQ-B71 is used, IQSource can be switched between RF and Baseband (BB) source. For baseband inputs, additional options (IQBBDither , IQBBLowPass , IQBBBalanced and IQBBImp) are available. |
| 10) | The TriggerMode can be switched between Immediate (IMM), External (EXT - Trigger provided by the backpanel BNC connector), IF Power (IFP - Standard Bandwidth Detector) and RF Power (RFP - Bandwidth Extended Detector for FSP).<br>Use TriggerLevel to set the level for IF and RF Power Trigger level. |

**Required Licenses**

This component requires the license "Design Environment" (ads_schematic) for placing the component and "Ptolemy Simulator" (sim_systime) for simulation.

# 9 Sink Instruments

## 9.1 ARB_IQ_Sink

**Symbol and Description**


The ARB_IQ_Sink model downloads time domain IQ data from ADS to the R&S Vector Signal Generator or Arbitrary Waveform Generator or R&S I/Q Modulation Generator.

The simulated IQ data are stored from ADS to the local PC disc and then automatically transferred to the ARB generator by calling the RS ADS Interface.

The files which are downloaded to the ARB are called "ARB_IQ_Sink_I.SIG" and "ARB_IQ_Sink_Q.SIG" and are stored in the "\data" directory of your simulation.

Note: Please make sure that your ADS design delivers an equal number of I and Q data by adjusting the START and STOP parameters of the simulation (e.g. Default-TimeStart/Stop and DefaultNumericStart/Stop). If the number is not equal a warning is displayed in the R&S simulation window and the smaller number is used.

| Parameters | | | | |
|---|---|---|---|---|
| **Name** | **Description** | **Default** | **Unit** | **Type** |
| RunRFSetup | Set RF parameters: YES, NO [1)] | YES | -- | bool |
| RunPreSim | Waveform upload is done before the simulation: YES, NO | NO | -- | bool |
| RunPostSim | Waveform upload is done after the simulation: YES, NO | YES | -- | bool |
| RunPreset | Preset the instrument: YES, NO [2)] | | -- | bool |
| LocalFileName | Name of the copy of the IQ data file (extension-free) [3)] | '' | -- | string |
| LocalFileType | Type for file Pin "Q"on disc: TIM, SIG, WV | SIG | -- | enum |
| RFFrequency | RF Frequency [4)] | 1 GHz | Hz | real |
| RFLevel | RF Level [4)] | -30 dBm | dBm | real |
| RFRefOscSource | Source for the 10 MHz reference frequency: INT, EXT | INT | -- | enum |
| RFOn | Determine if RF is switched on after IQ data download; YES, NO [5)] | YES | -- | bool |
| ARBSampleClock | Clock rate of the D/A converter [6)] | 1MHz | Hz | real |
| ARBClockSource | Source of the ARB clock: INT, EXT | INT | -- | enum |
| ARBFileName | Name of the file to be generated on the ARB | 'ADS_IN' | -- | string |
| ARBComment | Comment for the ARB file | '' | -- | string |
| ARBOn | Switch ARB on after IQ download: YES, NO | YES | -- | bool |
| ARBTrigger | Trigger mode of the ARB: AUTO, RETR | AUTO | -- | enum |
| IQBBGain | Baseband Gain: AUTO, -3dB, 0dB, 3dB, 6dB [7)] | AUTO | -- | enum |
| IQWideBand | IQ Wideband Mode: ON, OFF [7)] | OFF | -- | bool |
| Marker1On | Time Marker 1 is on [samples] | 10 | -- | string |
| Marker2On | Time Marker 2 is on [samples] | 10 | -- | string |
| IQBBOutputBal | Differential outputs: YES, NO [8)] | NO | -- | bool |
| IQDigBitWidth | Digital output bit width: 1 … 16 [9)] | 14 | -- | int |
| IQDigBitAlignment | Digital output bit alignment: LSB lowest, MSB highest [9)] | LSB lowest | -- | enum |
| IQDigBitUnused | Digital output unused bits state: LOW, HIGH [9)] | LOW | -- | enum |

