



3010 and 3030 Series Modules



Getting Started with afDigitizer

Document no. 46892/676

Issue 4

14 March 2007

Introduction

afDigitizer is an ActiveX software component that provides the functionality of an RF digitizer. It provides an RF digitizer interface to control Aeroflex 3010/3011 ('3010 Series') and 3030/3030A/3035 ('3030 Series') PXI modules using the respective modules' driver software. An afDigitizer executable also provides an RF digitizer soft front panel, using the ActiveX component's features.

Signal analyzer 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	Part no.	Compilation containing soft front panels, drivers, application software, help files, data sheets and operating manuals for modules in the 3000 Series.
	46886/028	
	help files:	af3010 Function Library Reference (af3010 online help) af3030 Function Library Reference (af3030 online help) afDigitizer Reference (afDigitizer online help)
Operating manuals	46892/637	3010 Series RF Synthesizer
	46892/639	3030 RF Digitizer
	46892/718	3030A Wideband RF Digitizer
	46892/722	3035 6 GHz Wideband RF Digitizer
User Guide	46892/808	PXI Studio logical instruments and plugin applications
Data sheet	46891/144	3010/3011 RF Synthesizer
Data sheet	46891/146	3030 RF Digitizer
Data sheet	46891/236	3030A Wideband RF Digitizer
Data sheet	46891/243	3035 6 GHz Wideband RF Digitizer

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Getting started with afDigitizer

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 3030 Series RF digitizer 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 3030 Series RF digitizer PXI module, although a different external frequency source can be used.

Aeroflex 3030 Series RF digitizer PXI module

The Aeroflex 3030 is a PXI RF digitizer module. It down-converts frequency and digitizes RF signals of up to 20 MHz bandwidth with a 14-bit converter. Digitized RF samples can be streamed out of a front panel LVDS output at full speed or can be stored in a large internal RAM and read back over the PXI bus.

The 3030A module is similar, but has an extended frequency range to 2.7 GHz, an extended bandwidth to 36 MHz and provides list mode operation.

The 3035 module is similar to the 3030A, but has an extended frequency range to 6 GHz.

3030 Series modules require an external local oscillator such as a 3010 Series RF synthesizer PXI module or other RF source.

Documentation for 3010 Series and 3030 Series modules

The following may be helpful in learning more about the 3010 Series RF synthesizer and 3030 Series RF digitizer (this documentation is available on the PXI Modules CD-ROM, part number 46886/028, supplied with modules):

- [Data sheets and operating manuals](#)
- af3010 Online help (function reference)
(default location for a Windows NT machine is *C:\VXIPNP\WinNT\af3010\af3010.hlp*)
- af3030 Online help (function reference)
(default location for a Windows NT machine is *C:\VXIPNP\WinNT\af3030\af3030.hlp*)
- www.aeroflex.com

Introduction

What is afDigitizer?

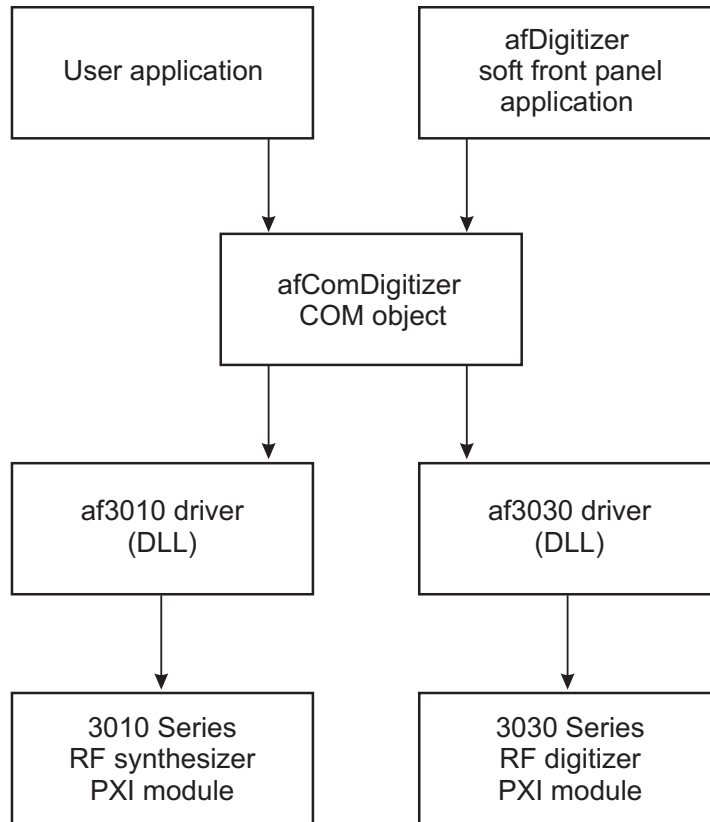
afDigitizer is a set of components that provides the functionality of an RF signal generator. It consists of an underlying dll and a pair of wrappers that present alternate interfaces for differing programming environments. Each of the afDigitizer components provides an RF digitizer interface to control Aeroflex 3010 Series and 3030 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 afDigitizer components can execute correctly only on PXI systems equipped with an Aeroflex 3030 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 digitizer soft front panel?

The Aeroflex digitizer **soft front panel** is a virtual instrument application of the RF digitizer. It is a graphical user interface that interactively operates the afComDigitizer COM object (which in turn controls the 3010 Series and 3030 Series modules) and displays the results. Its relationship to other components is shown in Fig. 1.



C6174

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

Installing afDigitizer

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

- 3010 and 3030 Series drivers
- afDigitizerDll and afComDigitizer COM object
- afDigitizer soft front panel.

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

Note: Ensure that you install the 3010 Series and 3030 Series PXI module drivers before the dll/COM object and the afDigitizer soft front panel application.

Hardware setup

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

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.*

Digitizer hardware can be any combination of 3010 Series and 3030 Series modules.

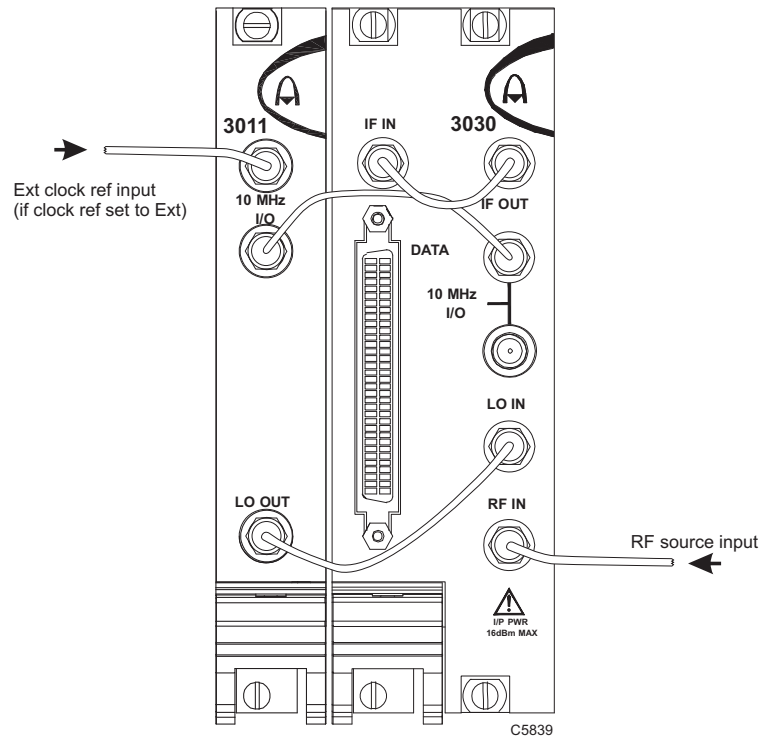


Fig. 2 Example of hardware setup

INTRODUCTION

- Locate the 3010 Series module in the slot immediately to the left of the 3030 Series module.
- Make sure that 3010 Series and 3030 Series drivers, the afDigitizer controls and soft front panel are installed on the computer (connected to the PXI chassis or on the embedded computer in the PXI chassis).
- Connect 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 3030 Series module.
- Link LO OUT of the 3010 Series module to LO IN of the 3030 Series module.

For examples described in this document, the following additional setup is necessary:

- Connect either of the following RF signals, level 0 dBm or less, to the RF IN connector of the 3030 Series module:

Unmodulated carrier signal, less than ± 20 MHz offset from 2 GHz (for example, 1.999 GHz)

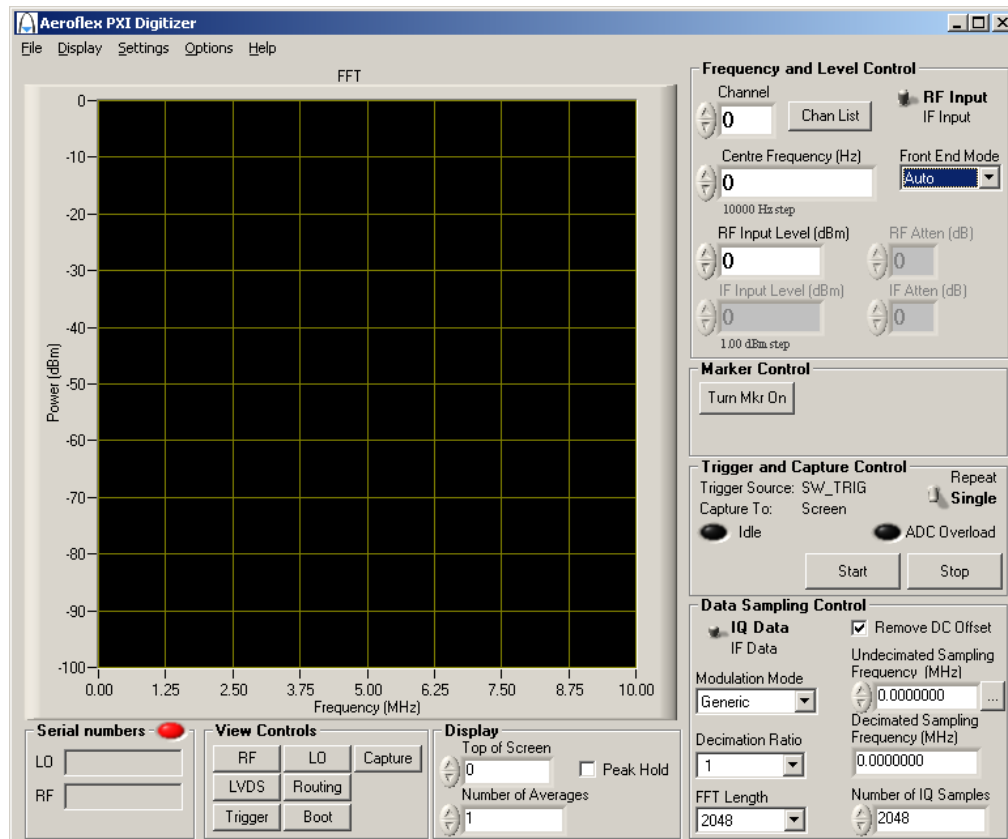
MSK-modulated (preferably with random data) RF signal of 2 GHz.

