

Using R&S® Instruments within Agilent® ADS® Software Application Note

Products:

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

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® and LINUX® operating systems are available.

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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 presented. 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 ZVA / ZVB / ZVT ZVL	RS_S1P_Model RS_S2P_Model RS_S3P_Model 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 FSG / FMU36 / FSP / FSU / FSUP / FSQ / 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, SMIQ+B60, 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* 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" 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.

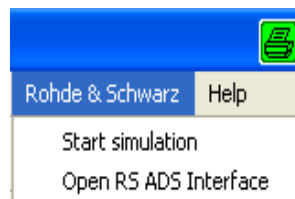
Please restart ADS in order to complete the Design Kit installation.

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:

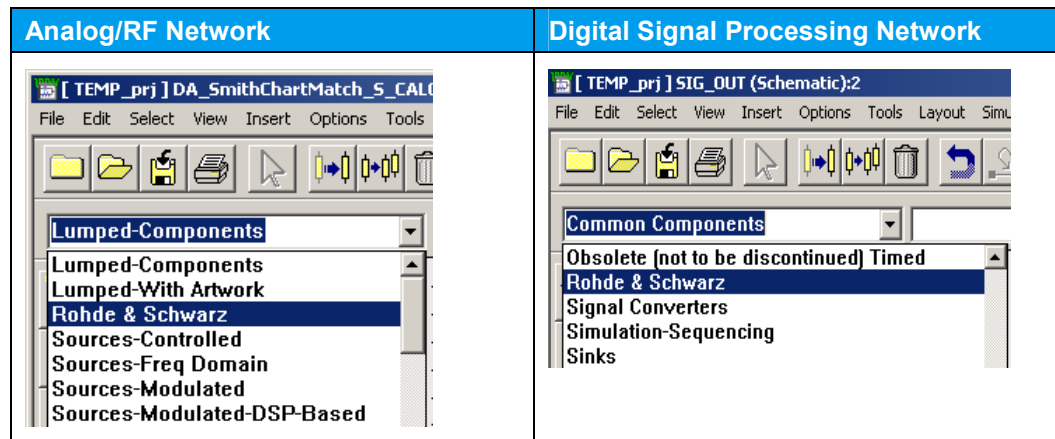


Use "*Start simulation*" to start your simulation in combination with a data import and export from the R&S instruments.

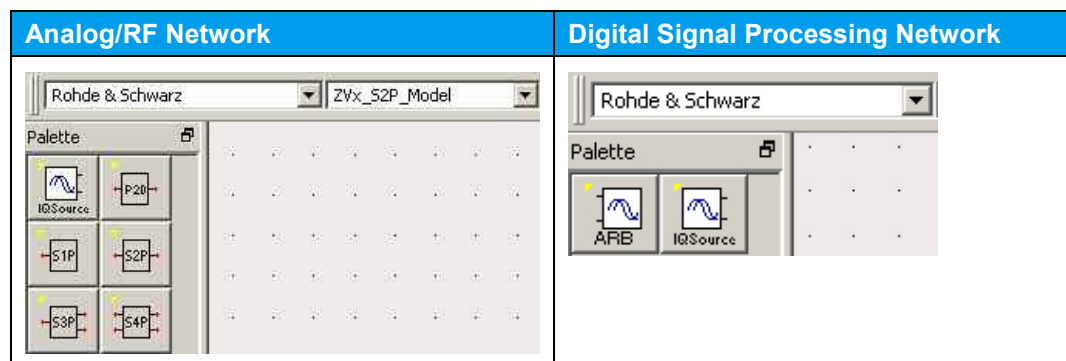
Use "*Open RS ADS Interface*" for configuration of the instrument connection and interface customization.

2. New Component Entries

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



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



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.

Welcome

You are using an unregistered version of RSADSIF. This version has full functionality and no expiration date. As we are continuously improving the program, we depend on your comments and experience with RSADSIF. Therefore, we kindly ask you to register RSADSIF. Registration is free of charge and does not obligate you or your company.

To register:

1. Fill out the registration form below.
2. Click 'Copy Registration Form to Clipboard'.
3. Open your mail client and paste the clipboard into the email message field with 'Ctrl-V'.
4. Send the registration form to TM-Applications@rohde-schwarz.com.

You will receive an email from Rohde & Schwarz with your registration key.

Name *

* The registration key is derived from your name. Please fill out Email and country as well. All other fields may be filled out optionally. Please help us by also providing these few details.

Company Dep.

Street City

Telephone Country *

Email *

Comments

Once you received your registration key

1. Enter your User Name and Registration Key.
2. Click 'Continue'.

RSADSIF will start immediately. This registration form will no longer appear at program start.

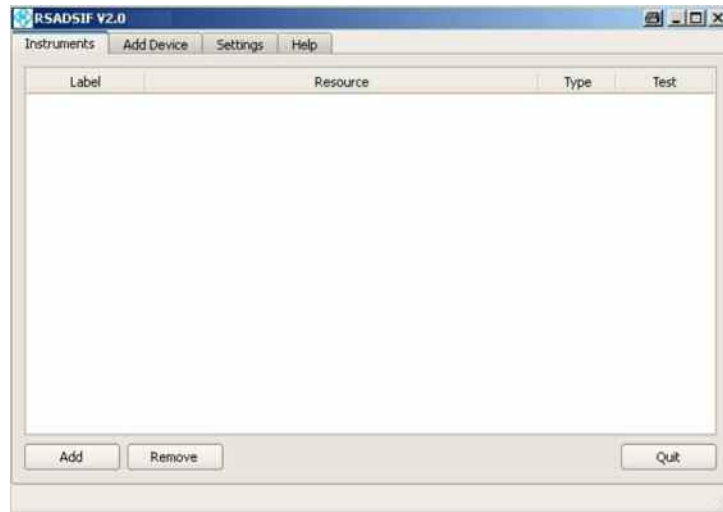
User Name

Key Code

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



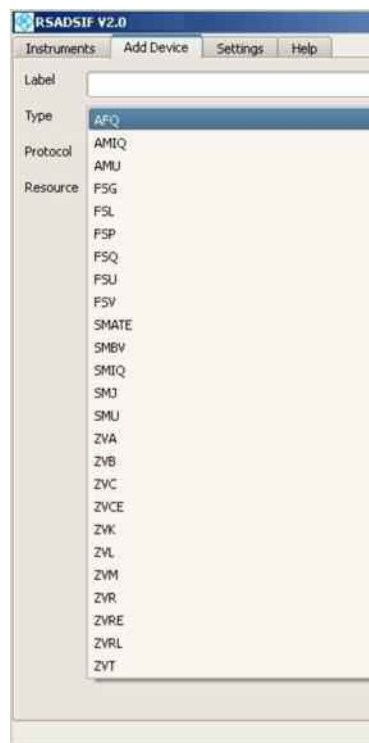
5.2 Operating

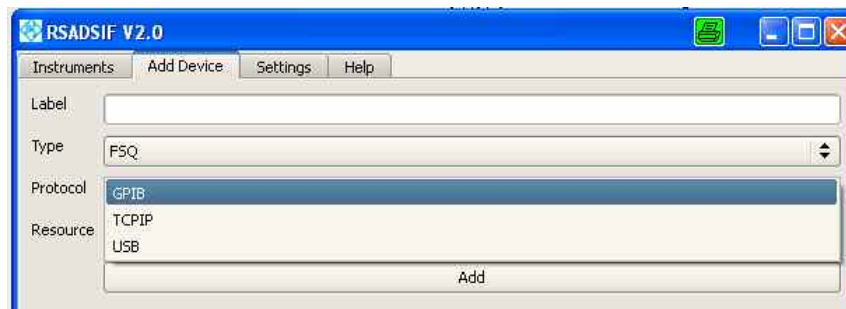


The RS ADS Interface software supports the usage of any interface to connect to the instrument (IEEE bus, LAN interface, USB).