| Pins and Files | | |
|---|---|---|
| **Name** | **Description** | **Signal Type** |
| Pin "I" | I input waveform data | Scalar Timed |
| Pin "Q" | Q input waveform data | Scalar Timed |

| Footnotes | | | |
|---|---|---|---|
| 1) | If RunRFSetup is selected, the settings for RFFrequency, RFLevel, RFRefOscSource and RFOn will be executed. Not supported for AMIQ, AMU or AFQ. | | |
| 2) | If RunPreset is selected, the command "SYST:PRES" (equivalent to pressing the PRESET key at the frontpanel) will be executed before other settings are performed on the instrument | | |
| 3) | If no filename is entered, no copy is generated on the local PC and the file is only downloaded to the ARB. | | |
| 4) | Not supported for AMIQ, AMU or AFQ | | |
| 5) | Not supported for AMIQ, AMU or AFQ. | | |
| 6) | The clock rate can be set in a range of | | |
| | 400 Hz to 100 MHz | for SMU/AMU/SMJ + B9/B10/11 | |
| | 1 kHz to 40 MHz | for SMIQ + B60 | |
| | 10 Hz to 100 MHz | for AMIQ | |
| | 400 Hz to 150 MHz | SMBV | |
| | 1 kHz to 300 MHz | AFQ100A | |
| | 1kHz to 600 MHz | AFQ100B | |
| 7) | Only available for SMU/SMJ100A. | | |
| 8) | Only available for AMIQ-B2 / SMU-B16 / SMJ-B16 / AFQ100A / AMU200A / AFQ. | | |
| 9) | Only available for AMIQ-B2 / AFQ100A / AMU-B18. | | |

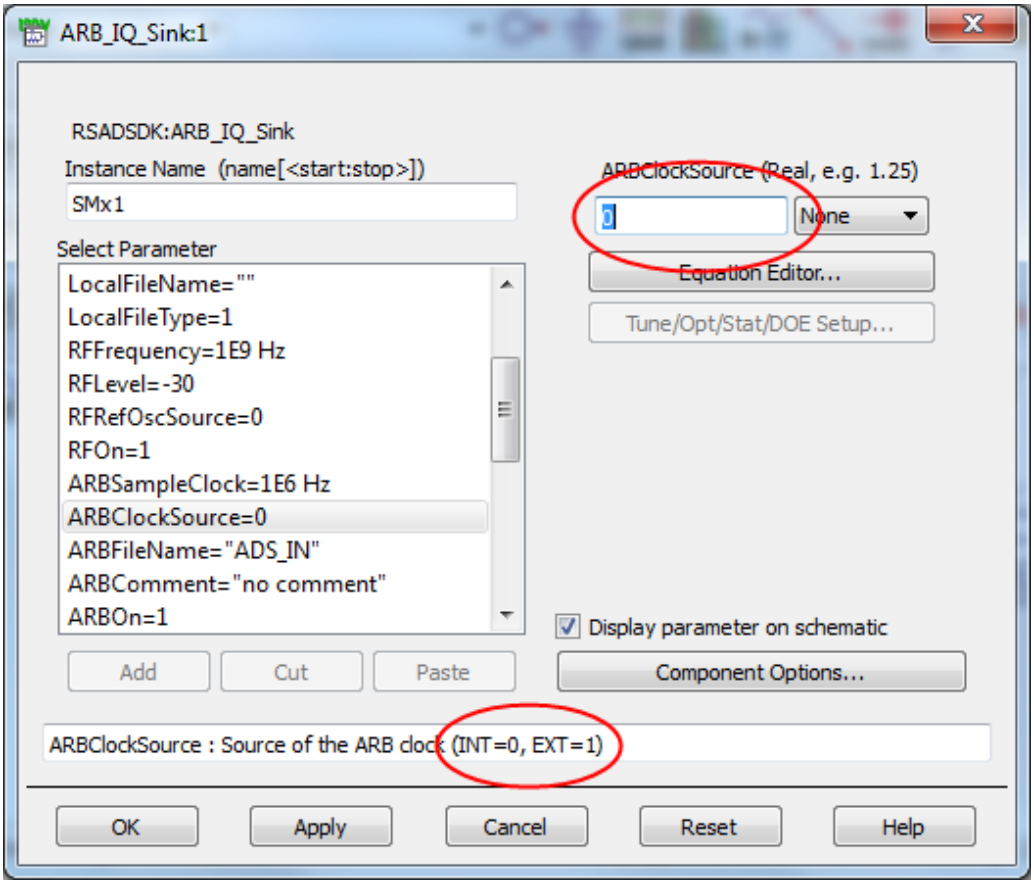
| Notes | |
|---|---|
| 1) | *RunPreSim* and *RunPostSim* determine if the communication with the instrument shall be done before and/or after the simulation of the circuit.<br>If you do not the simulator to control the component, select *NO* for both values. |
| 2) | The data from the simulation are always stored as SIG files with the name "ARB_IQ_Sink_I.SIG" and "ARB_IQ_Sink_Q.SIG" in the "\data" directory of the current project.<br>If you want additional copies of the file in the SIG or TIM format, you can specify LocalFileName and LocalFileType for name and type.<br>The complete filenames will be <LocalFileName>_[I/Q].[SIG/TIM]. |
| 3) | If *ARBSampleClock* is set to 0, the Samples Clock is derived from the timing of the simulation. Otherwise, the entered value will be used.<br>At least 1 component in the design must specify the timing. |
| 4) | If *ARBOn* is selected, the ARB will be reset, the file generated (name *ARBFileName*) by the simulation will be loaded and started. |
| 5) | *Marker1On* and *Marker2On* specify the number of samples the marker will stay on (TTL High). The marker will then turn off (TTL Low) until the end of the waveform is reached.<br>If you want to realize e.g. a Marker Pulse with ON/OFF Ratio of 1/1, please set the value to ½ of the total samples number. |
| 6) | Data are always written in the non-volatile memory of the instrument. |