***Note:** An MSK modulated RF signal can be generated using a 3020 Series PXI RF signal generator together with a 3010 Series RF synthesizer by loading and playing an ARB file (created using **IQCreator**[®]) with MSK modulation. The 3020 Series module should have Option 100 (which enables **IQCreator**[®]) fitted. **IQCreator**[®] can generate ARB waveforms with modulations, which can be loaded and played in a 3020 Series PXI RF signal generator. This application can be downloaded from www.aeroflex.com.*

Using the afDigitizer soft front panel

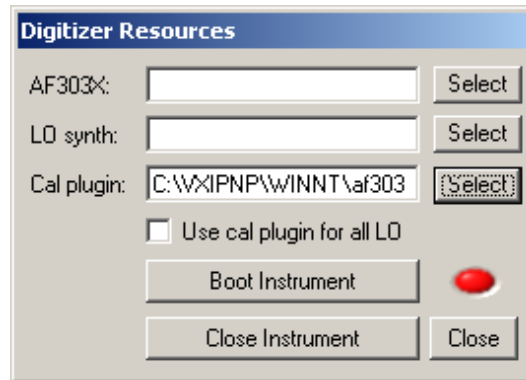
Start the digitizer soft front panel

After setting up the [hardware](#) as described on page 7, start the digitizer soft front panel application (*Start\Programs\Aeroflex\Digitizer\RF Digitizer Soft Front Panel*):

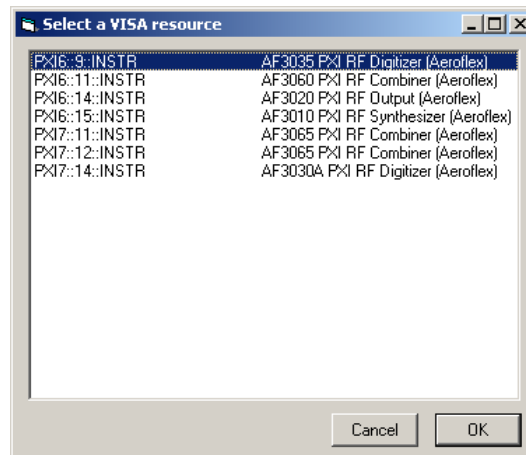


Boot the modules

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

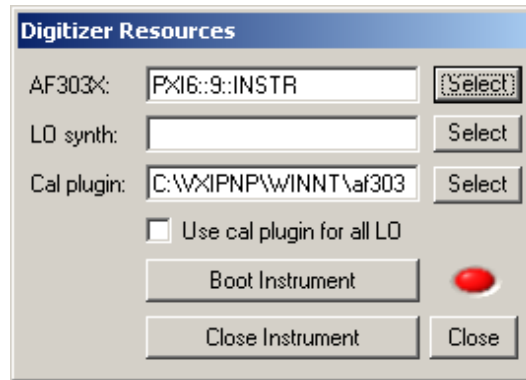


- Press the **Select** button next to the AF3030X: text box. This displays the Select a VISA resource window with the 3030 Series resource already selected by default:

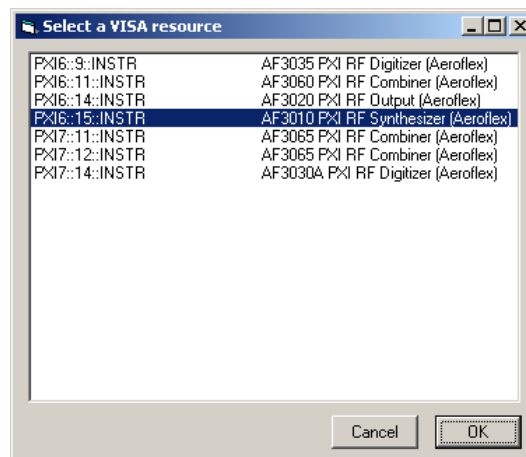


BOOTING AND BASICS

- If you have more than one 3030 Series module in the chassis, select the appropriate 3030 Series resource name and press **OK**. This updates the 3030 Series resource:

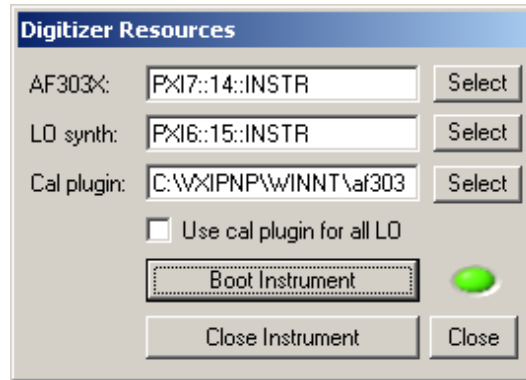


- Press the **Select** button next to the LO synth: text box in the Digitizer Resources window. This displays the Select a VISA resource window with the first 3010 Series module in the list selected by default:



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 3030 Series module (in the above case *PXI6::15::INSTR*) and press **OK**. This updates the Digitizer Resources window:

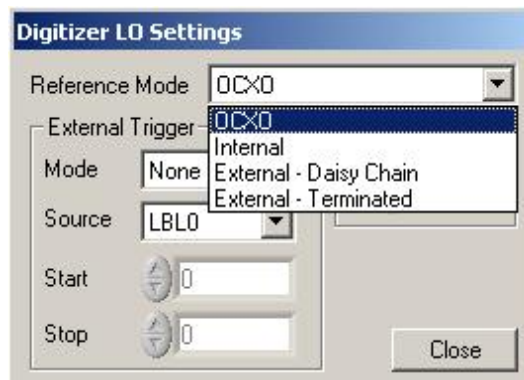


- Press **Boot Instrument** in the Digitizer Resources window. The indicators in the Digitizer Resources and main windows turn yellow during booting and then green if booting is successful. If booting fails or the instrument session is closed (for example, by pressing **Close Instrument**), the indicators turn red.
- The Digitizer Resources window closes automatically if booting is successful.
- The serial numbers of the LO (3010 Series) and RF (3030 Series) are also updated in the main window after a successful boot.

Set the 3010 Series module's clock reference

The default clock source 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.

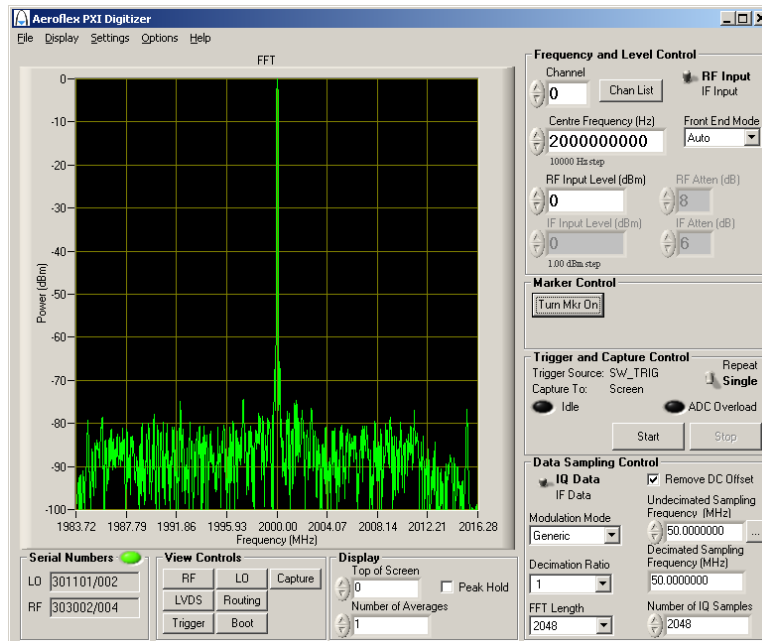
- If an external 10 MHz clock reference is connected to one of the 3010 Series module's 10 MHz I/O connectors, and the other 10 MHz I/O connector is used to pass on the 10 MHz clock to another module/instrument, set the Reference Mode to *External - Daisy Chain*.
- If an external 10 MHz clock reference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



Check for correct operation

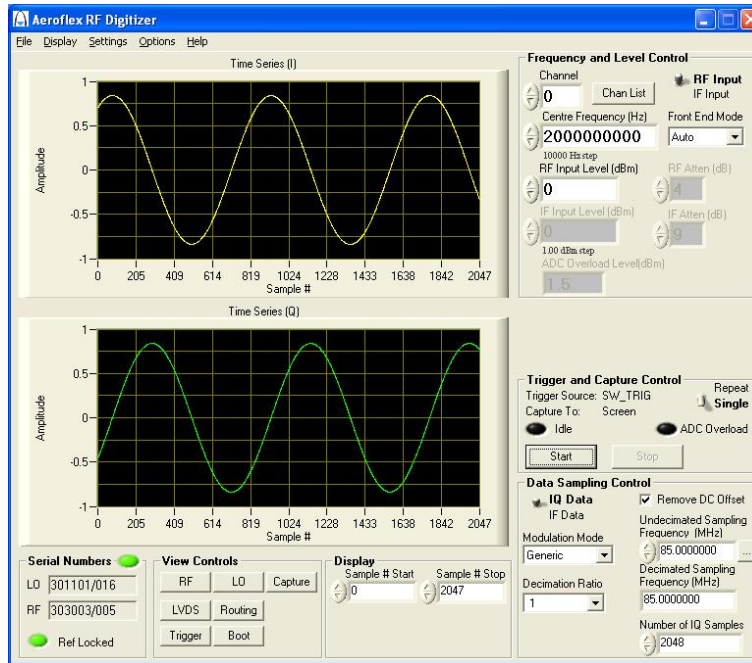
Using the toggle in the Trigger and Capture Control group, select the **Single** or **Repeat** mode as required. Press **Start** to perform a capture. If Repeat mode is selected, pressing **Stop** halts the operation.

- If the **hardware** is set up as on page 7, the FFT display in the soft front panel should be similar to the following picture. Verify that the frequency and level measurement of RF signal are correct.
- Increment/decrement the RF frequency and verify that the change is reflected on the soft front panel. Change the center frequency on the soft front panel if the input RF frequency is out of range.
- Change the level of the RF signal and verify that the change is reflected on the soft front panel.



BOOTING AND BASICS

- Change the display to Time Series (**Display\Time Series**) and press **Start**. The trace captured should be similar to the following:



- Verify that the I and Q data is the same as the modulated signal. If the RF input signal is unmodulated carrier, I and Q should be sinusoidal waveforms at the same frequency as the offset from the center frequency.

Detailed soft front panel operation

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

Menu bar



File

Save Captured Data to File captures the 16-bit sample data into the specified location.

Click **E**xit to close the application.

Display

Allows you to view results in different formats:

FFT

This is the default, displaying a single graph showing logarithmic power versus frequency.

Time Series

Displays two graphs showing I and Q magnitude (in IQ mode) or IF magnitude (in IF mode) versus sample number.

IQ Polar

Presents I and Q data as a polar response (available in IQ mode only).

Numeric

Displays a table of the current captured I and Q data (in IQ mode) or IF data (in IF mode) against sample number.

Set up how the selected format is presented:

FFT Display Settings

Graticule Visible hides or displays the graticule.

Vertical Scaling provides scaling from 0.01 dB/div to 20 dB/div.

Span selects either Full or Truncated (approx. 66%) span. For example, with Modulation Mode set to UMTS and with a Decimation Ratio of 2, Full span is the full decimated bandwidth of the module — 30.72 MHz — and Truncated limits this to the module's bandwidth of 20 MHz, placing graticule lines at integer frequencies for easier reading.

Time Series Settings

Graticule Visible hides or displays the graticule.

Separate IQ Traces displays individual graphs of Time Series (I) and Time Series (Q). Both graphs are displayed with a common horizontal axis scaling (as set by Sample # Start and Sample # Stop in the **Display** group).

Overlaid IQ Traces displays colored I and Q traces on a single graph; I is yellow and Q is green.

Y-axis Autoscale, when selected, automatically sets the scaling of signal magnitude to the peak value. When it is deselected, you can set the values manually using the Magnitude Min and Magnitude Max controls. The values of Magnitude Min and Magnitude Max apply to both I and Q when IQ Separate Graphs is selected.

IQ Polar Display

Graticule Visible hides or displays the graticule.

Autoscale, when selected, scales the I and Q signal magnitudes to the peak value. When it is deselected, you can set the values manually using the I Axis Range (\pm) and Q Axis Range (\pm) controls.

Settings

Load and **Save** allow you to load and save soft front panel configurations from and to your preferred locations. The default location is *C:\Program Files\Aeroflex\Digitizer\settings*, and configurations are saved as *.ini files.

You can edit, copy and paste settings files as required. 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.

Directories lets you choose the locations for front-panel configuration settings and synthesizer plugin dlls.

Options

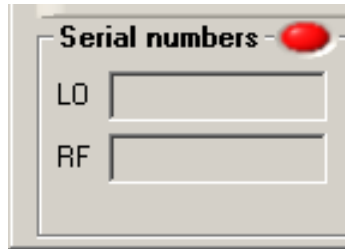
Click **View** to see what options are fitted to the module(s), and access their details separately using the LO and RF radio buttons.

Help

Instrument Information provides revision numbers and serial numbers for both 3010 Series (synthesizer) and 3030 Series (digitizer) software and hardware, together with dates of last calibration. The File Info button displays file version details for the various components of the Digitizer software, and the Cal Info button does the same for calibration details.

About provides the version number of the soft front panel.

Serial numbers



A dialog box titled "Serial numbers" with a red close button in the top right corner. It contains two input fields: "LO" and "RF".

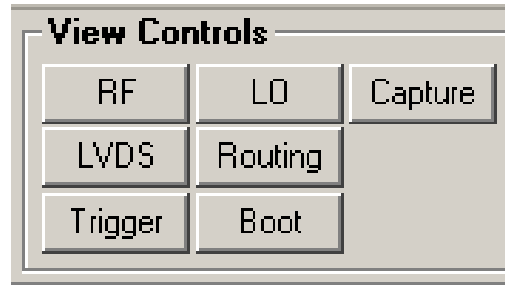
LO

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

RF

The 3030 Series module's serial number appears in this field after a successful boot.

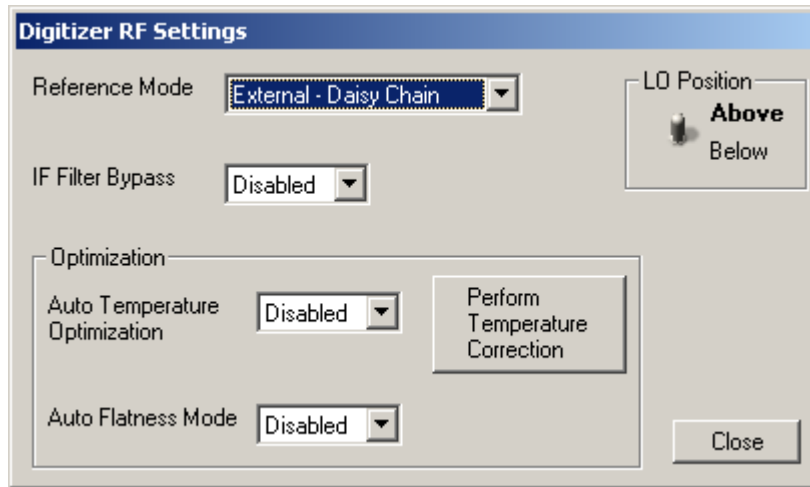
View Controls



This group contains separate controls to:

- Adjust digitizer RF settings (**RF**)
- Adjust 3010 Series synthesizer settings (**LO**)
- Configure how the digitizer captures and stores data (**Capture**)
- Configure the LVDS interface (**LVDS**)
- Configure input and output routing between the digitizer, its front panel, and the PXI backplane (**Routing**)
- Select the digitizer's trigger source (**Trigger**)
- Select digitizer resources and boot the digitizer (**Boot**)

RF



Reference Mode

External – Daisy Chain causes the internal oscillator to lock to the 10 MHz reference connected to the 10 MHz I/O connector.

Internal causes the internal oscillator to free run at the center of its range, at a nominal frequency of 61.44 MHz (3030) or 103.68 MHz (3030A/3035).

IF Filter Bypass

When enabled, causes the anti-aliasing filter to be bypassed, allowing signals outside its passband to reach the ADC. Level calibration is maintained. Allows you to observe spurious and other signals within the module's bandwidth that would otherwise be removed by the filter.

Optimization

Allows you to choose how the 3030 Series module compensates for the effect of temperature changes and RF frequency response.

Auto Temperature Optimization monitors the temperature of the module at regular intervals and adjusts the correction figure for the current temperature. You can turn this off if it might interfere with a time-critical measurement.

Perform Temperature Correction forces an immediate update, after which the timer starts a new interval.

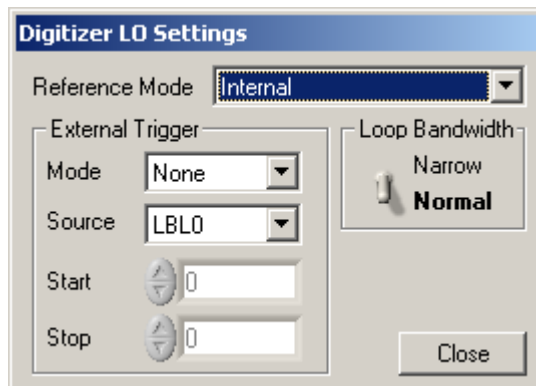
Auto Flatness Mode compensates for the slope of the RF response, and may be needed for measurements taken over a wide bandwidth. It applies compensation to 'flatten' the response over the chosen bandwidth. The change in RF level due to RF response may not be significant for narrow-bandwidth measurements, which should be taken into account as auto flatness mode compensation may slow measurement time considerably. Default is 'Disabled'.

LO Position

Above/Below sets the LO to a frequency 46.08 MHz (3030) or 77.76 (3030A, 3035) above or below the RF frequency.

LO

This control sets up the 3010 Series signal generator to provide the LO signal for the 3030 Series digitizer.



Reference Mode

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

If an external 10 MHz clock reference is connected to one of the 3010'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

Sets the external trigger mode for the 3010 Series module. Used to control channel-hopping.

Mode

None	Not in hopping mode
Advance	Steps incrementally through the list of 128 channels. The Start and Stop fields let you define a subset of channels.
Toggle	Toggles between Channel 0 and Channel 1.
Hop	Receives channel address from 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

Start

Sets the start channel number.

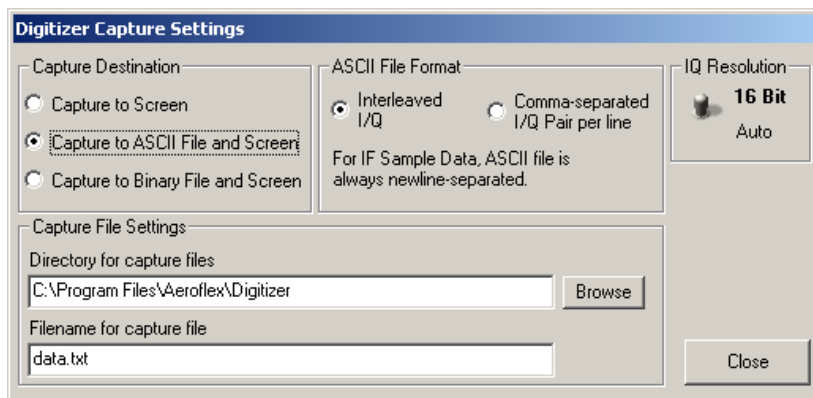
Stop

Sets the finish channel number.

Loop Bandwidth

Click to toggle between Narrow and Normal. Select Narrow loop bandwidth for better phase noise, or Normal for fastest switching speed consistent with good signal quality.

Capture



Capture Destination

By default, the 3030 Series module captures data to the screen (**Capture to Screen**), but you can also capture results to ASCII (**Capture to ASCII File and Screen**) or binary files (**Capture to Binary File and Screen**) whilst continuing to display on-screen.

Capture File Settings

This feature is visible only when saving to file (ASCII or binary). It opens a browser to define a filename plus extension (default is *.txt*) and location for storing data.

ASCII File Format

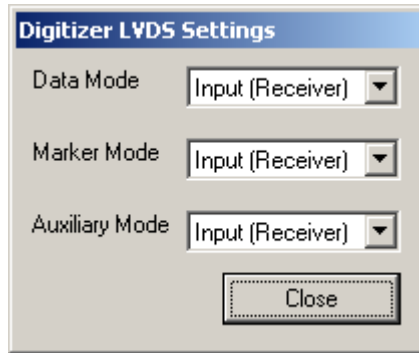
This feature is visible only when saving to an ASCII file. Files can be saved as interleaved I/Q pairs (I followed by Q) or I/Q pairs separated by commas; the number of pairs stored is in multiples of 16. IF data is stored as an ASCII file; the number of pairs stored is in multiples of 32.

IQ Resolution

Sets the resolution of the IQ data to be captured. **Auto** uses 16 or 32 bits depending on the resolution allowed for the current modulation and decimation.

LVDS

Defines the data, marker and auxiliary modes for the LVDS. You can set each LVDS Data, Auxiliary and Marker mode for input, output or tri-state (default) operation.



Set **Marker Mode** to Input when using a marker bit as a trigger input.

Set **Auxiliary Mode** to Input when using an auxiliary bit as a trigger input.

Set **Data Mode** to Input when using Spare 0 as a trigger input.

[Trigger](#) (page 30) gives details of LVDS trigger types.

Routing

Routing displays a matrix that provides interconnection between input and output signals on the PXI backplane bus, the DATA connector and the TRIG input, as shown diagrammatically in Fig. 3. This provides great flexibility in how you can route signals between modules.

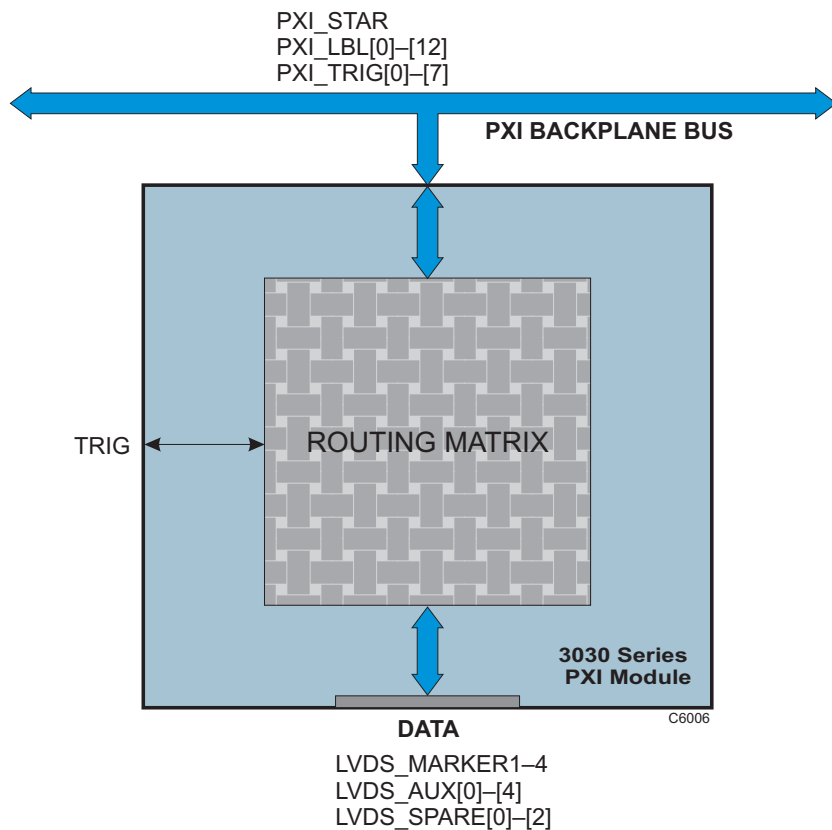


Fig. 3 Routing matrix functions

Routing Scenarios

This allows you to select a predefined routing matrix connection. A tick against the scenario's title shows that it is selected.

Routing Matrix

Use the [routing matrix](#) (Fig. 4) 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 and select the appropriate LVDS mode.

Reset connects all input signals to GND and disables the outputs (LVDS outputs go tri-state). This is the default state.

When operating in default digitizer mode (routing matrix reset), all necessary input, output and trigger signals are available on front-panel DATA, SMA and 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.

VIEW CONTROLS

Output enable
check box

Input signal
selection

Digitizer Routing

Routing Scenarios

LVDS Aux to PXI LBL

Routing Matrix

OE	Output	Input	Mode	Output	Input	OE	Output	Input
<input type="checkbox"/>	PXI Trig[0]	GND	<input type="checkbox"/>	LVDS Marker[1]	GND	<input type="checkbox"/>	Front SMB	GND
<input type="checkbox"/>	PXI Trig[1]	GND	<input type="checkbox"/>	LVDS Marker[2]	GND	<input type="checkbox"/>	Seq Strobe	GND
<input type="checkbox"/>	PXI Trig[2]	GND	<input type="checkbox"/>	LVDS Marker[3]	GND	<input type="checkbox"/>	Seq Reset	GND
<input type="checkbox"/>	PXI Trig[3]	GND	<input type="checkbox"/>	LVDS Marker[4]	GND	<input type="checkbox"/>	Timer Sync	GND
<input type="checkbox"/>	PXI Trig[4]	GND	<input type="checkbox"/>	LVDS Aux[0]	GND	<input type="checkbox"/>	LA In[0]	GND
<input type="checkbox"/>	PXI Trig[5]	GND	<input type="checkbox"/>	LVDS Aux[1]	GND	<input type="checkbox"/>	LA In[1]	GND
<input type="checkbox"/>	PXI Trig[6]	GND	<input type="checkbox"/>	LVDS Aux[2]	GND	<input type="checkbox"/>	LA In[2]	GND
<input type="checkbox"/>	PXI Trig[7]	GND	<input type="checkbox"/>	LVDS Aux[3]	GND	<input type="checkbox"/>	LA In[3]	GND
<input type="checkbox"/>	PXI Lbl[0]	GND	<input type="checkbox"/>	LVDS Aux[4]	GND	<input type="checkbox"/>	LA In[4]	GND
<input type="checkbox"/>	PXI Lbl[1]	GND	<input type="checkbox"/>	LVDS Spare[0]	GND	<input type="checkbox"/>	LA In[5]	GND
<input type="checkbox"/>	PXI Lbl[2]	GND	<input type="checkbox"/>	LVDS Spare[1]	GND	<input type="checkbox"/>	LA In[6]	GND
<input type="checkbox"/>	PXI Lbl[3]	GND	<input type="checkbox"/>	LVDS Spare[2]	GND	<input type="checkbox"/>	List Strobe	GND
<input type="checkbox"/>	PXI Lbl[4]	GND						
<input type="checkbox"/>	PXI Lbl[5]	GND						
<input type="checkbox"/>	PXI Lbl[6]	GND						
<input type="checkbox"/>	PXI Lbl[7]	GND						
<input type="checkbox"/>	PXI Lbl[8]	GND						
<input type="checkbox"/>	PXI Lbl[9]	GND						
<input type="checkbox"/>	PXI Lbl[10]	GND						
<input type="checkbox"/>	PXI Lbl[11]	GND						
<input type="checkbox"/>	PXI Lbl[12]	GND						

3030A,
3035
only

Output signal

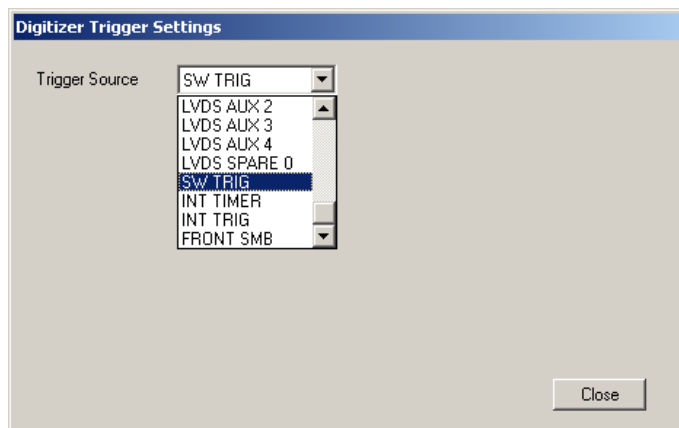
Input signal

C5904

Fig. 4 Routing matrix inputs and outputs

Trigger

Allows you to select the trigger source from a drop-down list:



Software trigger

- **SW TRIG**

This is a non-triggered capture mode. Click on **Start** to capture samples (defined by Number of Samples) when in Single/Repeat mode, without waiting for any external event. Click **Stop** to end the capture.

There are two modes available in software capture mode: 'immediate' and 'armed'. Armed mode allows for faster data gathering. Refer to the [help files](#) for full details.

Hardware triggers

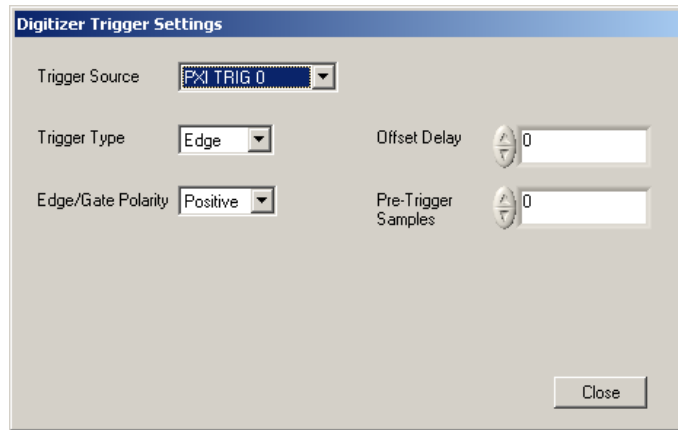
Remaining triggers on the drop-down list are hardware triggers. When any of these are selected, triggering is dependent on trigger events, including the correct arming of the trigger.

The module ignores triggers that occur during the sample capture.

Refer to the [help files](#) for full details.

VIEW CONTROLS

Most of the hardware triggers share a common triggering interface:



Trigger Type

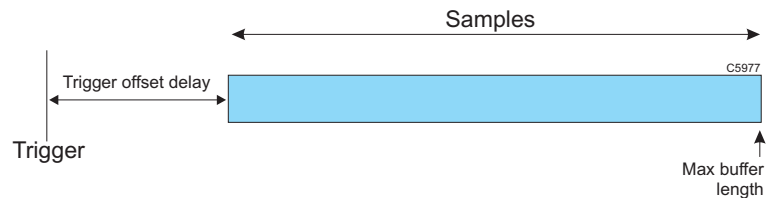
set to Edge or Gate

Edge/Gate Polarity

set Positive or Negative

Offset Delay

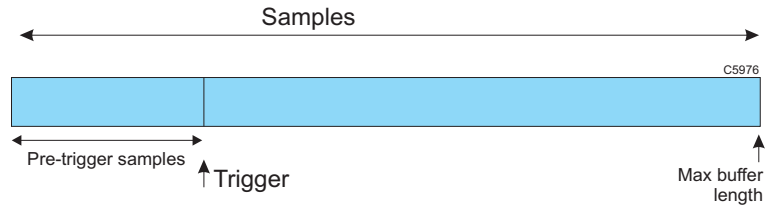
all hardware triggers can be delayed in the range 0 to $+2^9$ decimated samples.



VIEW CONTROLS

Pre-Trigger Samples
(Edge trigger type)

sets the number of pre-trigger samples present in the captured data buffer. Increase this value to move the position of the trigger point in the captured data further from the start.

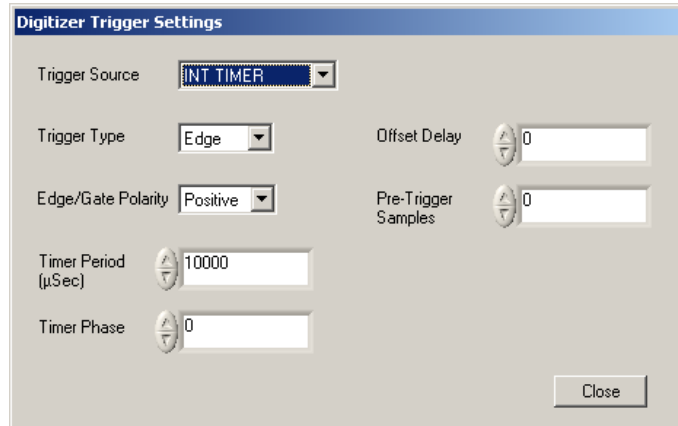


VIEW CONTROLS

- **PXI TRIG** [0–7]
Takes its trigger input from any one of eight bits of the PXI trigger bus that is common to all modules in the chassis.
- **PXI STAR**
Takes its trigger input from a module that has ST functionality and is fitted in PXI slot 2.
- **PXI LBL** (Local Bus Left) [0–12]
Takes its trigger input from the slot to the left of the 3030 Series module (viewed from the front panel), using the PXI local bus. Choose from any of 13 bits for the trigger; this bus is common only to the 3030 Series module and the module to its left.
- **LVDS MARKER** [1–4]
Takes its trigger from any of four Marker bits on the DATA connector. Ensure that LVDS Marker Mode is set to Input.
- **LVDS AUX** [0–4]
Takes its trigger from any of five Auxiliary input bits on the DATA connector. Ensure that LVDS Auxiliary Mode is set to Input.
- **LVDS SPARE**
Takes its trigger from the Spare 0 input bit on the LVDS data bus. Ensure that LVDS Data Mode is set to Input. Because the data bus is set to receive when this trigger is used, it is not then possible to output data on the DATA connector.
- **FRONT SMB**
Takes its trigger from the TRIG connector on the 3030 Series module's front panel.

- **INT TIMER**

Takes its trigger from the internal timer.



The screenshot shows a dialog box titled "Digitizer Trigger Settings". It contains several controls:

- Trigger Source:** A dropdown menu set to "INT TIMER".
- Trigger Type:** A dropdown menu set to "Edge".
- Edge/Gate Polarity:** A dropdown menu set to "Positive".
- Offset Delay:** A numeric input field with a spinner, set to "0".
- Pre-Trigger Samples:** A numeric input field with a spinner, set to "0".
- Timer Period (μSec):** A numeric input field with a spinner, set to "10000".
- Timer Phase:** A numeric input field with a spinner, set to "0".
- Close:** A button in the bottom right corner.

Timer Period

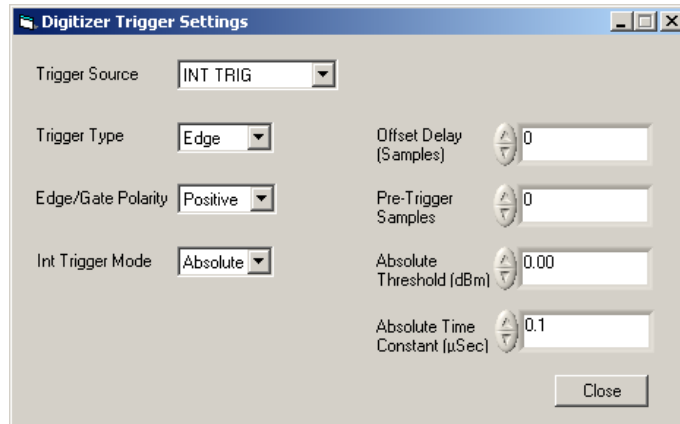
sets the period of the internal timer (50% mark/space ratio)

Timer Phase

adjusts the phase of the internal timer signal in multiples of the resampled sample clock period for the selected modulation mode. This allows you to synchronize the timer trigger with external events.

- **INT TRIG**

Takes its trigger from the internal level trigger.



The image shows a software dialog box titled "Digitizer Trigger Settings". It contains several configuration options:

- Trigger Source:** A dropdown menu set to "INT TRIG".
- Trigger Type:** A dropdown menu set to "Edge".
- Edge/Gate Polarity:** A dropdown menu set to "Positive".
- Int Trigger Mode:** A dropdown menu set to "Absolute".
- Offset Delay (Samples):** A numeric input field with a value of 0.
- Pre-Trigger Samples:** A numeric input field with a value of 0.
- Absolute Threshold (dBm):** A numeric input field with a value of 0.00.
- Absolute Time Constant (µSec):** A numeric input field with a value of 0.1.

A "Close" button is located at the bottom right of the dialog box.

VIEW CONTROLS

Int Trigger Mode	<p>Select the internal level trigger mode: Absolute/Relative</p> <p>Absolute: the digitized signal is filtered using an absolute time constant. An internal level trigger is generated when the level of this filtered signal exceeds the absolute level trigger threshold (specified in dBm). The absolute time constant and level settings may affect the trigger delay.</p> <p>Relative: the digitized signal is filtered using both a fast and a slow time constant. For a step level change, the amplitude difference between the two resultant filtered signals produces a pulse, its duration and level determined by the difference between the fast and slow time constants. The pulse is then compared with the 'relative threshold trigger level' to create the internal trigger. Fig. 5 shows this.</p> <p>When the relative threshold trigger level is entered as positive, the difference signal = (fast signal – slow signal). When relative threshold trigger level is entered as negative, the difference signal = (slow signal – fast signal).</p> <p>Only +ve Trigger Edge/Gate Polarity is available when using relative mode.</p>
Absolute Time Constant	Sets the time constant for the absolute level internal trigger.
Absolute Threshold	Sets the absolute threshold level in dB.
Slow/Fast Time Constant	Sets the slow and fast time constants used in relative internal trigger mode.
Relative Threshold	The threshold value (dBm) compared with the difference signal filtered using Relative Slow and Fast Time Constants.

VIEW CONTROLS

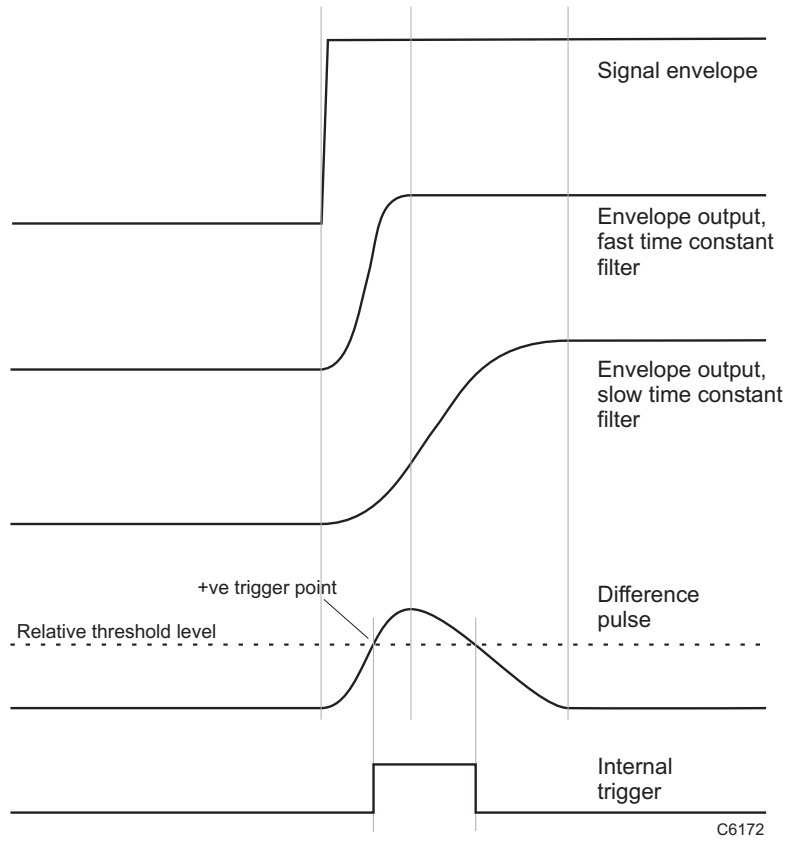
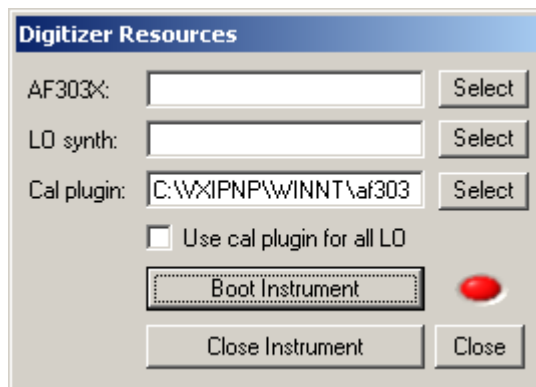


Fig. 5 Relative internal level trigger mode

Boot



Press **Select** next to the AF303X: text box. This displays the Select a VISA resource window with the 3030 Series resource already selected by default. If you have more than one 3030 Series module in the chassis, select the appropriate 3030 Series resource name and press **OK**. This updates the 3030 Series resource.

Press **Select** next to the LO synth: text box in the Digitizer 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 3030 Series module and press **OK**. This updates the Digitizer Resources window.

***Note:** when you boot a particular 3030 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 60 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 3030 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** in the Digitizer Resources window. The indicators in the Digitizer 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 Digitizer Resources window closes automatically if booting is successful.

The serial numbers of the LO (3010 Series module) and RF (3030 Series module) are also updated in the main window after a successful boot.

Display

The screenshot shows a 'Display' menu with the following options:

- Top of Screen**: A numeric input field containing '0' with up/down arrow buttons.
- Peak Hold**: An unchecked checkbox.
- Number of Averages**: A numeric input field containing '1' with up/down arrow buttons.

OR

The screenshot shows a 'Display' menu with the following options:

- Sample # Start**: A numeric input field containing '0' with up/down arrow buttons.
- Sample # Stop**: A numeric input field containing '2047' with up/down arrow buttons.

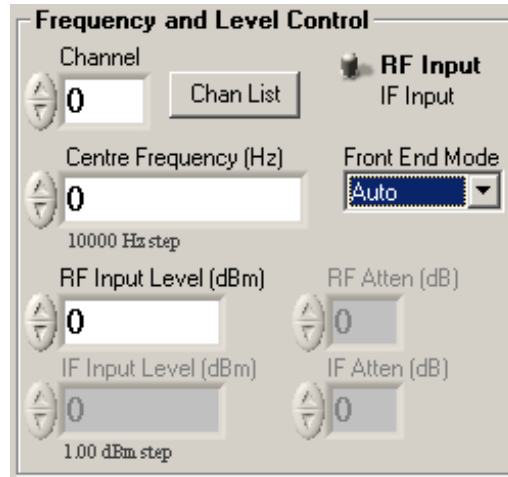
This field changes, depending on which format is selected in the [Display](#) menu.

When FFT is selected, **Top of Screen** lets you determine the highest power level displayed on the left side of the screen. **Number of Averages** sets the number of averages over which the measurement is made.

Peak Hold retains peak power values on the FFT display and can be used for spotting transients.

When Time Series is selected, **Sample # Start** and **Sample # Stop** let you change the starting sample and last sample, allowing you to 'zoom in' on data.

Frequency and Level Control



Channel

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

Chan List

Click this to set up individual channels. You can [Load](#) and [Save](#) (page 18) the settings to make setup easier.

Centre Frequency (Hz)

This is the RF input frequency. This defines the center frequency of the FFT trace and selects appropriate correction values.

The module is tuned by setting the RF center frequency and the LO offset [position](#) (above or below). From these two values, the module calculates the LO frequency that must be applied to the LO input and sets the 3010 Series synthesizer module accordingly.

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

RF Input Level (dBm)

Set this to the peak level of the input RF signal to ensure the best dynamic range and signal-to-noise ratio. This field is grayed out when the toggle switch is set to **IF Input**.

Change the RF input level using the up/down arrows or by entering the value.

IF Input Level (dBm)

Set this to the peak level of the input IF signal to ensure the best dynamic range and signal-to-noise ratio. This field is grayed out when the toggle switch is set to **RF Input**.

Set the IF input level using the up/down arrows or by entering the value.

RF Atten (dB)

Sets the RF attenuator value, which changes the input level to the mixer. This value can only be adjusted manually if **Front End Mode** is set to Manual or Auto-IF.

Change the RF attenuator level using the up/down arrows or by entering the value.

IF Atten (dB)

Sets the IF attenuator value, which changes the input level to the ADC. This value can only be adjusted manually if **Front End Mode** is set to Manual.

Change the IF attenuator level using the up/down arrows or by entering the value.

***Note:** the numeric fields of the RF and IF input level and attenuator controls are color-coded. **Red** shows that the value can be changed but will not affect the hardware setup until you change the input source or front-end mode; **gray** shows that the parameter cannot be changed manually but is the current setting; white shows that the value can be edited and will affect the hardware immediately.*

RF/IF Input toggle switch

Set this to RF or IF depending on whether your input signal is RF or has already been downconverted to IF. Apply IF or RF signals to the appropriate input on the 3030 Series module. If the signal is RF, the digitizer downconverts it and provides attenuator configuration and filtering options. RF frequency settings and input level or IF input level controls are enabled, depending on which is selected, and unused controls are grayed out.

Front End Mode

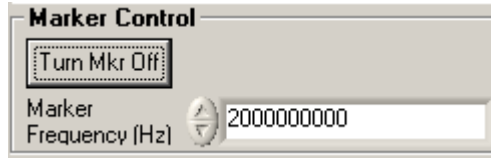
RF input:

- | | |
|---------|--|
| Auto | the RF input level set is used to optimize RF and IF attenuator gain settings automatically. |
| Auto-IF | the IF input level set is used to optimize the IF attenuator setting, but you have manual control of RF attenuation. |
| Manual | ignores the RF input level you set, giving complete control over the settings of the RF and IF attenuators. |

IF input:

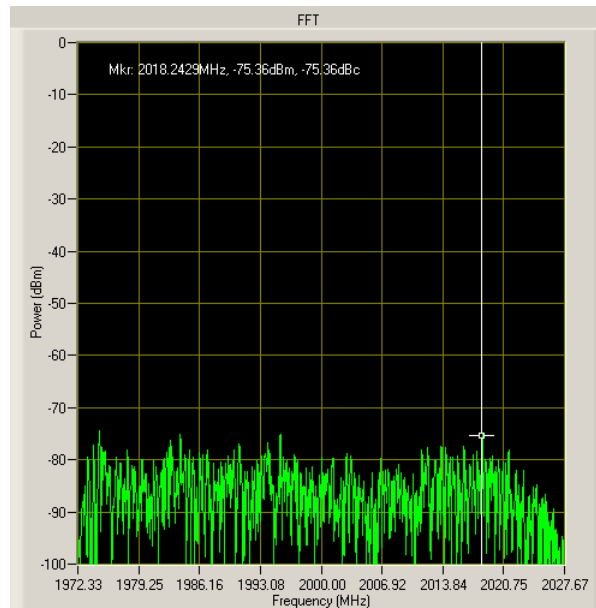
- | | |
|------------------|---|
| Auto and Auto-IF | the IF input level set is used to optimize the IF attenuator setting. |
| Manual | gives complete control over the setting of the IF attenuator. |

Marker Control

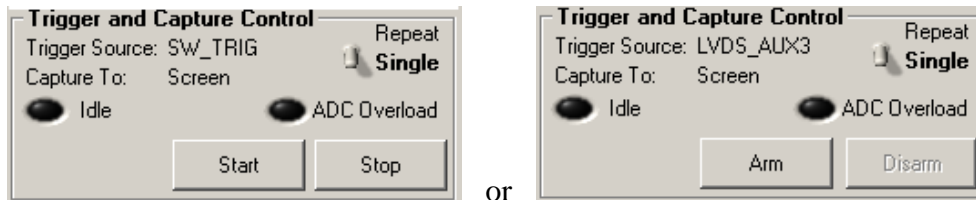


Turn Mkr On: enables a vertical line on the display with a peak level marker. Move the marker line by click-dragging it with the cursor or by entering a frequency in the Marker Frequency (Hz) field.

Figures on the display show the current frequency, and peak relative and absolute levels at that frequency.



Trigger and Capture Control



Measuring: indicator lights green when capturing samples.

Idle: indicator is unlit when no samples are being captured.

Waiting for trigger: indicator lights green while waiting for a trigger

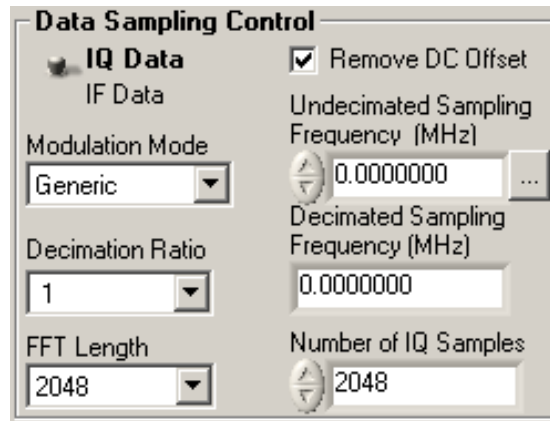
ADC Overload: indicator lights if the ADC was overloaded during the last measurement.

When Trigger Source is set to SW TRIG (**Trigger** in the View Controls group), use the **Start** and **Stop** buttons to capture samples without waiting for any external event.

When Trigger Source is set to a hardware source, use the **Arm** and **Disarm** buttons to enable/disable sample capture dependent on the chosen trigger event.

The **Repeat/Single** toggle switch enables single or continuous samples to be taken.

Data Sampling Control



The screenshot shows a dialog box titled "Data Sampling Control". It features a toggle switch for "IQ Data" (selected) and "IF Data". Below this are three dropdown menus: "Modulation Mode" set to "Generic", "Decimation Ratio" set to "1", and "FFT Length" set to "2048". On the right side, there is a checked checkbox for "Remove DC Offset". Below it are two frequency input fields: "Undecimated Sampling Frequency (MHz)" with a value of "0.0000000" and a spin button, and "Decimated Sampling Frequency (MHz)" with a value of "0.0000000". At the bottom right is a "Number of IQ Samples" input field with a value of "2048" and a spin button.

IQ/IF Data toggle switch

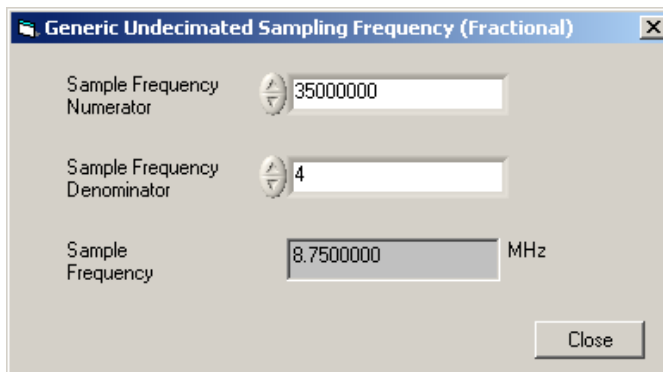
Selects IQ or IF data.

Modulation Mode

(IQ data format only) Sets the digital modulation mode:
Generic/UMTS/GSM/CDMA2000 1X/2319 Emu(lation).

The sample rate varies depending upon modulation mode and decimation ratio:

- Generic: user-defined. Use this mode to create or emulate any modulation scheme. Enter any sample rate up to 50 MHz (3030) or 85 MHz (3030A/3035)
or
define a fractional rate by setting the numerator and denominator. Click on the button adjoining the Undecimated Sample Rate box to open the popup panel and enter a fractional sample rate:



Pre-defined rates:

- UMTS data mode: $61.44 \text{ MHz}/2^N$ (where $N = 1$ to 10)
- GSM resampled IQ data mode: $13 \text{ MHz}/(3 * 2^N)$, where $N = 0$ to 4 ($2^{(4-N)}$ times symbol rate of $13 \text{ MHz}/48$)
- CDMA2000 1X resampled IQ data mode: $9.8304/2^N$, where $N = 0$ to 3 ($2^{(3-N)}$ times chip rate of 1.2288 MHz)
- 2319 emulation mode: $65.28/2^N$, where $N = 4$ or 5 .

Undecimated Sampling Frequency (MHz)

Displays the internal undecimated sampling rate before division by the decimation ratio.

UMTS	61.44 MHz	= 3.84 MHz (3GPP chip rate) x 16
GSM	4.3333 (rec.) MHz	= 270.8333 (rec.) kHz (GSM bit rate) x 16
CDMA2000 1X	9.8304 MHz	= 1.2288 MHz (CDMA2000 chip rate) x 8
2319 Emulation	65.28 MHz	= 3.84 MHz (3GPP chip rate) x 17
IF	61.44 MHz	

Sample rates

	IQ (Msymbol/s)	IQ data format
UMTS	30.72	16
	15.36	16
	7.68	16/32
	3.84	16/32
	1.92	16/32
	0.96	16/32
	0.48	16/32
	0.24	16/32
	0.12	16/32
GSM	0.06	16/32
	4.33333	16/32
	2.16666	16/32
	1.08333	16/32
	0.541667	16/32
CDMA2000	0.270833	16/32
	9.8304	16
	4.9152	16
	2.4576	16
2319 Emulation	1.2288	16/32
	4.08	16/32
	2.04	16/32

Decimated Sampling Frequency (MHz)

IQ data format only: displays the result of the undecimated sampling rate divided by the decimation ratio.

Decimation Ratio

(IQ data format only) Select a decimation ratio, dependent on the modulation mode:

GENERIC	2^n where $n = 0$ to 14
GSM	2^n where $n = 0$ to 4
UMTS	2^n where $n = 1$ to 10
CDMA2000 1X	2^n where $n = 0$ to 3
2319 Emulation	2^n where $n = 4, 5$

See [Data timing](#) on page A-1.

Number of (IF/IQ) Samples

The name of the field changes to reflect the sample type selected.

Sets the sample size (number of samples to be captured), up to 32×10^6 IQ pairs or 128×10^6 IF samples.

FFT Length

Varies with number of IF/IQ samples set.

Remove DC Offset

Removes the DC component from captured IF or IQ data. Removes DC components at the edge of the span at full and/or $\frac{1}{2}$ sample rate.

Note: if DC but no signal is present on the input, a sawtooth waveform is displayed on I and Q time series screens.

Channel List

Click **Chan List** on the soft front panel to display individual channel settings (Fig. 6).

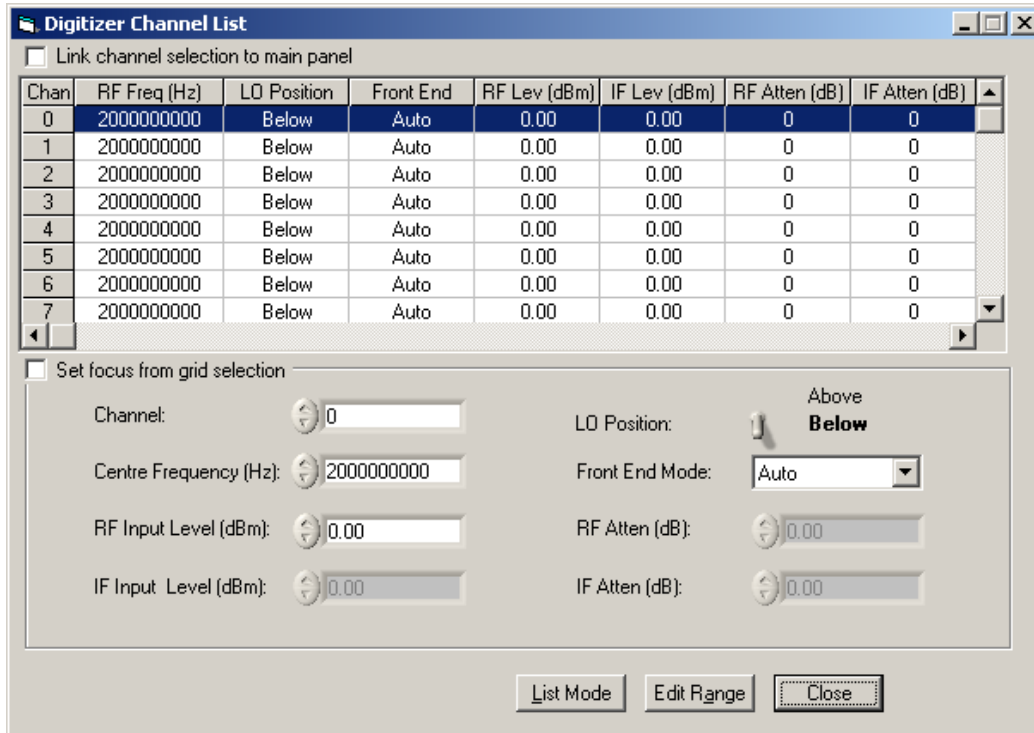


Fig. 6 Edit channel list settings

LIST MODE

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

- Channel
- RF Freq (Hz)
- LO Position
- Front End Mode
- RF Level (dBm)
- IF Level (dBm)
- RF Atten (dB)
- IF Atten (dB)

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.

If you check the **Link channel selection to main panel** box, clicking on any row of a channel list on this screen makes it become the active channel on the soft front panel.

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

***Note:** LO external trigger mode ([Digitizer LO Settings](#), page 23) must be None to edit the RF frequency of the channel.*

Some of the non-applicable parameters of the channel are disabled (depending on the setup) and are not editable.

LIST MODE

Click **Edit Range** to display the Edit Channel Range screen (Fig. 7), 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.



The screenshot shows a dialog box titled "Digitizer Edit Channel Range". It contains several input fields and buttons:

- Channel range, from:** 0 **to:** 127
- Centre Frequency (Hz):** 2000000000 **Set**
- LO Position:** Above (selected), Below **Set**
- RF Input Level (dBm):** -136.00 **Set**
- IF Input Level (dBm):** -136.00 **Set**
- RF Atten (dB):** 0.00 **Set**
- IF Atten (dB):** 0.00 **Set**
- Front End Mode:** Auto **Set**
- Close** button

Fig. 7 Edit all channel settings

Getting started using Microsoft Visual Basic 6.0

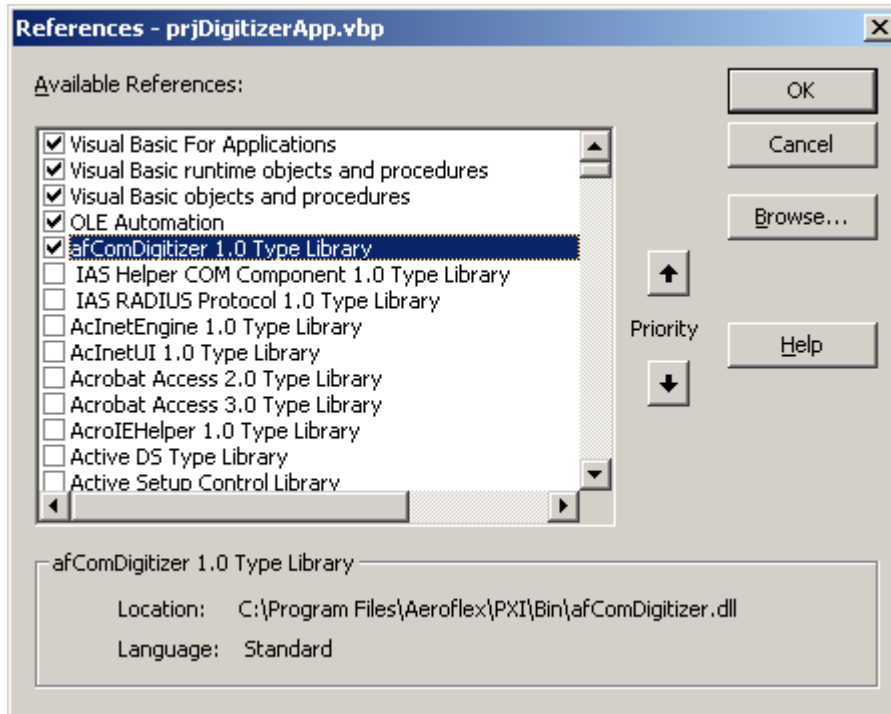
For simplicity, use the afComDigitizer COM component within the Microsoft Visual Basic programming environment.

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

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

Import the afComDigitizer 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 afComDigitizer type library is selected as shown below:



Create an instance variable for the afComDigitizer 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 afDigitizer1 As afCoDigitizer
```

Initialize the instance variable

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

```
Set afDigitizer1 = New afCoDigitizer
```

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

From this point on, the afDigitizer1 object can be used. For example, the following code boots the module and then sets a 0 dBm input level at the maximum supported center frequency

```
afDigitizer1.BootInstrument("PXI6::15::INSTR",  
PXI6::14::INSTR", False)  
afDigitizer1.RF.CentreFrequency =  
afDigitizer1.RF.CenterFrequencyMax  
afDigitizer1.RF.FrontEndMode =  
AFCOMDIGITIZERLib.afDigitizerDll_femAuto  
afDigitizer1.RF.RFInputLevel = 0.0
```

Alternatively, the following code does exactly the same:

```
Dim afDigitizer1Rf as IafCoDigitizerRf

afDigitizer1.BootInstrument("PXI6::10::INSTR", "
PXI6::9::INSTR", False)

set afDigitizer1Rf = afDigitizer1.RF
afDigitizer1Rf.CentreFrequency =
afDigitizer1RF.CentreFrequencyMax
afDigitizer1Rf.FrontEndMode =
AFCOMDIGITIZERLib.afDigitizerDll_femAuto
afDigitizer1Rf.RFInputLevel = 0.0
```

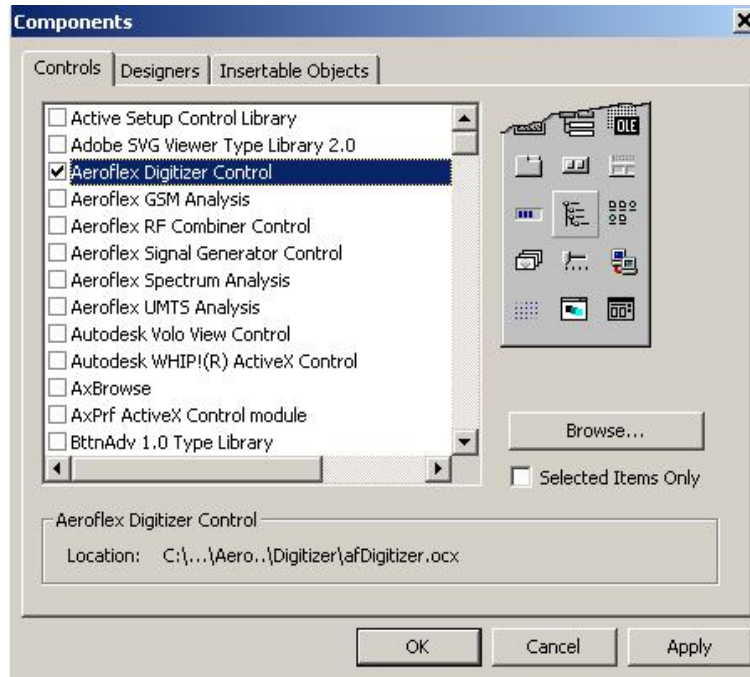
Example overview

In this example, we configure 3010 Series and 3030 Series modules using the afComDigitizer COM object to capture the IF and IQ data.

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 Microsoft Chart Control and Aeroflex Digitizer Control in the Microsoft Visual Basic control palette (right-click on the Microsoft Visual Basic control palette and click *Components...* Select *Aeroflex Digitizer Control*, *Microsoft Chart Control 6.0* and press **OK**).

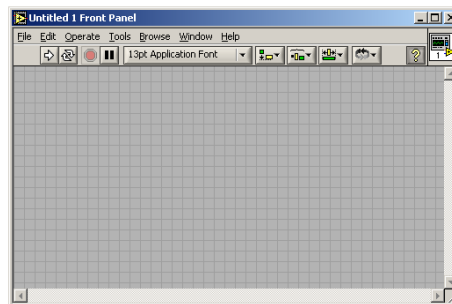
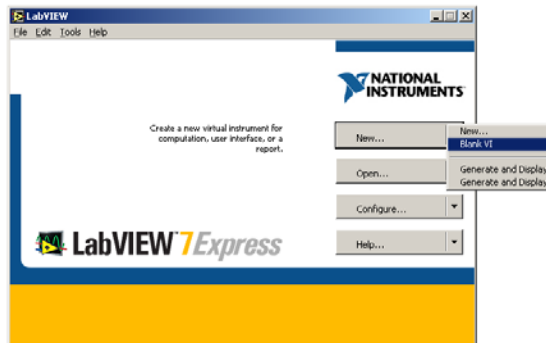


Getting started using National Instruments LabVIEW 7.0/7.1

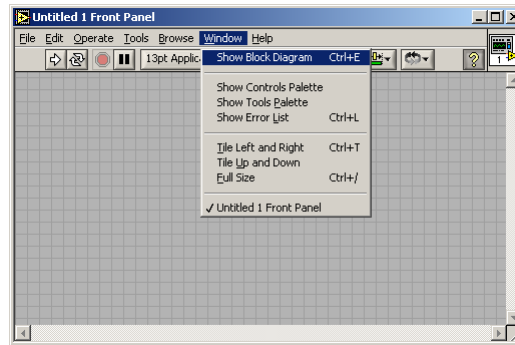
Adding the afComSigGen COM object component to a LabVIEW front panel

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

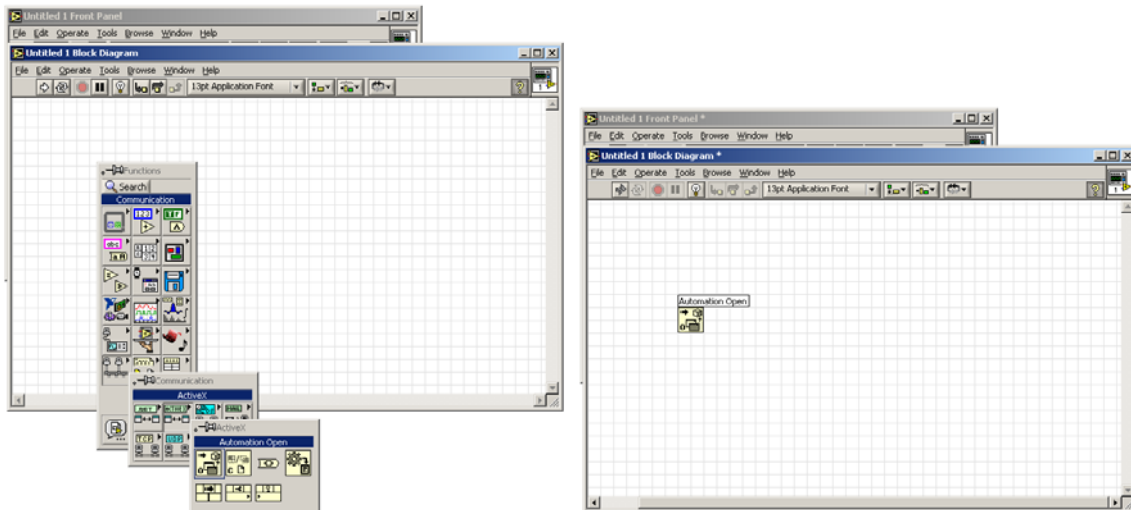
- 1 Start the NI LabView application.
- 2 Click *New\Blank VI*, or open an existing front panel.



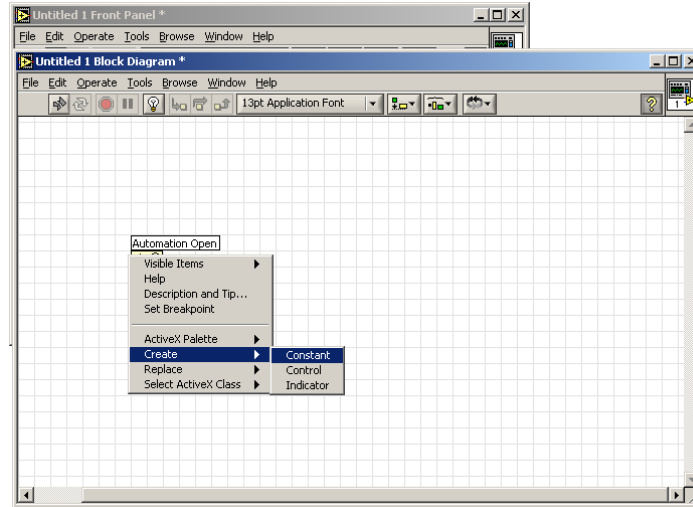
- 3 Click *Window\Show Block Diagram*



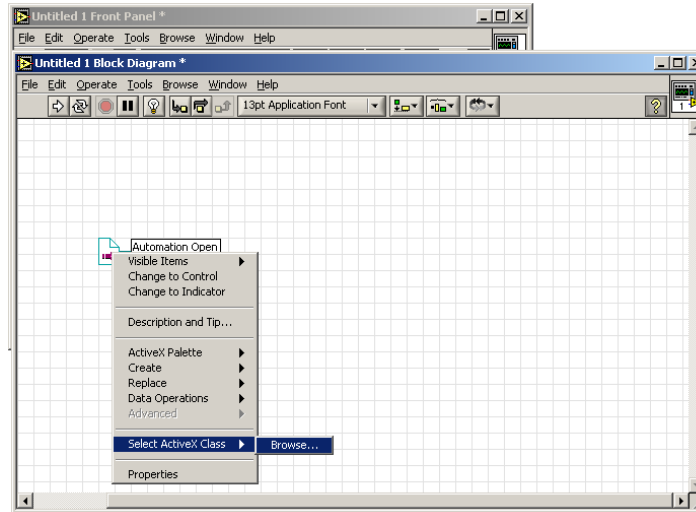
- 4 If the Functions window is not displayed, right-click in the block diagram window and pin the Functions Window.
- 5 Add an 'Automation Open' (*Functions\Communication\ActiveX\Automation Open*) to the block diagram.



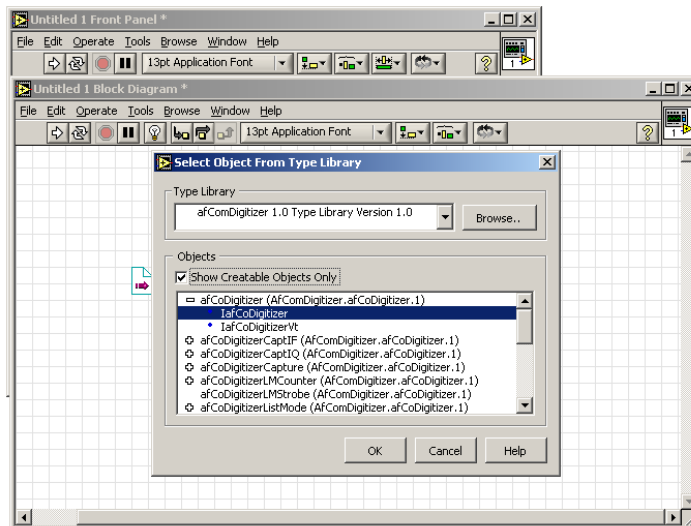
- 6 Right-click over the 'Automation Refnum' input of the created 'Automation Open' and click *Create/Constant*



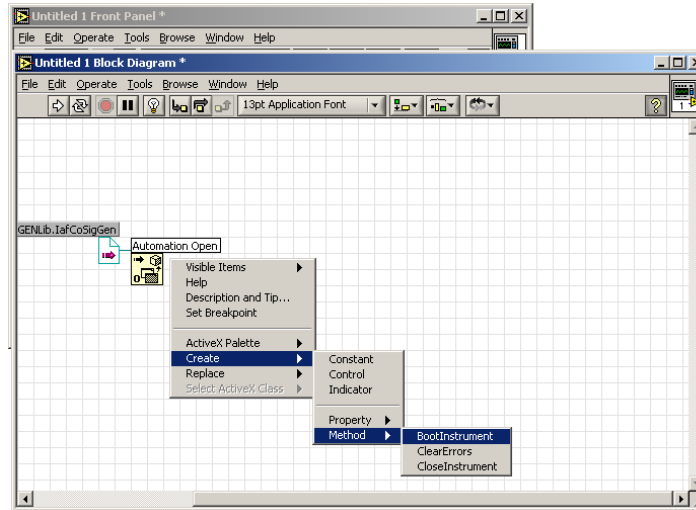
- 7 Right-click on the created 'Automation Refnum' and click on *Select ActiveX Class/Browse...* