



3010 and 3020 Series Modules



Getting Started with afSigGen

Document no. 46892/678

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Introduction

The afSigGenDll and afComSigGen COM object are software components that provide the functionality of an RF signal generator. They provide an RF signal generator interface to control Aeroflex 3010/3011 ('3010 Series') and 3020/3020A/3025 ('3020 Series') PXI modules using the respective modules' driver software. An afSigGen executable also provides an RF signal generator soft front panel, using the COM object's features.

Signal generator functionality is also available within the PXI Studio application.

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Associated documentation

The following documentation covers specific aspects of this product:

PXI Modules CD-ROM	46886/028	Compilation containing soft front panels, drivers, application software, help files, data sheets and operating manuals for modules in the 3000 Series.
	help files:	af3010 Function Library Reference (af3010 online help) af3020 Function Library Reference (af3020 online help) afSigGen Reference (afSigGen online help)
Operating manuals	46892/637	3010/3011 RF Synthesizer
	46892/638	3020 Digital RF Signal Generator
	46892/717	3020A Digital RF Signal Generator
	46892/721	3025 6 GHz Digital RF Signal Generator
User Guide	46892/808	PXI Studio logical instruments and plugin applications
Data sheet	46891/144	3010/3011 RF Synthesizer
Data sheet	46891/145	3020 Digital RF Signal Generator
Data sheet	46891/235	3020A Digital RF Signal Generator
Data sheet	46891/242	3025 6 GHz Digital RF Signal Generator

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Getting started with afSigGen

Background

PXI

The PXI (PCI eXtensions for Instrumentation) specification defines a rugged PC platform for measurement and automation. The PXI specification defines mechanical, electrical and software specifications and builds upon CompactPCI specifications. PXI offers the same high performance electrical features of the PCI (Peripheral Component Interconnect) standard, such as a 132 MB/sec data rate and plug-and-play functionality in a strong Eurocard format. Its software specification includes support for standard operating system frameworks (such as Win32) and driver support.

Further detailed information including PXI specifications and white papers can be found at the PXI System Alliance website www.pxisa.org.

Aeroflex 3010/3011 RF Synthesizer PXI module

The Aeroflex 3010 is a PXI RF synthesizer covering the frequency range 1500 to 3000 MHz, with a fixed nominal output level of 0 dBm. It can be used as a local oscillator for an Aeroflex 3020 Series digital RF signal generator PXI module.

The 3011 is identical to the 3010, except that the 3011 has a high-stability OCXO fitted.

This document assumes that a 3010/3011 is used as the local oscillator source for the 3020 Series digital RF signal generator module, although a different external frequency source can be used.

Aeroflex 3020 Series digital RF signal generator PXI modules

The Aeroflex 3020 is an RF signal generator output module that contains dividers to give a frequency range of 250 MHz to 2.5 GHz, IQ modulators, leveling control, step attenuation to –120 dBm, and a dual-channel arbitrary waveform generator.

The 3020A module is similar, but has an extended frequency range to 2.7 GHz and provides list mode operation and optional differential I and Q I/O.

The 3025 module is similar to the 3020A, but has an extended frequency range to 6 GHz.

3020 Series modules require an external local oscillator such as a 3010 Series RF synthesizer PXI module or other RF source.

Documentation for 3010 and 3020 Series modules

The following may be helpful in learning more about the 3010 Series RF synthesizer and 3020 Series digital RF signal generator (this documentation is available on the Operating Guide CD-ROM, part no. 46886/028, supplied with modules):

- [Data sheets and operating manuals](#)
- af3010 Online help (function reference)
(default location for a Windows 2000 machine is *C:\VXIPNP\WinNT\af3010\af3010.hlp*)
- af3020 Online help (function reference)
(default location for a Windows 2000 machine is *C:\VXIPNP\WinNT\af3020\af3020.hlp*)
- www.aeroflex.com

Introduction

What is afSigGen?

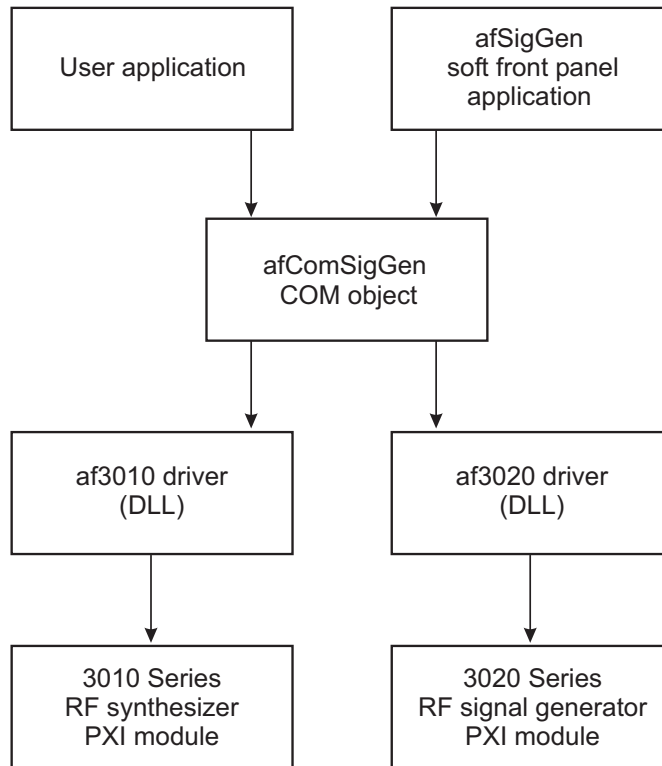
afSigGen is a set of components that provides the functionality of an RF signal generator. It consists of an underlying dll and a pair of wrappers that present alternate interfaces for differing programming environments. Each of the afSigGen components provides an RF signal generator interface to control Aeroflex 3010 Series and 3020 Series PXI Modules using their respective driver modules.

The components consist of an underlying dll (which presents a C interface), a C++ wrapper (supplied in source code form) and a Microsoft COM component. Whilst the C interface or the C++ wrapper will be the programming interface of choice in some environments, many software development environments (such as Microsoft Visual Basic and National Instruments LabVIEW) make the use of COM objects a more natural fit.

Note that any application using any of the afSigGen components can execute correctly only on PXI systems equipped with an Aeroflex 3020 Series module and a supported LO source (normally an Aeroflex 3010 Series module), since it uses the drivers installed in the PXI system to control the respective modules.

What is the Aeroflex signal generator soft front panel?

The Aeroflex signal generator **soft front panel** is a virtual instrument application of the RF signal generator. It is a graphical user interface that interactively operates the afComSigGen COM object (which in turn controls the 3010 Series and 3020 Series modules) and displays the results. Its relationship to other components is shown in Fig. 1.



C6173

Fig. 1 How the afSigGen soft front panel relates to other components

Installing afSigGen

Refer to the 3000 Series Common Installation Guide (part no. 46882/663) for installation instructions for

- drivers
- afSigGenDll and afComSigGen COM object
- soft front panel.

The Common Installation Guide is supplied with each module both as a paper booklet and as a PDF document on the Operating Guide CD-ROM.

Note: Ensure that you install the 3010 Series and 3020 Series PXI module drivers before the dll/COM object and the afSigGen soft front panel application.

Hardware setup

You need to position and interconnect the modules as shown (Fig. 2) for correct operation of the afSigGen control:

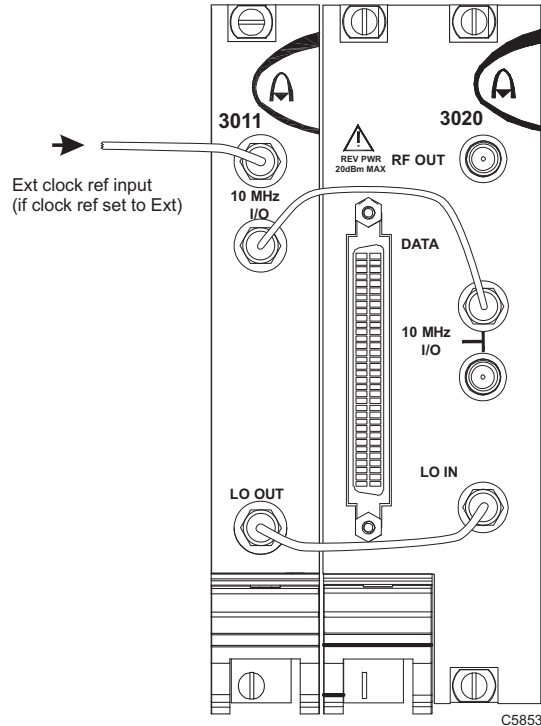


Fig. 2 Example of hardware setup

Note: The PXI chassis may have an embedded PXI controller running the application software or be connected via a PCI-to-PXI interface kit to a computer running the application software.

SigGen hardware can be any combination of 3010 Series and 3020 Series modules.

INTRODUCTION

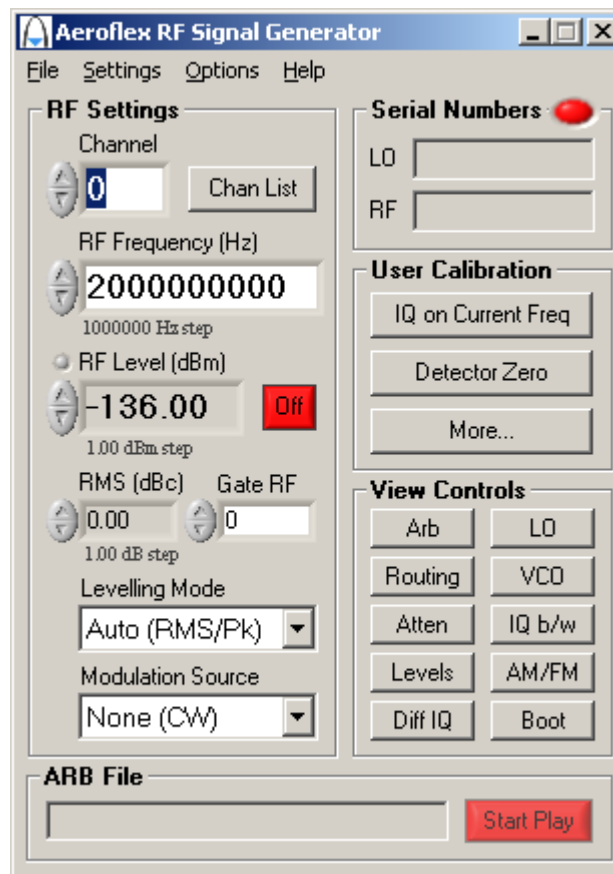
- Locate the 3010 Series module in the slot immediately to the left of the 3020 Series module.
- Make sure that 3010 Series and 3020 Series drivers, the afSigGen controls and soft front panel are installed on the computer (connected to the PXI chassis or on the embedded computer in the PXI chassis).
- If the VCO source of the 3020 Series module is to be set to 'External Reference' (instead of using the PXI backplane 10 MHz signal), link the 10 MHz I/O connectors on the two modules.
- If the 3010 Series module's clock reference is to be set to 'External', link the 10 MHz external clock reference to the 10 MHz I/O connector of either the 3010 Series or 3020 Series module.
- Link LO OUT of the 3010 Series module to LO IN of the 3020 Series module.