# 10 ADS 2011

With ADS 2011 there have been many changes regarding legacy Design Kit support. As a result, ADS 2011 is no longer compatible with with Design Kits from previous versions and vice versa. To use ADS2011 with the RS ADS Interface you need the latest Version (2.3 or later).

## 10.1 Changes in ADS

| Changes | |
|---|---|
| 1) | Unified palette (only one palette regardless of simulation mode |
| 2) | All dropdown options have been replaced with a text entry. All valid options (numbers) are noted in the option description.Table text, see example below. |



## 10.2 Changes in the RS ADS Interface

You need the latest version of the ADS Interface (version 2.3 or later) to work with ADS 2011. You need to install the RSDK2011 Design Kit.

## 10.3 Update to ADS 2011

| Update Procedure | |
|---|---|
| 1) | Install ADS 2011 |
| 2) | Install Rohde & Schwarz ADS Interface (for ADS 2011) |

## 10.4 Update Projects to ADS 2011

| Project Update | |
|---|---|
| 1) | Open your project in your old ADS version and note all RS Component settings |
| 2) | Convert your project to an ADS 2011 workspace |
| 3) | Open your project and delete all RS Components |
| 4) | Place your RS Components from the new palette again |
| 5) | Reconfigure your components |
| 6) | Run your simulation as in previous versions |

# 11 Required Licenses

This component requires the license "Design Environment" (ads_schematic) for placing the component and "Ptolemy Simulator" (sim_systime) for simulation.

# 12 Hardware and Software Requirements

## 12.1 PC Requirements

**Recommended system configuration for the provided R&S software:**

- Operating system:
  Windows XP or Windos 7
  Microsoft Internet Explorer 5.0 or higher

  Or:

  LINUX REDHAT

- Generic PC requirements:
  - Pentium II 450 MHz or higher
  - 1024 MByte
  - 100 MByte free hard disc space plus space for storing data files
  - XGA monitor (1024x768)

- IEC/IEEE bus interface
  (for instrument control over IEEE Bus)

- LAN interface
  (for instrument control over LAN interface)

### 12.1.1 Software Requirements

- Agilent ADS 2009A or above including simulators which are required for the decided simulation
- VISA (Virtual Instrument Software Architecture)
  - National Instruments VISA Version 4.6 or above
    OR:
  - Agilent VISA Version M.01.01 or above

For detailed information on system requirements of Agilent ADS, please refer to the manual "Installation on PC Systems" of your ADS installation.

# 13 Frequently Asked Questions

**Question**

The "Rohde & Schwarz" menu bar does not work (I can not start the simulation or open the RS Interface)

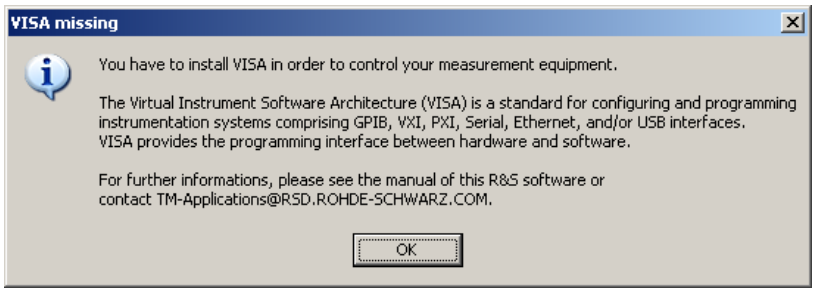
**Answer**

After the installation, ADS may need to be restarted in order to read in the Environmental Variable that tells ADS where to find the RS ADS Interface.

Please restart ADS. This might be necessary 2 times.

**Question**

After installing and starting the RS ADS interface, the message




pops up.

**Answer**

Please install the VISA interface by downloading and installing the latest version using either

- National Instruments VISA (http://www.ni.com/visa) or
- Agilent VISA (http://www.agilent.com > search for "VISA")

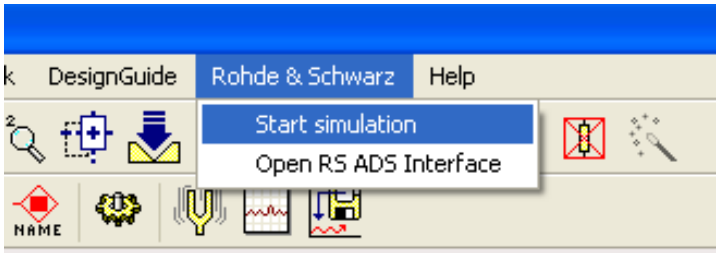
**Question**

When I press the Simulation button

the simulation starts, but stops due to errors, and the instruments are not controlled by the PC

**Answer**

Please use the menu entry "Rohde & Schwarz > Start simulation"




in order to start the simulation with R&S instrument integration.

**Question**

I can not find my instrument connected via the network interface.

**Answer**

Please start the RS ADS Interface, use the VISA Resource Editor and add a Network instrument connection by using the "Add" button.

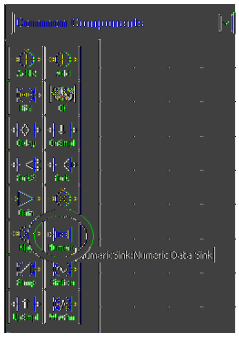
**Question**

When I start my digital simulation with the ARB sink, the error message: *"There are no sources or sinks that control the simulation"* occurs.

**Answer**

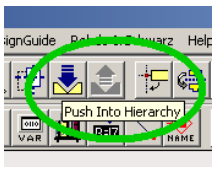
The ARB_IQ_Sink component is set to *"ControlSimulation = NO"* by default. It will collect as many data as are available.
Please insert a source that has the attribute *"ControlSimulation = YES"*.

As a workaround (if you do not have any other elements controlling the simulation), add a "NumericSink" control that controls the simulation:



If this is not possible in your design, please push into the ARB_IQ_Sink (select the button below and click the ARB_IQ_Sink component) and set both TimedDataWrite elements to "ControlSimulation = YES".

Details on the Control of the Simulation can be found in the ADS Manual "ADS Ptolemy Simulation", Chapter 3, Paragraph "Sources and Sinks Control the Simulation".




Note that these settings will NOT be stored when leaving the design.

**Question**

When I run a simulation based on an S4P model I get the error “Not all S-parameters on one channel”.