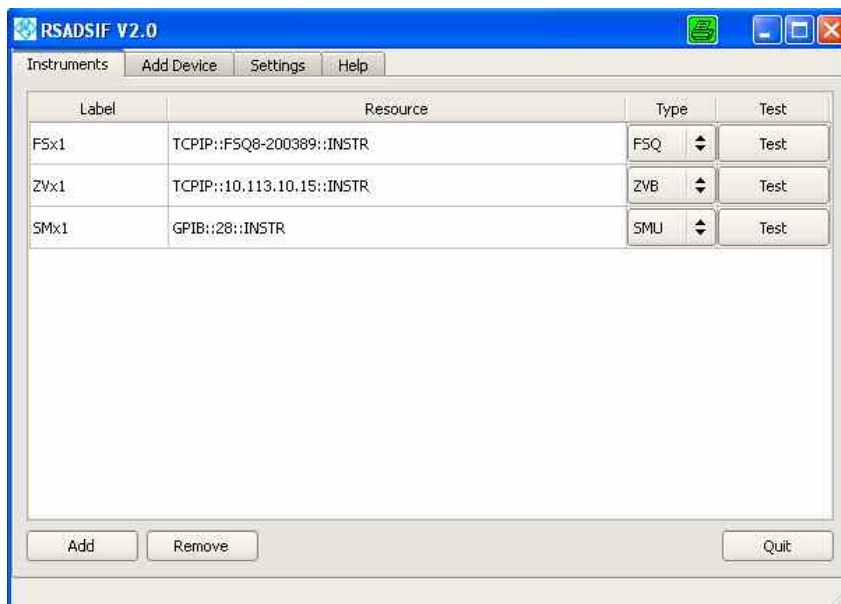
Use the tab Add Device to add instruments to your setup:

Choose a label, an instrument type, the protocol and the resource:





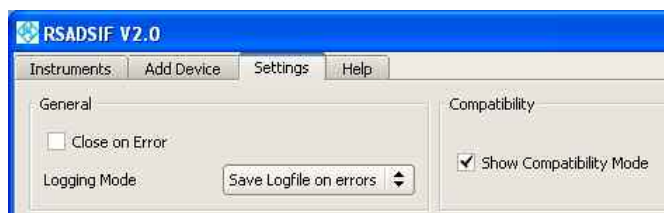
Examples for connecting instruments via LAN and GPIB:

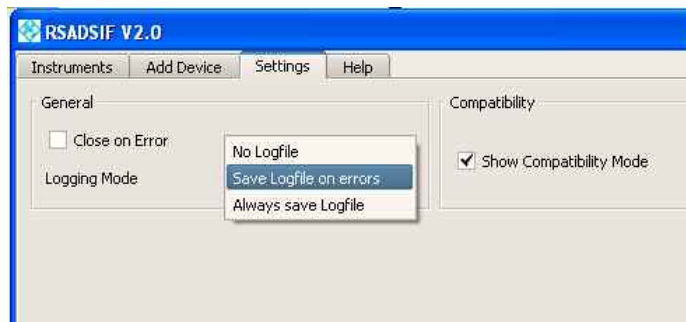


Using "Remove", the selected entry can be deleted.
 "Rename" will change the selected resource entry.

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.

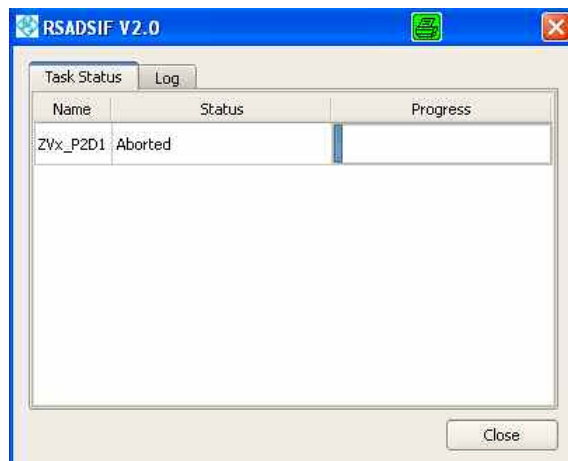




The path for saving a logfile is: Path: C:\WINNT\RS\RSADSIFLOG



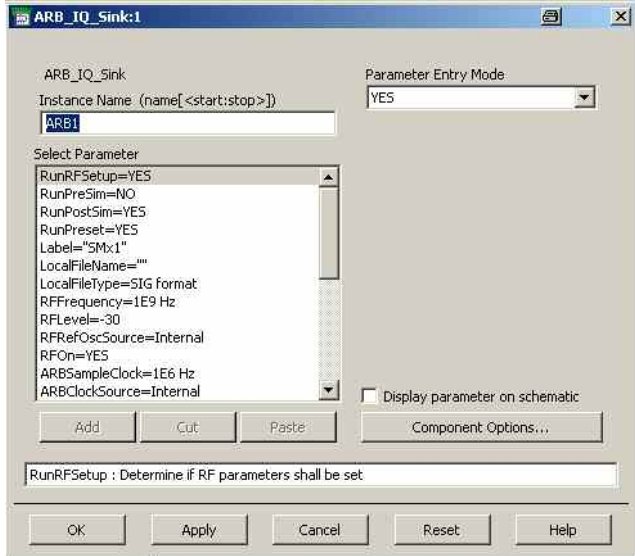
While running the simulation

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:

Example: ARB Sink

```

DF
: DF
: DF
DefaultNumericStart=0
DefaultNumericStop=157*SymbolTime/TStep
DefaultTimeStart=0 * SymbolTime
DefaultTimeStop=157 * SymbolTime
DefaultSeeds=1234567
: OutVar="E60lv"

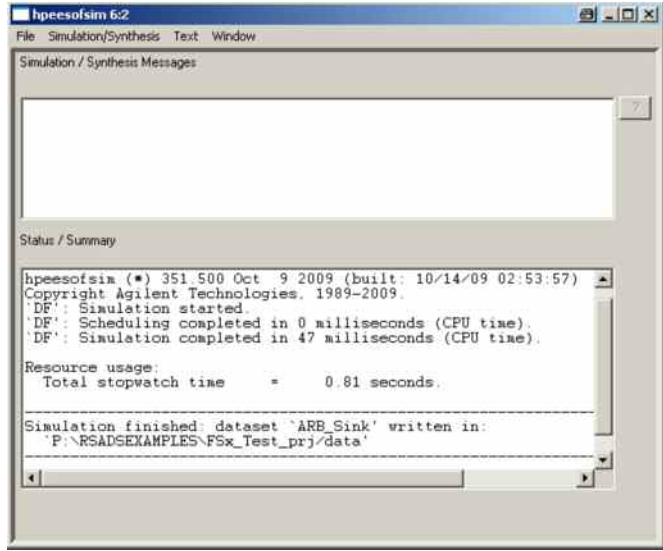
VAR
VAR2
SymbolRate=1 MHz
deltaF=1.5*SymbolRate
deltaP=0
RF_Freq=2. GHz
SoftLim=100
Rpp=0
NF=0
Random=1
TStep=SymbolTime / SampPerSymbol
SampPerSymbol=10
SymbolTime=(1/SymbolRate) sec.
EBN=40
ModOutPower=dbmtoW(-40)
Eb=ModOutPower * SymbolTime / 2
Ns=Eb / (10** EBN / 10 %)

NoisePwr=No * ( 1 / TStep )
NoiseStdDev=sqrt( NoisePwr * 50 )

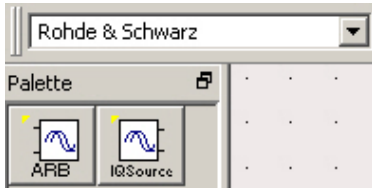
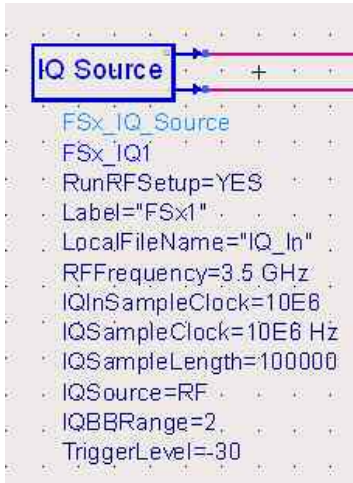
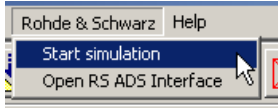
ARB_Sink
ARB_Sink
LocalFileName=""
RFFrequency=1000E6 Hz
RFLLevel=0
ARBSampleClock=1/TStep
ARBSampleName="ADS_NY"
ARBComment="no comment"
    
```

7) Start the simulation using the menu entry "Rohde & Schwarz > Start simulation":

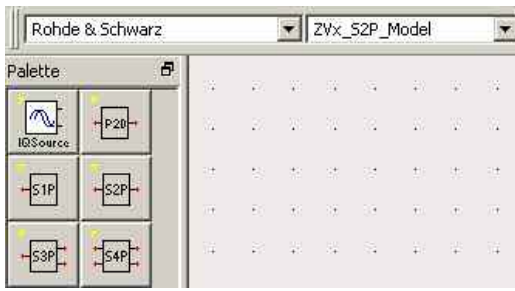
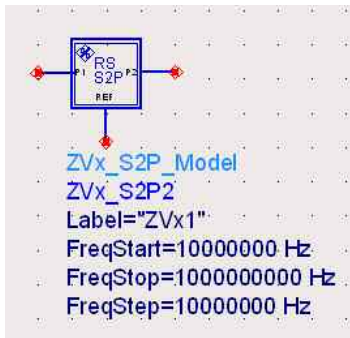
8) Wait until the simulation has finished:

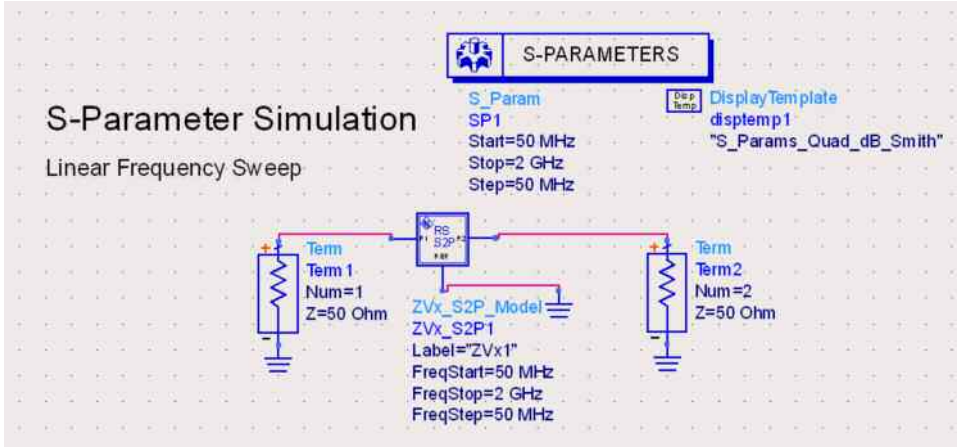
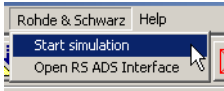
	 <p>The screenshot shows the 'hpeesofsim 6.2' application window. The title bar includes 'File Simulation/Synthesis Text Window'. The main area is divided into two sections: 'Simulation / Synthesis Messages' (which is currently empty) and 'Status / Summary'. The 'Status / Summary' section contains the following text:</p> <pre>hpeesofsim (*) 351 500 Oct 9 2009 (built: 10/14/09 02:53:57) Copyright Agilent Technologies, 1989-2009. 'DF': Simulation started. 'DF': Scheduling completed in 0 milliseconds (CPU time). 'DF': Simulation completed in 47 milliseconds (CPU time). Resource usage: Total stopwatch time = 0.81 seconds. Simulation finished, dataset 'ARB Sink' written in: 'P:\RSADSEXAMPLES\Fsx_Test_prj\data'</pre>
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 "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 " <i>Rohde & Schwarz > Start simulation</i> ":
	
8)	Wait until the simulation has finished and the R&S ADS Interface dialog box closes.
9)	Evaluate your simulations results.

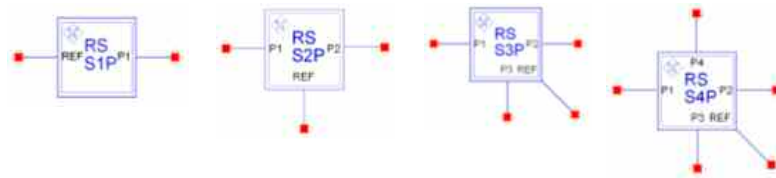
7 Model Source Instruments

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 swept 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

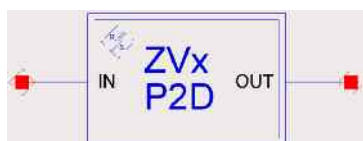
Pins and Files		
Name	Description	Signal Type
Pin "REF"	Reference Port	S parameter
Pin "P1"..."P4"	Ports of the DUT	S parameter
File Format	SnP file format	---

Footnotes	
1)	<p>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.</p> <p>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.</p>

Notes	
1)	<p>RunPreSim and RunPostSim determine if the communication with the instrument shall be done before and/or after the simulation of the circuit.</p> <p>If you do not want the simulator to control the component, select NO for both values.</p>
2)	<p>If RunPreset is selected, the instrument will be reset and all channel assignments, ... will be executed before other settings are performed on the instrument.</p> <p>If RunPreset is not selected, the necessary channels are queried automatically from the instrument.</p> <p>S parameters distributed on several channels can not be used for this measurement.</p>
3)	<p>If RunRFSetup or RunPreset is selected, the settings for FreqStart, FreqStop, and FreqStep will be executed.</p>
4)	<p>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.</p>

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 swept 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"	--	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
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. 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. If RunPreset is not selected, the necessary channels are queried automatically from the instrument. 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.

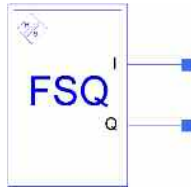
Required Licences:

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/ 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
RRefOscSource	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 <ul style="list-style-type: none"> • for FSQ / FMU36 / FSG in the range of 10 kHz to 81.6 MHz in 0.1 Hz steps • for FSQ with option FSQ-B72 in the range of 20.4 MHz to 326.4 MHz in 0.1 Hz steps • for FSU / FSUP / FSP to discrete values: 32 MHz / 2n, n = 0 .. 11, resulting in a range of 15.625 kHz to 32 MHz • For FSV in the range of 100 Hz to 45 MHz in 0.1 Hz steps • For FSV with R&S®FSV-B70 option in the range of 100 Hz to 128 MHz in in 0.1 Hz steps • For FSL in the range of 10 kHz to 65.8 MHz
3)	The number of samples can be set <ul style="list-style-type: none"> • for FSQ / FSU / FSUP / FMU36 / FSG continuous in a range of 1 to 16.776.704 • for FSP without option FSP-B70 in a range of 1 to 130.560 • for FSP with option FSP-B70 in a range of 1 to 523.776 • for FSV continuously in a range of 1 to 20.000.000 • for FSL continuously in a range of 1 to 512.000
4)	20 MHz and 50 MHz filters are available with FSQ only. For FSV 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. 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. 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. 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, RFLLevel, RRefOscSource and RFOOn 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. If you want additional copies of the file in the SIG or TIM format, you can specify LocalFileName and LocalFileType for name and type. 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. 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. 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). 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_systeme) 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. DefaultTimeStart/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	YES	--	bool
LocalFileName	Name of the copy of the IQ data file (extension-free) 2)	"	--	string
LocalFileType	Type for file Pin "Q" on disc: TIM, SIG, WV	SIG	--	enum

RFFrequency	RF Frequency ¹⁾	1 GHz	Hz	real
RFLevel	RF Level ¹⁾	-30 dBm	dBm	real
RFFreqOscSource	Source for the 10 MHz reference frequency: INT, EXT	INT	--	enum
RFOOn	Determine if RF is switched on after IQ data download; YES, NO ¹⁾	YES	--	bool
ARBSampleClock	Clock rate of the D/A converter ³⁾	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
ARBOOn	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 ⁴⁾	AUTO	--	enum
IQWideBand	IQ Wideband Mode: ON, OFF ⁴⁾	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 ⁵⁾	NO	--	bool
IQDigBitWidth	Digital output bit width: 1 ... 16 ⁶⁾	14	--	int
IQDigBitAlignment	Digital output bit alignment: LSB lowest, MSB highest ⁶⁾	LSB lowest	--	enum
IQDigBitUnused	Digital output unused bits state: LOW, HIGH ⁶⁾	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)	Not supported for AMIQ, AMU or AFQ.		
2)	If no filename is entered, no copy is generated on the local PC and the file is only downloaded to the ARB.		
3)	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	
4)	Only available for SMU/SMJ100A.		
5)	Only available for AMIQ-B2 / SMU-B16 / SMJ-B16 / AFQ100A / AMU200A / AFQ.		
6)	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. If you do not 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 frontpanel) 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 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. If you want additional copies of the file in the SIG or TIM format, you can specify LocalFileName and LocalFileType for name and type. The complete filenames will be <LocalFileName>_[I/Q].[SIG/TIM].
5)	If ARBSampleClock is set to 0, the Samples Clock is derived from the timing of the simulation. Otherwise, the entered value will be used. At least 1 component in the design must specify the timing.
6)	If ARBOn is selected, the ARB will be reset, the file generated (name ARBFileName) by the simulation will be loaded and started.
7)	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. 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.
8)	Data are always written in the non-volatile memory of the instrument.

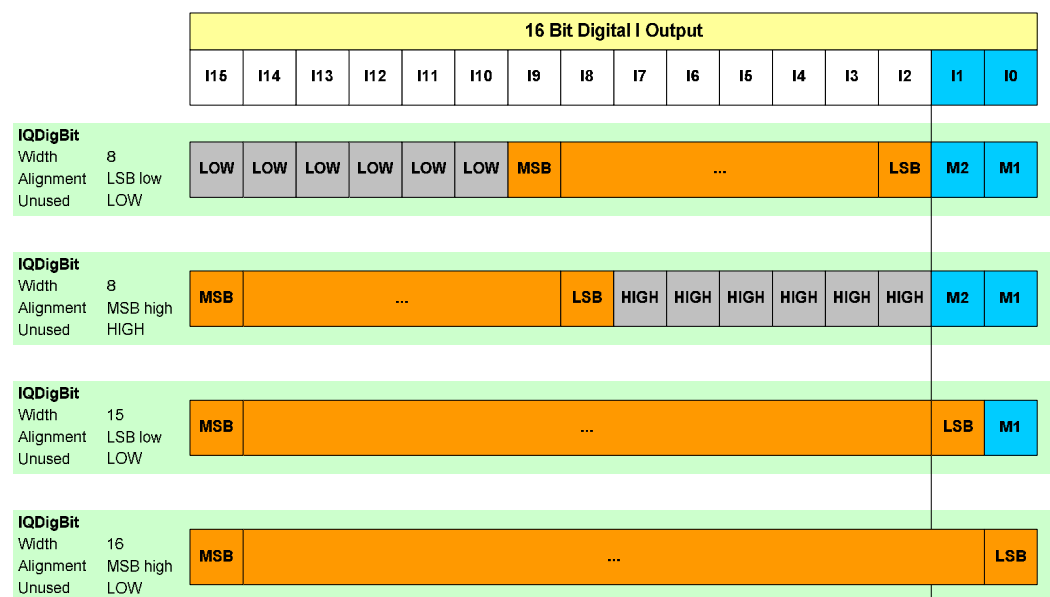
Digital Outputs (AMIQ-B2)

The RS ADS Interface is capable to output a digital bit pattern represented by Integer values (16-bit fixed point) to the AMIQ digital outputs (AMIQ-B2). The valid integer range is $0 \dots 2^{16} - 1 = 65.535$.

Digital outputs can be controlled using the 3 parameters IQDigBitWidth, IQDigBitAlignment and IQDigBitUnused. The digital bit stream is build up by the following steps:

1. Evaluate the number of used bits = Resolution (starting from LSB and search the highest MSB which is not 0 for the complete stream).
2. Adjust the pattern to the resolution specified by IQDigBitWidth. If Resolution > IQDigBitWidth, the last LSB's are truncated. If Resolution < IQDigBitWidth, the "new" LSB's will be filled with 0.
3. Align the pattern as specified in IQDigBitAlignment.
4. Fill not-used bits with 0 / 1 as specified in IQDigBitUnused.
5. Apply the marker patterns to marker outputs if IQDigBitWidth < 15.

The following image shows a detailed description about how the configuration of the Digital Outputs AMIQ-B2 can be configured:



Required Licenses

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

10 Hardware and Software Requirements

10.1 PC Requirements

Recommended system configuration for the provided R&S software:

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

Or:



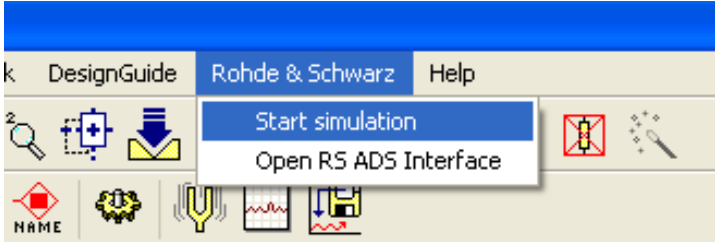
LINUX REDHAT
- Generic PC requirements:
 - Pentium II 450 MHz or higher
 - 1024 MByte
 - 100 MByte free hard disc space plus space for storing data files
 - XGA monitor (1024x768)
- IEC/IEEE bus interface
(for instrument control over IEEE Bus)
- LAN interface
(for instrument control over LAN interface)

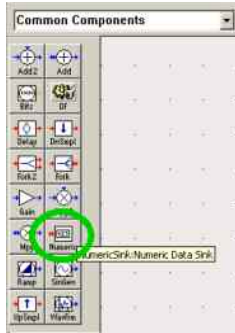
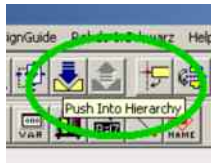
10.1.1 Software Requirements

- 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 aboveOR:
 - 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.

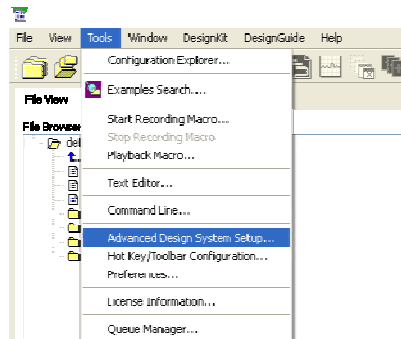
11 Frequently Asked Questions

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
	 <p>pops up.</p>
Answer	
	Please install the VISA interface by downloading and installing the latest version using either <ul style="list-style-type: none"> • 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
	 <p>the simulation starts, but stops due to errors, and the instruments are not controlled by the PC</p>
Answer	
	Please use the menu entry "Rohde & Schwarz > Start simulation"
	 <p>in order to start the simulation with R&S instrument integration.</p>

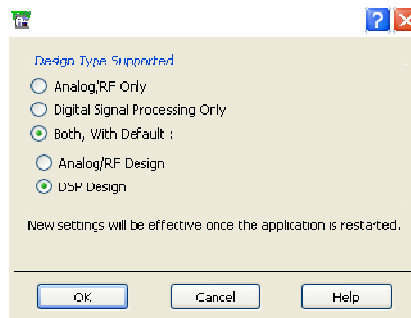
Question	
	I can not find my instrument connected via the network interface.
Answer	
	Please start the RS ADS Interface, use the VISA Resource Editor and add a Network instrument connection by using the "Add" button.
Question	
	When I start my digital simulation with the ARB sink, the error message: <i>"There are no sources or sinks that control the simulation"</i> occurs.
Answer	
	<p>The ARB_IQ_Sink component is set to <i>"ControlSimulation = NO"</i> by default. It will collect as many data as are available. Please insert a source that has the attribute <i>"ControlSimulation = YES"</i>. As a workaround (if you do not have any other elements controlling the simulation), add a "NumericSink" control that controls the simulation:</p>  <p>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 <i>"ControlSimulation = YES"</i>. 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".</p>  <p>Note that these settings will NOT be stored when leaving the design.</p>
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 menu entry "Tools - > Advanced Design System Setup..."



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



12 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			
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">- /PROPATH=<Project Path></td> <td>to pass the project directory</td> </tr> <tr> <td>- /PRE_RUN</td> <td>to indicate a pre-simulation run</td> </tr> </table>	- /PROPATH=<Project Path>	to pass the project directory	- /PRE_RUN
- /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			
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">- /PROPATH=<Project Path></td> <td>to pass the project directory</td> </tr> <tr> <td>- /POST_RUN</td> <td>to indicate a post-simulation run</td> </tr> </table>	- /PROPATH=<Project Path>	to pass the project directory	- /POST_RUN
- /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.			

13 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>

14 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.

15 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.

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system



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