Using the afSigGen soft front panel

Start the signal generator soft front panel

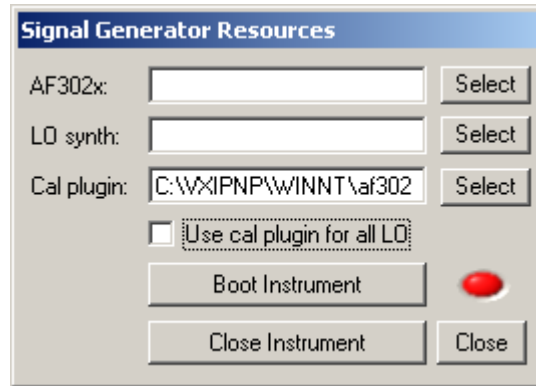
After setting up the [hardware](#) as described on page 7, start the signal generator soft front panel application

(*Start\Programs\Aeroflex\Signal Generator\RF Signal Generator Soft Front Panel*):

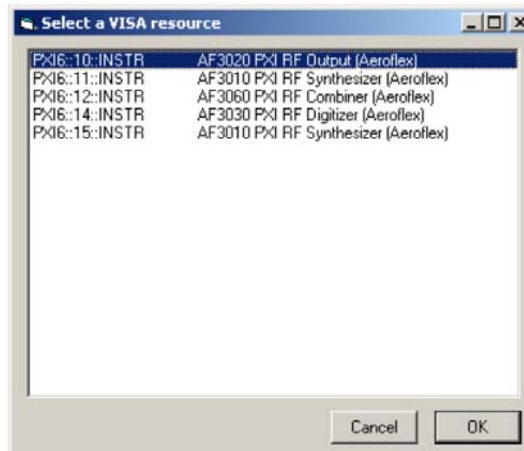


Boot the modules

Press the **Boot** key in the View Controls group. This displays the Signal Generator Resources window:

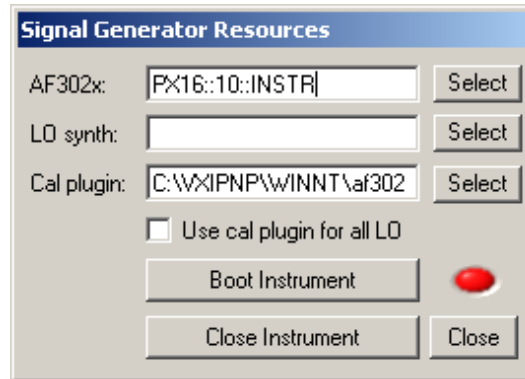


- Press the **Select** button next to the AF302x: text box. This displays the Select a VISA resource window with the 3020 Series resource already selected by default:

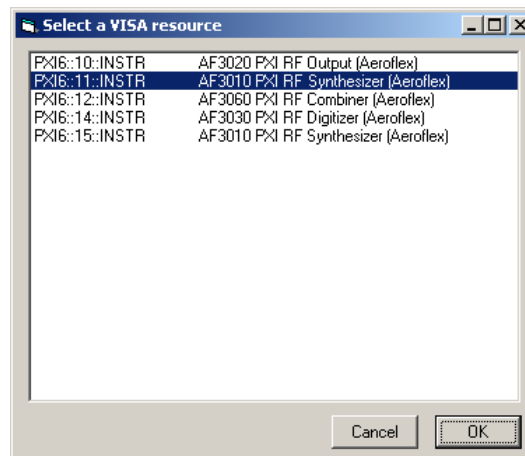


BOOTING AND BASICS

- If you have more than one 3020 Series module in the chassis, select the appropriate 3020 Series resource name and press **OK**. This updates the AF302x resource:

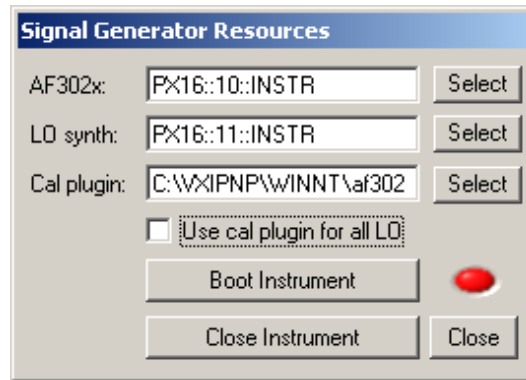


- Press the **Select** button next to the LO synth: text box in the Signal Generator Resources window. This displays the Select a VISA resource window with the first 3010 Series module in the list selected by default:



BOOTING AND BASICS

- If there is more than one 3010 Series module in the chassis, the default selected resource name may not be correct. Select the resource name of the 3010 Series module that is in the slot immediately to the left of the 3020 Series module (in the above case *PXI6::11::INSTR*) and press **OK**. This updates the Signal Generator Resources window:

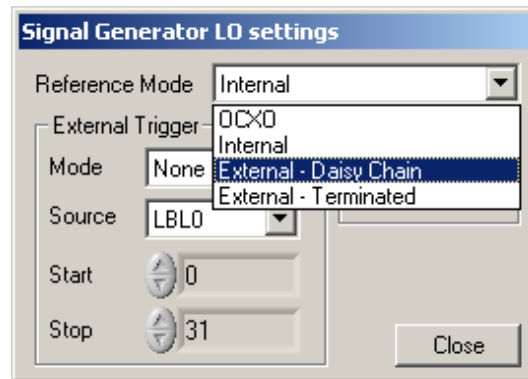


- Press **Boot Instrument** in the Signal Generator Resources window. The 'LEDs' in the Signal Generator Resources and main windows turn yellow during booting and then green if booting is successful. If booting fails or the instrument session is closed (for example, by pressing **Close Instrument**), the indicators turn red.
- The Signal Generator Resources window closes automatically if booting is successful.
- The serial numbers of the LO (3010 Series) and RF sources (3020 Series) are also updated in the main window after a successful boot.

Set the 3010 Series module's clock reference

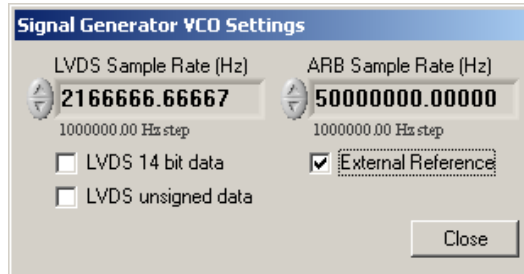
The default clock reference for the 3010 module is *Internal* (OCXO for 3011). To change the 3010 Series module's clock reference, press **LO** in the View Controls group.

- If an external 10 MHz clock reference is connected to one of the 3010 Series module's 10 MHz I/O connectors, and the other 10 MHz I/O connector is used to pass on the 10 MHz clock to another module/instrument, set the Reference Mode to *External - Daisy Chain*.
- If an external 10 MHz clock reference is connected to just one of the 10 MHz I/O connectors and this forms the end of a 10 MHz distribution chain, set the Reference Mode to *External - Terminated*.



Set the 3020 Series module's VCO reference

The default reference source for the 3020 Series module's VCO is internal, derived from the PXI backplane 10 MHz signal. If an external clock reference is connected to the 3020 Series module, it can be enabled by pressing **VCO** in the View Controls group and checking the *External Reference* box.



Generating RF

After booting, by default the signal generator does not generate any RF output. Changing the RF level controls as shown below produces a 2 GHz CW signal at 0 dBm.

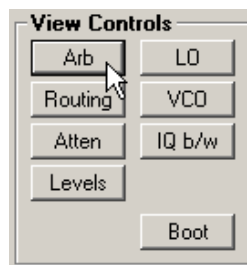


This signal can be checked using a spectrum analyzer (perhaps using a 3030 Series RF Digitizer) or a power meter, connected to the 3020 Series module's RF output. Changes to the signal generator's RF frequency and level should be reflected in the RF output.

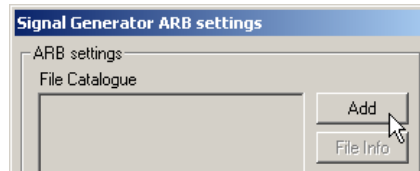
Arbitrary waveform

In order to generate an arbitrary RF waveform, you need to load a file that defines the waveform (made using **IQCreator**[®]):

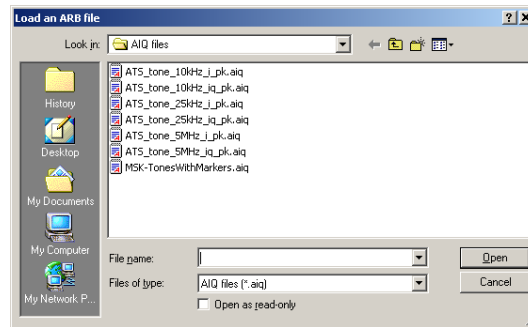
- Press **Arb** in the View Controls group...



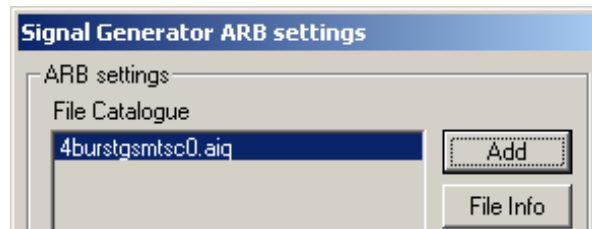
...to display the ARB window.



- Press **Add** in the ARB window, and select the ARB file (.aiq format) you require from the browser.

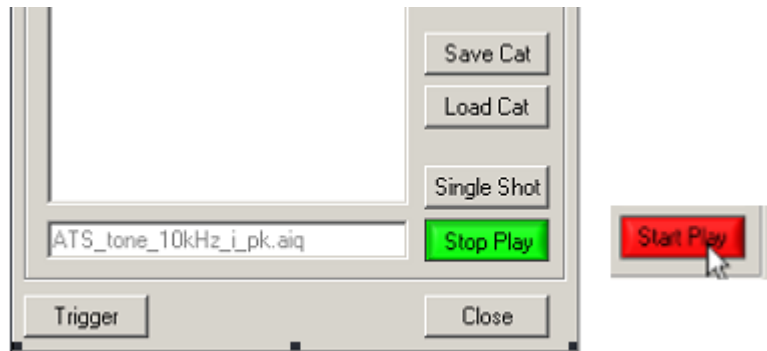


- The selected file appears in the File Catalogue:



BOOTING AND BASICS

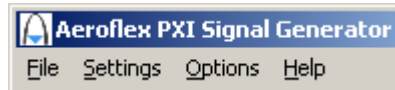
- Pressing **Start Play** causes the ARB file to start playing, and the waveform appears at the module's RF output. **Start Play** acts as a toggle to start and stop the ARB playing; when a file is playing, the button changes to **Stop Play**. Note that when you play an ARB file it automatically sets the soft front panel's Modulation Source to ARB.
- Pressing **Single Shot** plays the waveform once. If the waveform is already playing, pressing **Single Shot** initiates a further single play, after which playing stops.



Detailed soft front panel operation

This section provides more detail about the controls on the signal generator soft front panel. Many buttons and fields on the soft front panel also have associated drop-down help.

Menu bar



File

Click Exit to close the application.

Settings

Load and **Save** allow you to load and save soft front panel configurations from and to your preferred locations. If you did not change the default location when installing the software, it is *C:\Program Files\Aeroflex\SigGen\settings*, and configurations are saved as *.ini files.

You can edit, copy and paste settings files as required; for example, you may want to save only a new routing setup without changing other parameters. Edit the saved .ini file using a text editor (for example, Notepad) to remove unwanted parameters. Ensure only that you do not delete the General (VendorID, DeviceID) and Version (Major/Minor) parameters. Save the changed file. When the settings file is next loaded, the configuration of the soft front panel changes to match the parameters remaining in the settings file, leaving all other settings unchanged.

Directories lets you choose the locations for your front-panel configuration settings, ARB files and catalogs, synthesizer plugin dlls and calibration files.

Synthesizer plugins must support a VXIPNP (VISA) RF synthesizer resource capable of 1.5 GHz to 3 GHz. Certain exported functions are also required: refer to online help for details.

Options

Click **View** to see what options are fitted to the module(s), and access their details separately using the LO and RF radio buttons.

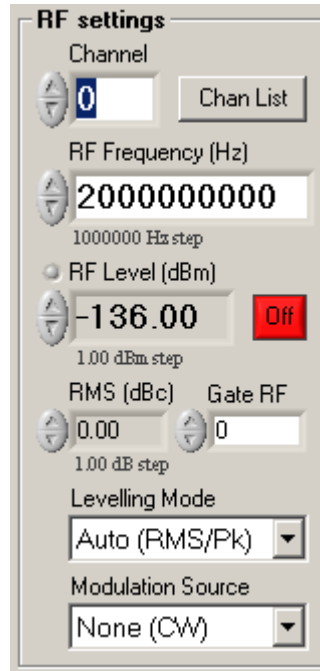
Help

Instrument Information provides revision numbers and serial numbers for both 3010 Series (synthesizer) and 3020 Series (signal generator) software and hardware, together with dates of last calibration.

About provides the version number of the soft front panel.

RF settings

The controls available in this group allow you to configure up to 128 channels using a channel list for frequency, level, leveling mode, and other parameters. These parameters are stored, and are recalled as each channel is selected. This selection can be manual (by clicking the up/down arrows of the Channel field) or by list mode operation.



The image shows a software control panel titled "RF settings". It contains several adjustable parameters:

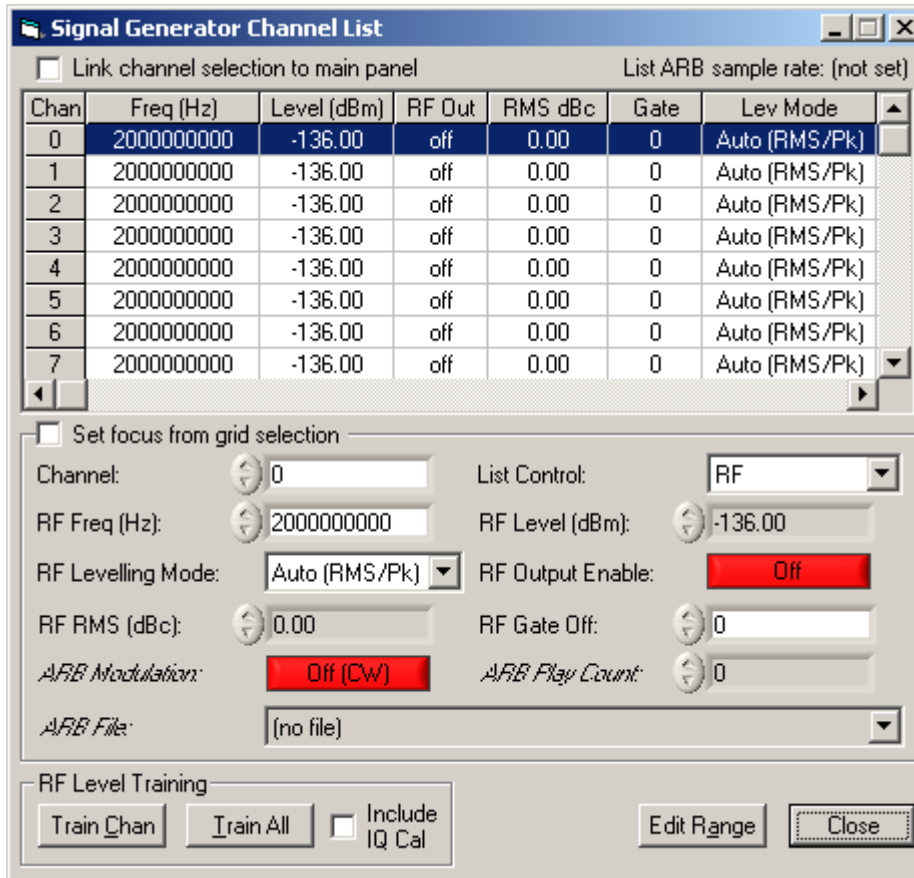
- Channel:** A numeric field showing "0" with up/down arrows and a "Chan List" button.
- RF Frequency (Hz):** A numeric field showing "200000000" with up/down arrows and a "1000000 Hz step" label.
- RF Level (dBm):** A numeric field showing "-136.00" with up/down arrows, a "1.00 dBm step" label, and a red "Off" button.
- RMS (dBc):** A numeric field showing "0.00" with up/down arrows and a "1.00 dB step" label.
- Gate RF:** A numeric field showing "0" with up/down arrows.
- Levelling Mode:** A dropdown menu currently set to "Auto (RMS/Pk)".
- Modulation Source:** A dropdown menu currently set to "None (CW)".

Channel

Sets the currently active channel in a range of 0 to 127.

Chan List

Click this to set up each of up to 128 channels. You can [edit, copy and paste](#) (page 0-18) the settings to make setup quick and easy.



RF SETTINGS ON SOFT FRONT PANEL

Edit the grid in the upper part of the screen by means of the fields in the lower part. Most fields (Channel, RF Freq (Hz), etc) are similar to those on the soft front panel. Edit each channel individually or by range for:

- Channel
- RF Freq (Hz)
- RF Levelling Mode
- RF RMS dBc
- RF Level (dBm)
- RF Output Enable
- RF Gate Off

Click on the link for details. Names of fields on the soft front panel may differ slightly from these, but the function is the same.

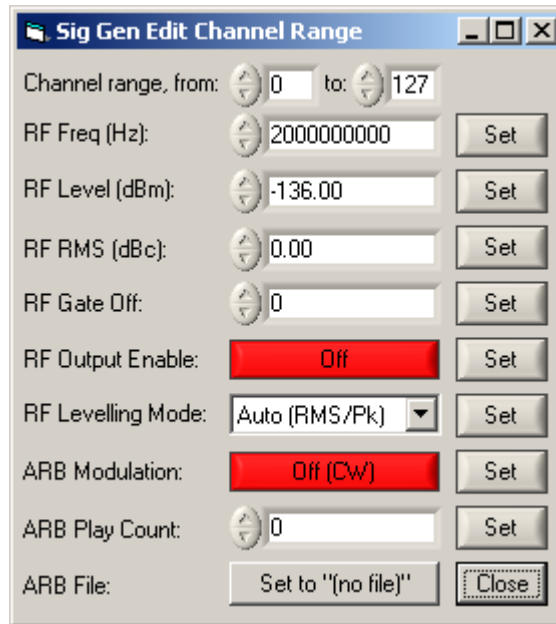
Check the **Set focus from grid selection** box to make the associated field active when you click on a channel parameter in the grid.

If you check the **Link channel selection to main panel** box, changing the channel on this screen also changes the active channel (as shown on the soft front panel) and vice versa.

Click **Edit Range** to display the Edit Channel Range screen, which lets you apply changes to a set of channels simultaneously, speeding up channel setup.

Define start and finish values for address numbers in the **Chan range, from:** and **to:** fields.

Insert values and click **Set** for each field. You are asked to confirm each action. When finished, click **Close** to return to the Channel List screen.



RF Frequency (Hz)

Set the output frequency using the up/down arrows or by entering the frequency in Hz or scientific (e) notation.

Step size: double-click on the step value under the frequency field to set up the size of frequency step.

RF Level (dBm)

Set the output level using the up/down arrows or by entering the value in dBm.

Step size: double-click on the step value under the RF level field to set up the size of level step.

Output

On/Off: enable or disable the RF output.

RMS (dBc)

IQCreator[®] files contain header information that indicates the RMS power level of the waveform. When using other sources of IQ, this information may not be present, in which case the RMS value needs to be entered in order to achieve the calibrated output level.

For files that do not contain RMS level header information, you can enter the RMS value of the signal here, and select **RMS** in the Levelling Mode field. The power output then matches that selected in the RF Level (dBm) field.

Step size: double-click on the step value under the field to set up the size of step for RMS value.

Gate RF

If set to 1 (enabled), this turns the RF output for the active channel off when $\sqrt{(I^2 + Q^2)}$ is near to zero. This minimizes IQ leakage to a nominal -80 dBc during periods when the signal is 'off'.

Levelling Mode

Auto (RMS/Pk) sets leveling automatically to RMS for ARB files that contain appropriate header information (most **IQCreator**[®] files), and to peak-to-peak for inputs that do not contain header information (for example, inputs via the DATA connector).

Frozen freezes leveling at the current settings.

Peak causes the set RF Level to appear at the RF output if you apply full-scale I and Q sample values. As I and Q are decreased, the output decreases proportionally.

RMS causes the set RF Level to appear at the RF output if you apply the RMS I and Q sample values. The module uses the RMS values in the header file; if there are none, it treats the signal as for Peak. Note that if the IQ samples contain peaks that exceed the RMS level, signals at the RF output may exceed the set RF Level. In this case, the maximum permitted RMS output power is reduced to accommodate the peak signal power of the waveform to avoid distortion.

Modulation Source

Select between:

LVDS (external modulation via DATA connector on front panel)

ARB (internal modulation using the arbitrary waveform generator)

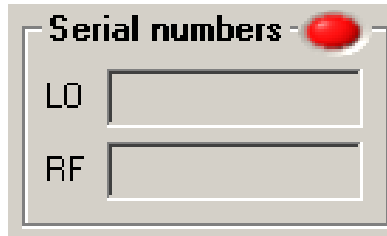
None (CW) (no modulation, carrier wave only). **None (CW)** sets I and Q to maximum level.

Internal AM

Internal FM

External Analog (allows use of IQ analog inputs when Option 001 is fitted to the 3020 Series module).

Serial numbers



The image shows a configuration window titled "Serial numbers" with a red indicator light. It contains two input fields: "LO" and "RF".

Field Label	Field Description
LO	Input field for the serial number of the 3010 Series module providing the LO.
RF	Input field for the serial number of the 3020 Series module.

LO

The serial number of the 3010 Series module providing the LO appears in this field after a successful boot.

RF

The 3020 Series module's serial number appears in this field after a successful boot.

User Calibration

Calibration is needed to ensure that some specifications — such as carrier leak — are met, and are guaranteed only if a user calibration has been performed. The module calibrates at the current frequency, or at a range of frequencies, and stores the results so that if you change frequency and return again, the calibration still applies. In all cases, an LO signal is required.

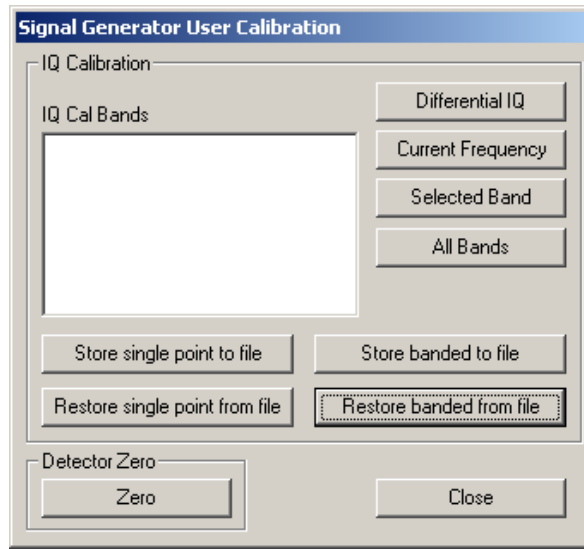
IQ on Current Freq

Calibrates the IQ modulator at the current frequency. Calibration is valid for frequencies within ± 1 MHz of the current frequency.

Detector Zero

Sets the leveling detector to zero. This ensures that the module meets the level accuracy specified in the data sheet.

More...



Differential IQ

Cal Outputs calibrates the differential IQ by setting input or output levels to 0 V and recalibrating DACs.

Cal Inputs nulls out any DC offset present at the input.

Current Frequency

Calibrates the IQ modulator at the current frequency.

Selected Band

Calibrates the IQ modulator over individual bands and returns the instrument to its current state.

All Bands

Calibrates the IQ modulator over the entire frequency range of the module and returns the instrument to its current state.

Store Single Point/Banded to File

Lets you save calibrations using the standard Windows browser. Calibrations are saved as *.ciq* files.

Restore Single Point/Banded from File

Lets you restore *.ciq* calibrations using the standard Windows browser.

Zero

Sets the leveling detector to zero. This ensures that the module meets the level accuracy specified in the data sheet.

View Controls



This group contains separate controls to:

- Set up the ARB function (**Arb**)
- Configure input and output routing between the digitizer, its front panel, and the PXI backplane (**Routing**)
- Configure attenuator settings (**Atten**)
- Define actual/maximum signal levels (**Levels**)
- Configure differential IQ settings (**Diff IQ**)
- Adjust 3010/3011 synthesizer settings (**LO**)
- Configure VCO settings (LVDS/ARB sample rates/ LVDS data position/sign) (**VCO**)
- Define the IQ bandwidth correction (**IQ b/w**)
- Set up internal modulation (**AM/FM**)
- Select signal generator resources and boot the signal generator up (**Boot**)

ARB settings

The **ARB** is a dual-channel arbitrary waveform IQ baseband source generator. It is used to generate signals from samples stored in non-volatile memory. Four marker bits may be stored with the samples, and these are processed to maintain their time relationship to the output waveforms.

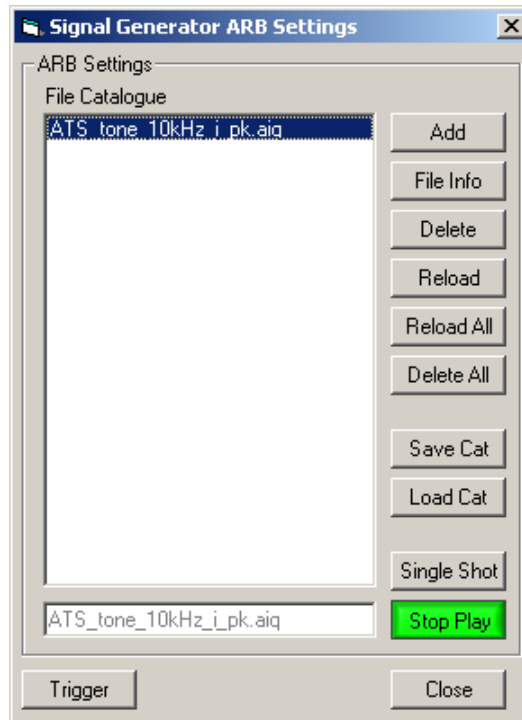
IQCreator[®] is a software package that allows you to create and package an arbitrary waveform file that can be loaded onto a 3020 Series digital RF signal generator. It is also possible to package and download files that have been created using other tools. Arbitrary waveforms that can be created by **IQCreator**[®] cover a wide range of digital modulation schemes.

IQCreator[®] is supplied on a CD-ROM together with a ‘getting started’ manual (part no. 46882/599) that tells you how to create, download and package waveforms to run on the ARB, and a user guide (part no. 46882/627) that details the different modulation schemes supported.

IQCreator[®] and its associated documentation are also available to download from the Aeroflex website <http://www.aeroflex.com/iqcreator>.

File Catalogue

This field displays files currently loaded into the ARB's memory.



Add

Lets you add an ARB waveform to the File Catalogue, using the standard Windows browser. The file must be in *.aiq* format (as generated by **IQCreator**[®]).

File Info

Provides information about the currently selected ARB file, such as file name and maximum output level.

VIEW CONTROLS

Delete

Deletes the currently selected ARB file from the specified catalog.

Reload

Reloads an ARB file from hard disk to the specified catalog.

Reload All

Reloads all ARB files from hard disk. This may improve performance if the ARB memory has become fragmented.

Delete All

Deletes all ARB files from the specified catalog.

Save Cat

Saves a catalog of the currently loaded files into a new folder. This function is available only on the soft front panel.

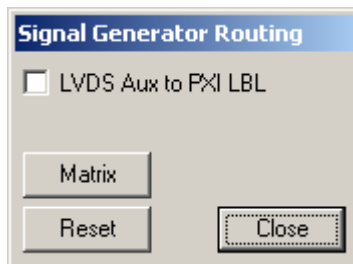
Load Cat

Loads a previously saved catalog of files from a named folder.

Start Play

Plays the selected ARB file and displays its filename. This function automatically sets the IQ source to ARB, and the VCO frequency appropriate to the file being played.

Routing



Matrix

Displays a matrix that provides interconnection between input and output signals on the PXI backplane bus, the DATA connector and the 3020 Series module's internal circuitry, as shown [diagrammatically](#) in Fig. 3. This provides great flexibility in how you route signals between modules.

VIEW CONTROLS

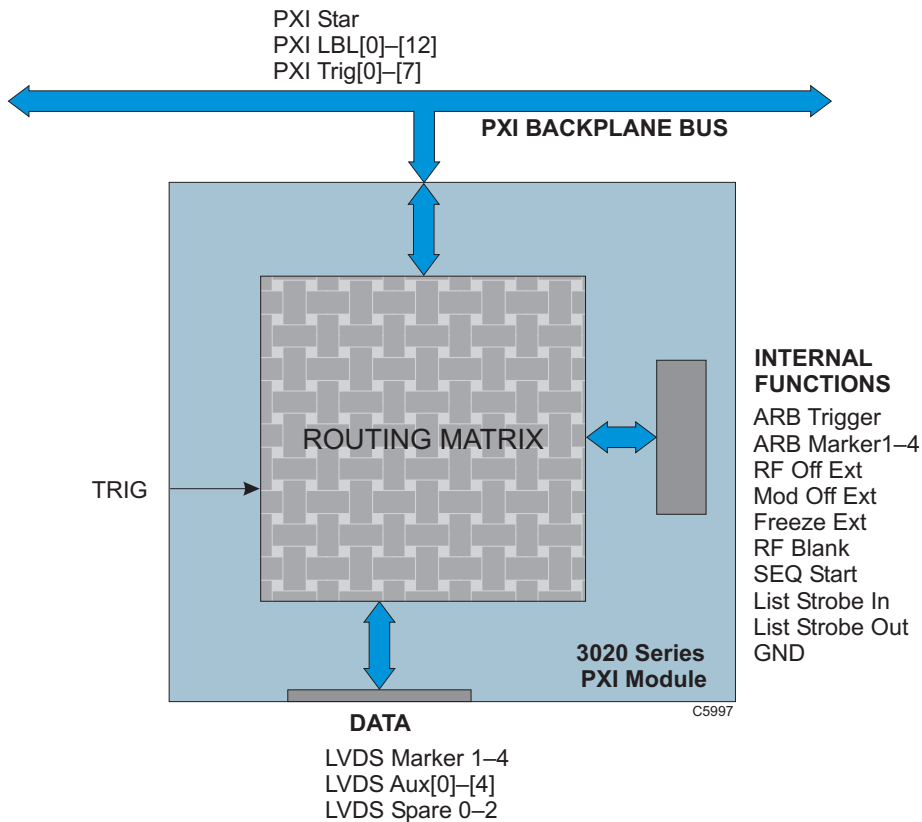


Fig. 3 Routing matrix functions

Use the [routing matrix](#) (page 36) to interconnect signals. Output signals form the body of the matrix. Select appropriate input signals from the drop-down menus under each down-arrow to create the interconnections.

Check the boxes to enable the outputs. **Reset** sets all input signals to GND, which is the default state.

VIEW CONTROLS

When operating the module in default signal generator mode (routing matrix reset), all necessary input, output and trigger signals are available on front-panel DATA, SMA or SMB connectors and there is no need to configure the matrix. If you need to set up particular signal routings, you can define these using the drop-down menus on the matrix and save them using the **Load** and **Save** commands in **Settings**, or use **Routing Scenarios** to access pre-set alternative routings, or contact Aeroflex if you need assistance in defining particular routing requirements.

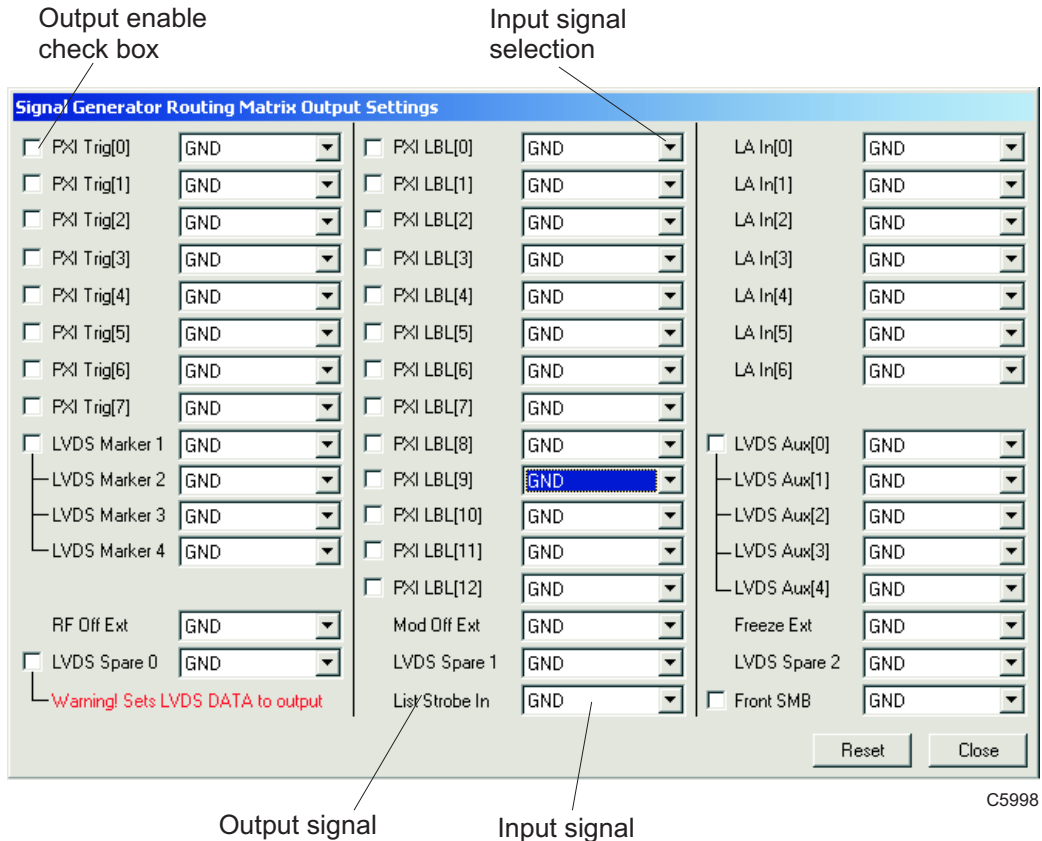


Fig. 4 Routing matrix inputs and outputs

VIEW CONTROLS

Reset

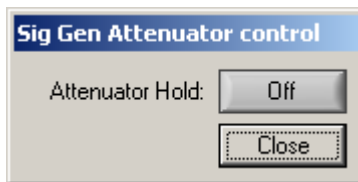
Sets all matrix settings to default values (inputs to GND).

LVDS Aux to PXI LBL

Configures the routing matrix to a frequently used routing scenario of LVDS Aux to PXI local bus connections.

Atten

Attenuator Hold



As the step attenuator changes range, small changes in VSWR can occur. Check the box to freeze the attenuator on its current range. A red indicator beside the RF Level (dBm) field shows either that attenuator hold is enabled or that the output level is not achieving the level requested.

The maximum positive excursion is restricted to the 8 dB range of the attenuator pad, but you can reduce the RF level over a range of up to 40 dB. However, the level accuracy specification is invalid if you exceed the pad's range by more than a few dB.

With **attenuator hold disabled**, the RF level hardware is set for optimum level accuracy and spectral purity, and changes to the attenuator setting are possible.

Note that level accuracy and spectral purity cannot be guaranteed outside the normal level range.

The current active RF channel cannot be changed while attenuator hold is on.

Levels

Actual Level

Shows the current actual output level achieved by the module. A red indicator beside the RF Level (dBm) field shows either that attenuator hold is enabled or that the output level is not achieving the level requested.

Maximum Level

Shows the maximum possible output achievable by the module for the current settings and waveform selected.

Level Type

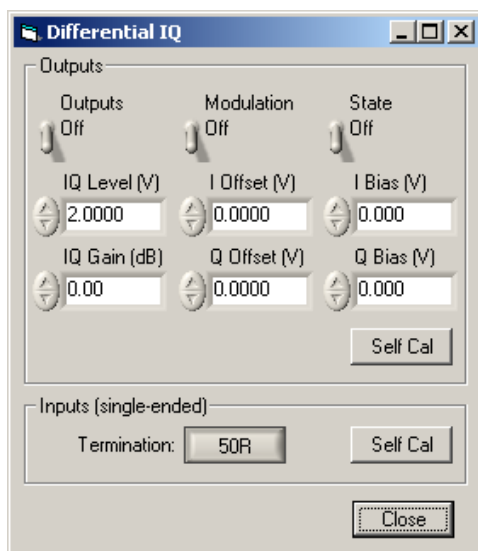
Shows whether the current RF output is RMS or peak.

Diff IQ

Displays a screen for setting up differential outputs and single-ended inputs.

When this option is fitted (available for 3020A/3025 only), the module provides balanced baseband I and Q **outputs** suitable for feeding devices with differential inputs. Signals that appear on I+ and I-, Q+ and Q-, are of equal magnitude but of opposite polarity. The positive or negative I and Q pairs can also be used as unbalanced single-ended outputs.

The module also accepts single-ended **inputs** into a switchable high or low impedance.



Outputs enables or disables the differential IQ outputs. When set Off, it removes the ARB signal component and sets bias and offset levels to 0 V. **Modulation** enables or disables the bias and offset voltages. When set Off, it zeroes bias and offset voltages but the ARB signal component remains.

State enables or disables the ARB signal component. When set Off, it disables the signal but bias and offset levels remain.

VIEW CONTROLS

IQ Level (V) specifies the peak-peak amplitude of the output signal component (see Fig. 5) into 50 Ω (single-ended) or 100 Ω (differential).

IQ Gain (dB) specifies the relative amplitudes of the I and Q signals. Adding gain (+x dB) to the signal increases the magnitude of the I component by $\frac{x}{2}$ dB whilst decreasing the magnitude of the Q component by the same factor. Similarly, removing gain (-x dB) from the signal increases the magnitude of the Q component by $\frac{x}{2}$ dB whilst decreasing the magnitude of the I component by the same factor.

I Offset (V) specifies the differential voltage between I+ and I- (see Fig. 5).

Q Offset (V) specifies the differential voltage between Q+ and Q-.

I Bias (V) specifies the common-mode I voltage.

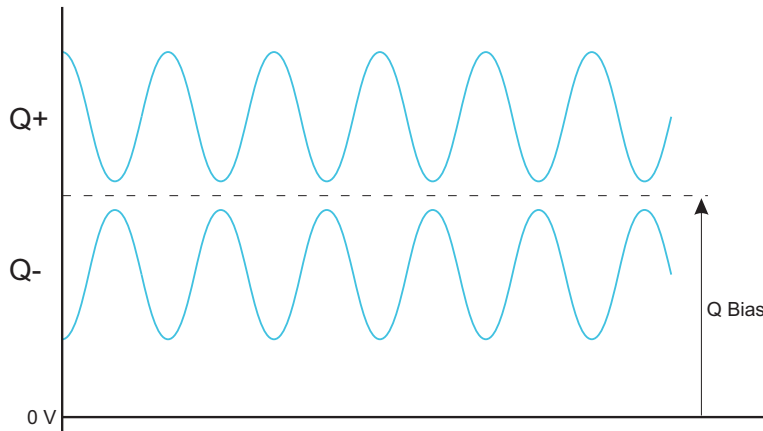
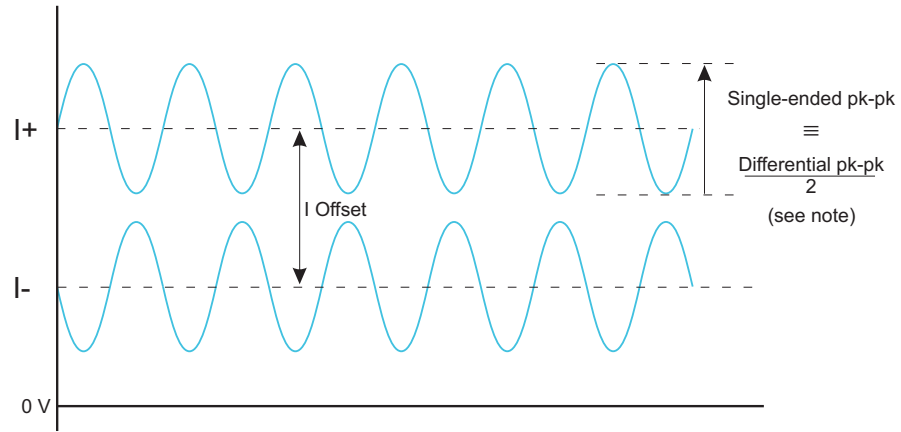
Q Bias (V) specifies the common-mode Q voltage (see Fig. 5).

Self Cal (output) calibrates the differential IQ by setting input or output levels to 0 V and recalibrating DACs.

Self Cal (input, single-ended) nulls out any DC offset present at the input.

Termination shows the value of input impedance selected. Inputs are enabled when [Modulation Source](#) is set to Ext Analog.

VIEW CONTROLS



Gain

Adding x dB increases I Level by x/2 and decreases Q Level by x/2.
Removing x dB increases Q Level by x/2 and decreases I Level by x/2.

C6169

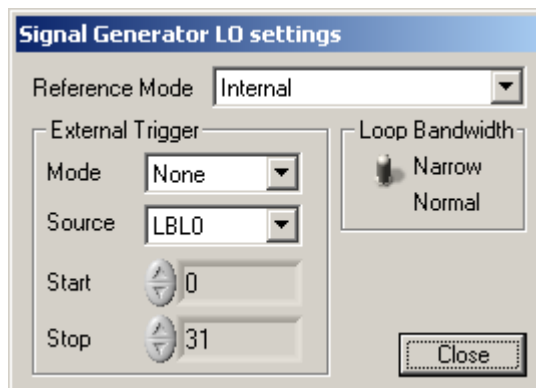
This diagram represents a condition where the signal is output into a floating 100 Ω load.

Note: the differential signal level is twice the single-ended signal level.

Fig. 5 Differential IQ parameters

LO

This configures a 3010 Series RF synthesizer to provide the LO signal for the 3020 Series RF signal generator.



Reference Mode

The default clock source for a 3010 module is *Internal* (OCXO for 3011).

If an external 10 MHz clock reference is connected to one of the 3010 Series module's 10 MHz I/O connectors, and the other 10 MHz I/O connector is used to pass on the 10 MHz clock to another module/instrument, set the Reference Mode to *External - Daisy Chain*.

If an external 10 MHz clock reference is connected to just one of the 10 MHz I/O connectors and this forms the end of a 10 MHz distribution chain, set the Reference Mode to *External - Terminated*.

External Trigger

Used to control channel-hopping.

Mode

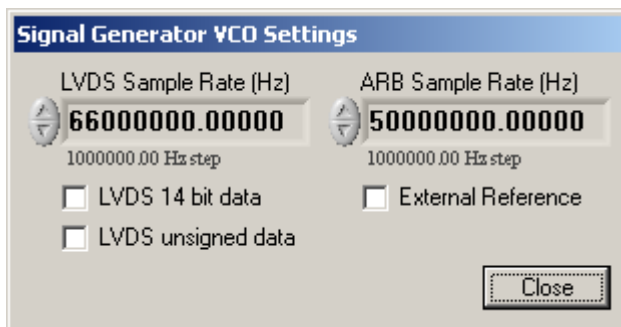
- None** Not in hopping mode
- Advance** Steps incrementally through the full list of 128 channels on receipt of a single-line trigger signal. The **Start** and **Stop** fields can be used to define a reduced list of channels.
- Toggle** Toggles between Channel 0 and Channel 1 on receipt of a single-line trigger signal.
- Hop** Receives the multi-line channel address and single-line trigger strobe signal from the PXI backplane. Provides completely independent hopping.

Source

Defines which lines on the PXI backplane are used for external triggering or addressing.
Select from:

- PTB** PXI Trigger Bus 0 to 7
- LBR** Local Bus Right 0 to 12
- LBL** Local Bus Left 0
- STAR** Star trigger

VCO



LVDS Sample Rate (Hz)

Sets the LVDS sample rate when Modulation Source is set to LVDS. The instrument calculates the interpolation automatically to place the interpolated frequency in the range 44 to 66 MHz.

ARB Sample Rate (Hz)

Set the ARB's sample rate when Modulation Source is set to ARB. This value is usually read from the ARB file's header, but you can adjust it if required. This is typically used if you acquire a file that does not contain the sample frequency in the header.

LVDS 14 bit data/LVDS unsigned data

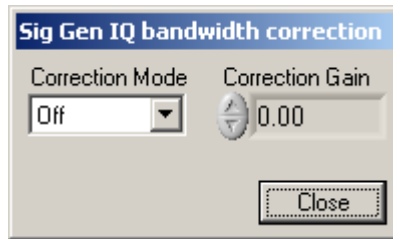
Select the data size (14-bit or padded to 16-bit) and sign (unsigned/signed) to match different data types.

External Reference

Checked: External 10 MHz reference via front-panel SMA connector

Unchecked: 10 MHz reference from PXI chassis.

IQ b/w



Correction Mode

Normally **Off**. On **Manual**, provides up to 3 dB compensation to correct for roll-off on the internal analog IQ path. The maximum correction of 3 dB provides a nominally flat response across 14 MHz. The maximum available power from the module is reduced by the correction figure selected.

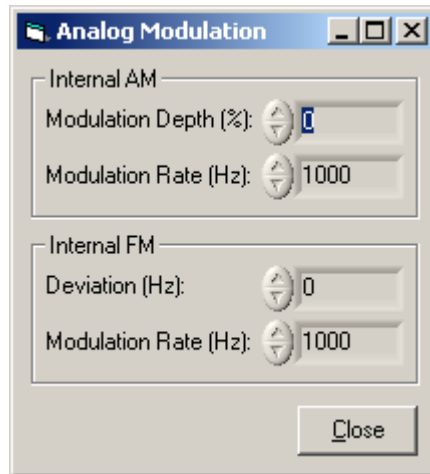
Correction Gain

Sets the gain for the Correction Mode when set to Manual.

AM/FM

Click to display the screen for setting up internal AM and FM modulation. Analog modulation is enabled when **Modulation Source** is set to Internal AM or Internal FM.

The modulation source for internal AM/FM analog modulation is a sinusoid with user-settable frequency (modulation rate).



Internal AM

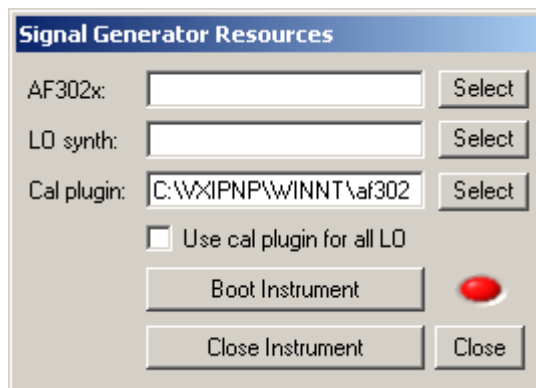
Modulation Depth (%) sets AM modulation depth, in %.

Modulation Rate (Hz) sets AM modulation rate, in Hz.

Deviation (Hz) sets FM deviation, in Hz.

Modulation Rate (Hz) sets FM modulation rate, in Hz.

Boot



Press the **Select** key next to the AF302x: text box. This displays the Select a VISA resource window with the 3020 Series resource already selected by default. If you have more than one 3020 Series module in the chassis, select the appropriate resource name and press **OK**. This updates the 3020 Series resource.

Press **Select** next to the LO synth: text box in the Signal Generator Resources window. This displays the Select a VISA resource window with the first 3010 Series module in the list selected by default. If there is more than one 3010 Series module in the chassis, the default selected resource name may not be correct. Select the resource name of the 3010 Series module that is in the slot immediately to the left of the 3020 Series module and press **OK**. This updates the Signal Generator Resources window.

***Note:** when you boot a particular 3020 Series module for the first time, calibration data is read from that module and placed in a local cache. This initial boot time is of the order of 30 seconds. Subsequent boots of this module after power is applied are considerably faster.*

VIEW CONTROLS

Cal plugin: the plugin provides for control of the LO during any user calibration procedure; for example, during IQ user calibration. Plugins for 3010 Series modules and 3410 Series digital RF signal generators are supplied on the CD-ROM.

Use cal plugin for all LO checkbox: this must be checked if you are not using a 3010 Series module as the LO. The plugin used must provide the minimum functionality to allow different sources to work correctly with the 3020 Series module. You can leave the checkbox ticked if you are using the plugin to control a 3010 Series module, but this is not recommended. When the checkbox is ticked the trigger functionality is reduced; so for example, hardware-controlled list mode operation will not be allowed.

Press **Boot Instrument**. The indicators in the Signal Generator Resources and main windows turn yellow during booting and then green if booting is successful.

The Signal Generator Resources window closes automatically if booting is successful.

The serial numbers of the LO (3010 Series module) and RF (3020 Series module) are also updated in the main window after a successful boot.

Getting started using Microsoft Visual Basic 6.0

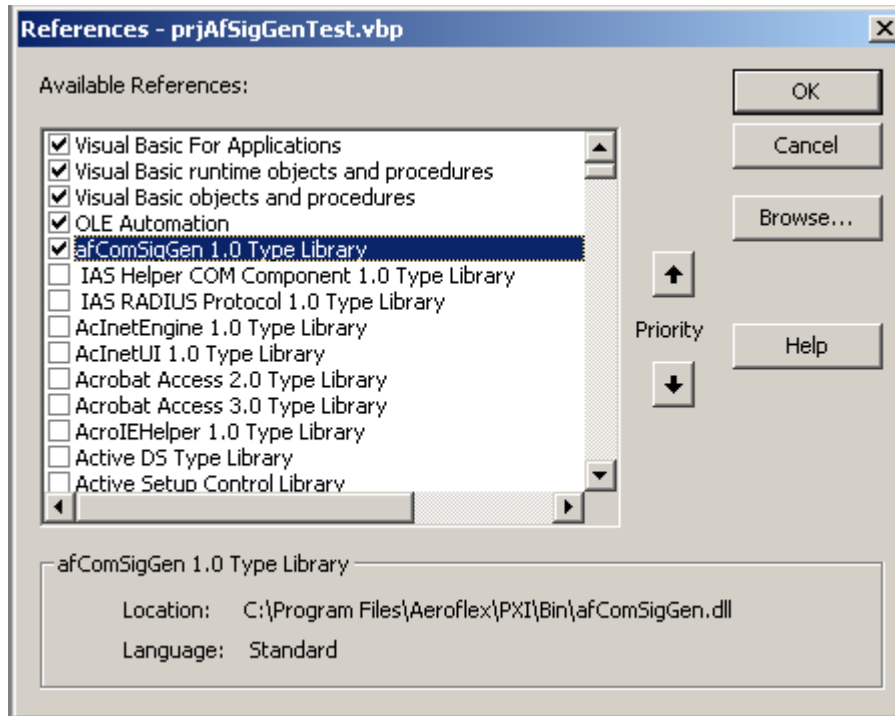
For simplicity, use the afComSigGen COM component within the Microsoft Visual Basic programming environment.

In order to use the afComSigGen component within Visual Basic, three preliminary steps must be undertaken:

- Import the afComSigGen type library into the Visual Basic project.
- Create an instance variable for the afComSigGen object.
- Initialize the instance variable

Import the afComSigGen type library

From the Microsoft Visual Basic Project menu, select *References*. This brings up a References dialog. In the list of included references, make sure that the afComSigGen type library is selected as shown below:



Create an instance variable for the afComSigGen object.

Typically, an instance variable is created as a member of a form or a class object by adding a declaration at the head of the code.

The instance variable can be declared as a member of a form or a class using:

```
Public WithEvents afSigGen1 As afCoSigGen
```

Initialize the instance variable

Once created, the instance variable needs to be initialized to reference an afCoSigGen object before it can be used. Do this with the following line of code:

```
Set afSigGen1 = New afCoSigGen
```

Typically, this would be done as part of the form or class initialization.

From this point on, the afSigGen1 object can be used. For example, the following code boots the module and then sets 0 dBm output level.

```
afSigGen1.BootInstrument("PXI6::10::INSTR",  
PXI6::9::INSTR", False)  
afSigGen1.RF.CurrentFrequency = afSigGen1.RF.FrequencyMax  
afSigGen1.RF.CurrentLevel = 0  
afSigGen1.RF.CurrentOutputEnable = True
```

Alternatively, the following code does exactly the same:

```
Dim afSigGen1Rf as IafCoSigGenRf

afSigGen1.BootInstrument("PXI6::10::INSTR", "PXI6::9::INSTR"
, False)
set afSigGen1Rf = afSigGen1.RF
afSigGen1Rf.CurrentFrequency = afSigGen1.RF.FrequencyMax
afSigGen1Rf.CurrentLevel = 0
afSigGen1Rf.CurrentOutputEnable = True
```

Example overview

In this example, we configure 3010 Series modules and 3020 Series modules using the afComSigGen COM object to generate an RF waveform.

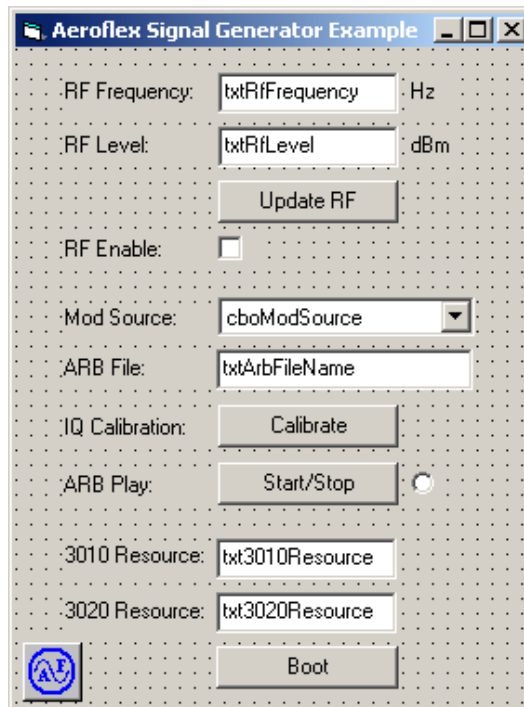
Set up the [hardware](#) as described on page 7.

Create a new standard EXE project

- Start Visual Basic 6.0 and select a new Standard EXE project.
- Add the afComSigGen object to the project references (from the Microsoft Visual Basic menu, select *Project...References* , select the afComSigGen Type Library and press **OK**).

Add an afComSigGen object to the Visual Basic form and change the properties

Add the Aeroflex Signal Generator control to the form. Also, add the other controls (button, combo and textbox) and change the properties (as described below) to create a form as in the following picture:



In the (General) (Declarations) section of the form's code module, add:

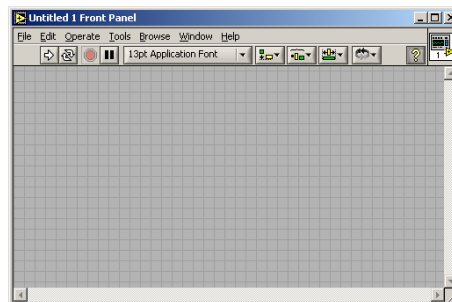
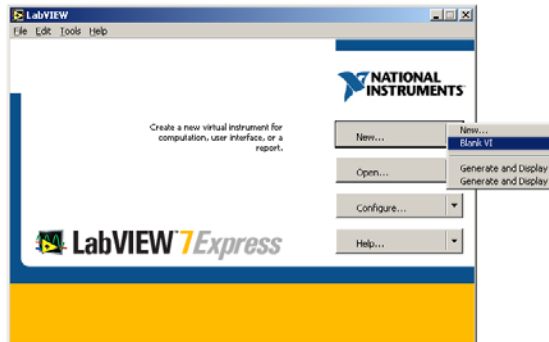
Public WithEvents afSigGen1 As afComSigGen.

Getting started using National Instruments LabVIEW 7.0/7.1

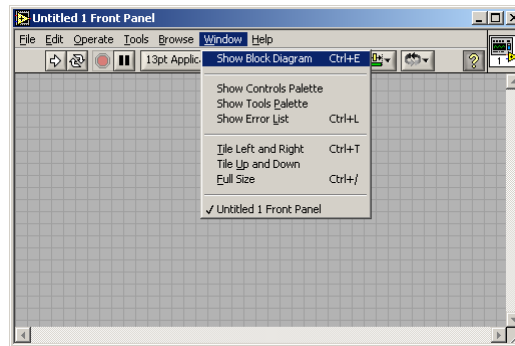
Adding the afComSigGen COM object component to a LabVIEW front panel

The front panel is the user interface for the LabVIEW application. Create a LabVIEW front panel by following the steps below:

- 1 Start the NI LabView application.
- 2 Click *New\Blank VI*, or open an existing front panel.

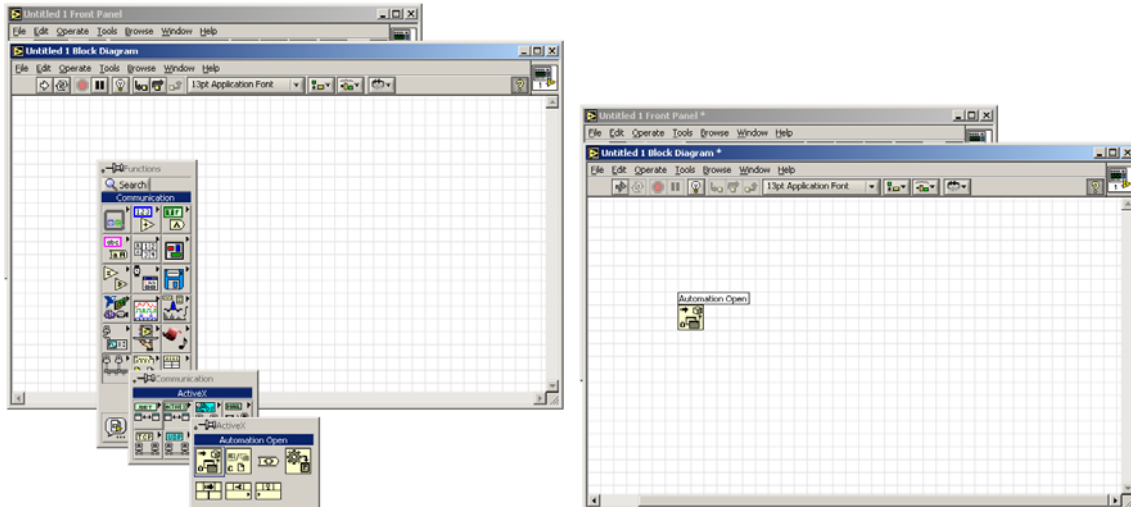


3 Click *Window\Show Block Diagram*

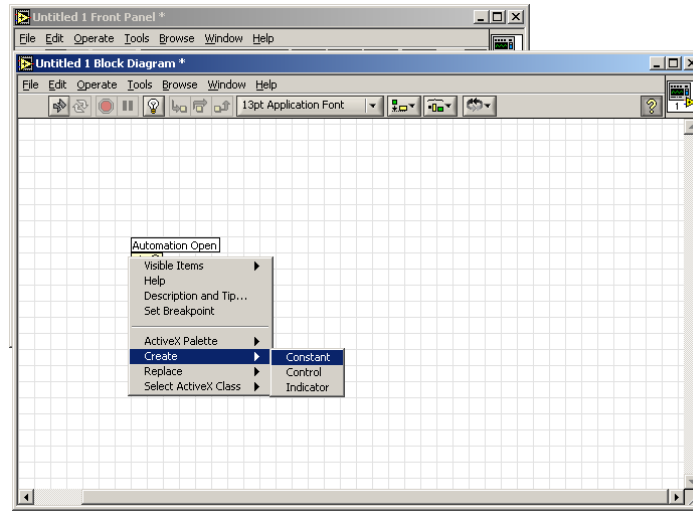


4 If the Functions window is not displayed, right-click in the block diagram window and pin the Functions Window.

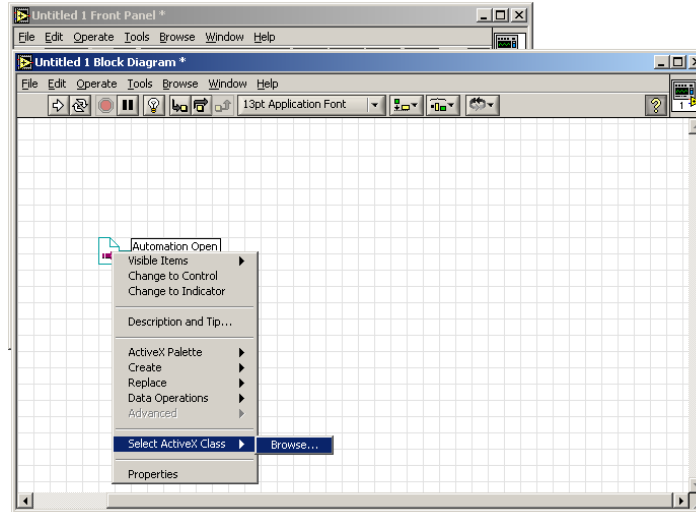
5 Add an 'Automation Open' (*Functions\Communication\ActiveX\Automation Open*) to the block diagram.



- 6 Right-click over the 'Automation Refnum' input of the created 'Automation Open' and click *Create/Constant*

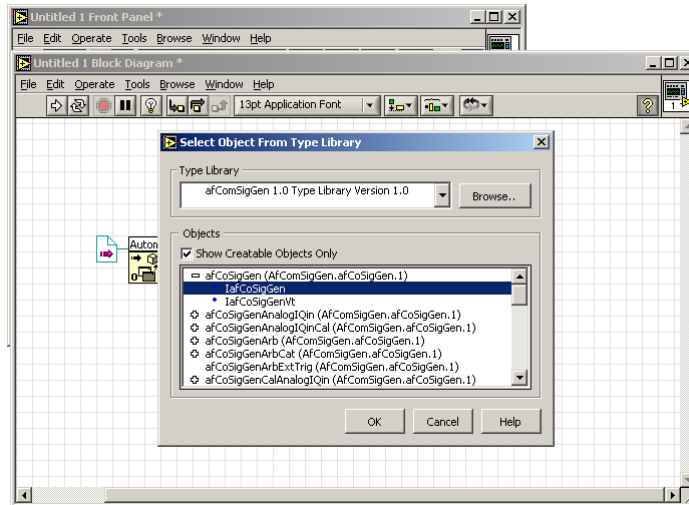


- 7 Right-click on the created 'Automation Refnum' and click on *Select ActiveX Class/Browse...* Note that this operation can take a little while.

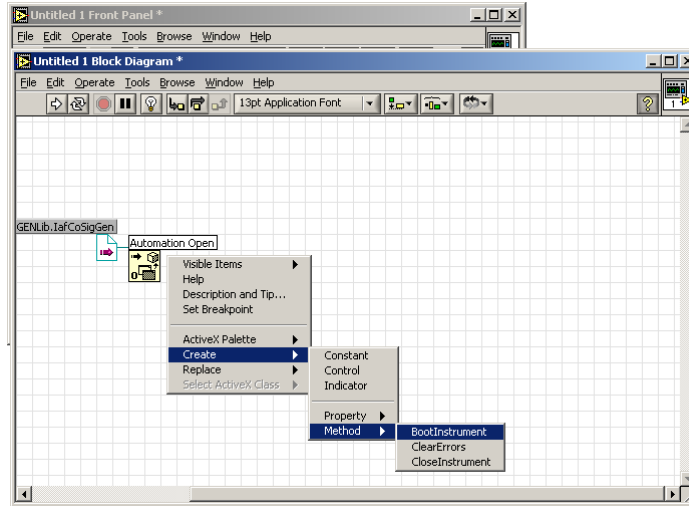


USING LabVIEW

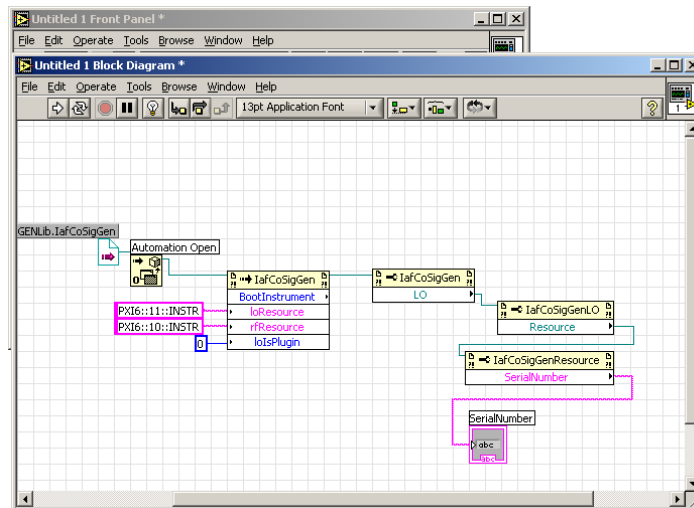
- 8 Select the afComSigGen type library from the list.
- 9 Tick the 'Show Creatable Objects Only' tick box.
- 10 Expand the afCoSigGen entry
- 11 Select IafCoSigGen.
- 12 Press the **OK** button



- 13 Right-click on the Automation Open – Automation Refnum output – this allows you to access properties or call methods of the afCoSigGen object.



- 14 To access sub-objects, for example afSigGen.LO.Resource.SerialNumber, do the following:
- 15 Right click on the Automation Open – Automation Refnum output and select *Create\Property\LO*.
- 16 Wire the Automation Refnum connection
- 17 Right-click on the LO output and select *Create\Property\Resource*.
- 18 Wire the Automation Refnum connection.
- 19 Right click on the Resource output and select *Create\Property\SerialNumber*.
- 20 Wire the Automation Refnum connection.



For further information on how to use COM objects in NI LabVIEW, please refer to the NI-supplied LabVIEW documentation or www.ni.com.

Getting started using Microsoft Visual C++ 6.0

Within the Microsoft Visual C++ environment, there are three separate interfaces that you can use:

- The afSigGenDll exports a C style interface that can be used directly from within C or C++ projects.
- The afSigGenCpp C++ wrapper, provided in source code form, provides a convenient way of accessing the above from C++ projects.
- The afComSigGen library provides a COM component which can be used from C or C++

The use of the C interface exported by the afSigGen dll or the C++ interface supplied by the C++ wrapper should be preferred within pure C or C++ projects.

Using the C interface (C or C++)

In order to use the C interface supplied by the afSigGen dll either directly or indirectly via the C++ wrapper, the dll must first be loaded. Do this implicitly by linking your project against afSigGenDll.lib (installed by default in *C:\Program Files\Aeroflex\Pxi\Library*) or explicitly using the Microsoft Windows API function 'LoadLibrary' and specifying 'afSigGenDll_32.dll' as the dll name.

All of the functions exported from the afSigGen dll return a status code. However, for the sake of brevity, the status codes are ignored in the outline that follows. Similarly, for simplicity, implicit loading of the dll is assumed.

In order to use the afSigGen components, do the following:

- 1 Include the afSigGenDll.h header file:

```
#include "afSigGenDll.h"
```

This file is located, by default, in *C:\Program Files\Aeroflex\PXI\Include* and so this path should be added to the include search path of the project.

- 2 Declare a variable to hold a handle to your afSigGen object:

```
afSigGenInstance_t afSigGen1;
```

- 3 Create the afSigGen object:

```
afSigGenDll_CreateObject(&afSigGen1);
```

- 4 Start using the afSigGen object.

For example, to set a 0 dBm output at the maximum frequency:

```
double maxFrequency;
afSigGenDll_BootInstrument(afSigGen1,
"PXI6::10::INSTR", "PXI6::9::INSTR", AF_FALSE);
afSigGenDll_RF_FrequencyMax_Get(afSigGen1, &maxFrequency);
afSigGenDll_RF_CurrentFrequency_Set(afSigGen1, maxFrequency);
afSigGenDll_RF_CurrentLevel_Set(afSigGen1, 0.0);
afSigGenDll_RF_CurrentOutputEnable(afSigGen1, AF_TRUE);
```

- 5 Destroy the afSigGen object:

```
afSigGenDll_DestroyObject(afSigGen1);
```

Using the C++ interface (C++ only)

The C++ wrapper is designed to work when the project is linked directly against afSigGenDll.lib.

In order to use the afSigGenCpp components, do the following:

- 1 Add the C++ wrapper source to your project
Copy the afSigGenCpp.cpp file to your project directory. By default, this file is found in *C:\Program Files\Aeroflex\Pxi\Src*.

- 2 Add afSigGenCpp.cpp to the project source files.

- 3 Include the afSigGenCpp.h header file.

```
#include "afSigGenCpp.h"
```

This file is located, by default, in *C:\Program Files\Aeroflex\PXI\Include* and so this path should be added to the include search path of the project.

- 4 Open the afSigGenCpp namespace.

```
using namespace AfSigGenCpp;
```

- 5 Declare a variable to hold a handle to your afSigGen object.

```
AfSigGen afSigGen1;
```

- 6 Start using the afSigGen object.

For example, to set a 0 dBm output at the maximum frequency:

```
afSigGen1.BootInstrument("PXI6::10::INSTR",  
                        "PXI6::9::INSTR",  
                        AF_FALSE);  
afSigGen1.RF.CurrentFrequency = afSigGen1.RF.FrequencyMax;  
afSigGen1.RF.CurrentLevel = 0.0;  
afSigGen1.RF.CurrentOutputEnable = AF_TRUE;
```

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- 8.3 Aeroflex shall not be liable to the Licensee for any loss of use or for loss of profits or of contracts arising directly or indirectly out of any such infringement of patent, registered design, trademark or copyright.

9. TERMINATION

- 9.1 Notwithstanding anything herein to the contrary, this Licence shall forthwith determine if the Licensee:
- 9.1.1 As an individual has a Receiving Order made against him or is adjudicated bankrupt or compounds with creditors or as a corporate body, compounds with creditors or has a winding-up order made against it or
 - 9.1.2 Parts with possession of the Designated Equipment.
- 9.2 This Licence may be terminated by notice in writing to the Licensee if the Licensee shall be in breach of any of its obligations hereunder and continue in such breach for a period of 21 days after notice thereof has been served on the Licensee.
- 9.3 On termination of this Agreement for any reason, Aeroflex may require the Licensee to return to Aeroflex all copies of the Licensed Software in the custody of the Licensee and the Licensee shall, at its own cost and expense, comply with such requirement within 14 days and shall, at the same time, certify to Aeroflex in writing that all copies of the Licensed Software in whatever form have been obliterated from the Designated Equipment.

10. THIRD PARTY LICENCES

The software or part thereof may be the proprietary property of third party licensors. In such an event such third party licensors (as referenced on the package or the Order Acknowledgement) and/or Aeroflex may directly enforce the terms of this Agreement and may terminate the Agreement if the Licensee is in breach of the conditions contained herein.

11. EXPORT REGULATIONS

The Licensee undertakes that where necessary the Licensee will conform with all relevant export regulations imposed by the Governments of the United Kingdom and/or the United State of America.

12. NOTICES

Any notice to be given by the Licensee to Aeroflex shall be addressed to:

Aeroflex International Limited, Longacres House, Six Hills Way, Stevenage, SG1 2AN, UK.

SOFTWARE LICENCE AND WARRANTY

13. LAW AND JURISDICTION

This Agreement shall be governed by the laws of England and shall be subject to the exclusive jurisdiction of the English courts. This agreement constitutes the whole Contract between the parties and may be changed only by memorandum signed by both parties.

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