**Answer**

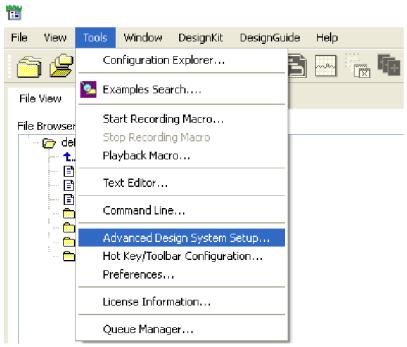
Please make sure that all S-Parameters that are to be measured are on one channel. An easy way is to use the “All S-Params” soft key on the instrument.

**Question**

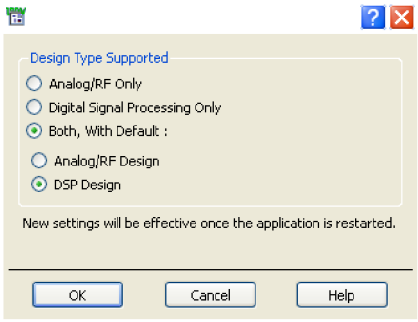
When I open a design containing R&S instruments, I get error messages and the symbols of the instruments are missing

## Answer

You have only support for an activated design type. Please change this in the menue entry *"Tools -> Advanced Design System Setup..."*




Set the supported design types to: *"Both, With Default:"* and choose your default type.



# 14 Details of operation

| Interoperation concept | | |
|---|---|---|
| **When the simulation is started via ADS using the special "Rohde & Schwarz >> Start simulation" menu entry, the following steps are executed:** | | |
| 1) | The current schematic is scanned for R&S components (this does not include hierarchical schematic components in lower layers). | |
| 2) | For each R&S component, all parameters are dumped to a file "RSADSIF.INI" in the base directory of the current project. | |
| 3) | The external tool "RSADSIF.EXE" is called with the parameters | |
| | - /PROPATH=<Project Path> | to pass the project directory |
| | - /PRE_RUN | to indicate a pre-simulation run |
| 4) | RSADSIF will establish the connection to the instruments, do all the configuration work, perform all measurements and store all acquired data in the "/data" directory of the current project. | |
| 5) | The simulator will start and run the simulation | |
| 6) | The external tool "RSADSIF.EXE" is called with the parameters | |
| | - /PROPATH=<Project Path> | to pass the project directory |
| | - /POST_RUN | to indicate a post-simulation run |
| 7) | RSADSIF will establish the connection to the instruments, do all the configuration work and load all simulated data from the "/data" directory of the current project to the instruments. | |

# 15 Literature


[1] Operating Manual Vector Network Analyzer R&S ZVA / ZVB

[2] Operating Manual Signal Analyzer R&S FSQ

[3] Operating Manual Spectrum Analyzer R&S FSU

[4] Operating Manual Spectrum Analyzer R&S FSP

[5] Operating Manual Spectrum Analyzer R&S FSV

[6] Operating Manual Vector Signal Generator R&S SMU

[7] Operating Manual Vector Signal Generator R&S SMBV

[8] Operating Manual IQ Modulation Generator R&S AMU

[9] Operating Manual R&S AFQ100A

[10] Operating Manual R&S AFQ100B

[11] Application Note 1MA147 "Using the ExIQ Box with FSQ and Agilent ADS Software"

[12] NI-VISATM User Manual, National Instruments
Available for free download:
http://www.ni.com/visa

[13] Agilent IO Library Suite - Agilent VISA User's Guide
will be installed if you install Agilent VISA on your PC (see subfolder "Documentation" and "Help" in the corresponding Start Menu folder)

[14] Using Instruments, Agilent Technologies (part of the ADS documentation)
Available for free download:
http://www.agilent.com/find/eesof-docs

[15] Understanding file formats, Agilent Technologies (part of the ADS Ptolemy documentation)
Available for free download:
http://www.agilent.com/find/eesof-docs

[16] Working with data files, Agilent Technologies (part of the ADS Circuit Simulation documentation)
Available for free download:
http://www.agilent.com/find/eesof-docs

[17] Design Kit Installation and Setup, Agilent Technologies (part of the ADS documentation)
Available for free download:
http://www.agilent.com/find/eesof-docs

[18] Operating Manual Spectrum Analyzer R&S FSV

# 16 Additional Information

After installation, the latest program information can be found in the file Changes.txt in the installation directory. You can access this file also from link Programs/ RS ADS Interface/History from your Start Programs folder.

For general information about using the supported R&S instruments and its features, please see the corresponding Operating Manuals.

Please contact TM-Applications@rohde-schwarz.com for comments and further suggestions.

# 17 Ordering information

| Vector Signal Generator*) and I/Q Modulation Generator*) / Modulation Source Options | | |
|---|---|---|
| R&S AFQ100A | IQ Modulation Generator | 1401.3003.02 |
| R&S AFQ100B | UWB Signal and I/Q Modulation Generator | 1410.9000.02 |
| | | |
| R&S AMU200A | Basic Instrument | 1402.4090.02 |
| R&S AMU200A -B9 | Max. 128 Msamples I and Q, Dig. Modulation | 1402.8809.02 |
| | | |
| R&S SMU200A | Basic Instrument | 1141.2005.02 |
| additional RF options | up to 100 kHz ... 6 GHz for 1st path | --- |
| R&S SMU-B13 | Baseband Main Module | 1141.8003.02 |
| R&S SMU-B11 | Max. 16 Msamples I and Q, Dig. Modulation | 1159.8411.02 |
| | | |
| R&S SMJ100A | Basic Instrument | 1403.4507.02 |
| additional RF options | up to 100 kHz ... 6 GHz | --- |
| R&S SMJ-B13 | Baseband Main Module | 1403.9109.02 |
| R&S SMJ-B11 | Max. 16 Msamples I and Q, Dig. Modulation | 1403.9009.02 |
| | | |
| R&S SMBV | Base Unit | 1407.6004.02 |
| R&S SMBV-B103 | 9 kHz to 3.2 GHz | 1407.9603.02 |
| R&S SMBV-B51 | Baseband Generator with ARB (32 Msample), 60 MHz RF bandwidth | 1407.9003.02 |

| Signal Analyzer*), Spectrum Analyzer*) and Options | | |
|---|---|---|
| R&S FMU36 | 36 MHz I/Q bandwidth, 16 to 705 Msample I/Q | 1303.3500.02 |
| | | |
| R&S FSG8 | 9 kHz to 8 GHz | 1303.0002.08 |
| | | |
| R&S FSQ3 | 20 Hz ... 3.6 GHz | 1155.5001.03 |
| R&S FSQ-B71 | Analog Baseband inputs | 1157.0113.02 |
| R&S FSQ-B17 | Digital Baseband Interface | 1163.0063.02 |
| | | |
| R&S FSU3 | 20 Hz ... 3.6 GHz | 1166.1660.03 |
| | | |
| R&S FSUP8 | 9 kHz ... 8 GHz | 1166.3505.08 |
| | | |
| R&S FSP3 | 9 kHz ... 3 GHz | 1093.4495.03 |
| | | |
| R&S FSV3 | 9 kHz to 3.6 GHz | 1307.9002.03 |
| R&S FSV-B17 | Digital Baseband Interface | 1310.9568.02 |
| | | |
| R&S FSL3 | 9 kHz to 3 GHz | 1300.2502.03 |
| **Network Analyzers*)** | | |
| R&S ZVA8 | 2-port Vector Network Analyzer 300 KHz ... 8 GHz | 1145.1110.08 |
| R&S ZVA8 | 4-port Vector Network Analyzer 300 KHz ... 8 GHz | 1145.1110.10 |
| R&S ZVB4 | 2-port Vector Network Analyzer 300 KHz ... 4 GHz | 1145.1010.04 |
| R&S ZVB4 | 4-port Vector Network Analyzer 300 KHz ... 4 GHz | 1145.1010.06 |
| R&S ZVT8 | Multiport Vector Network Analyzer 300 kHz... 8 GHz | 1300.0000.08 |
| R&S ZVL3 | Vector Network Analyzer, 3 GHz, 2 ports | 1303.6509.03 |

*) The use of other models is also possible. Only the instrument's minimum configuration for this application is stated. Please ask your local representative for a configuration suiting your needs.

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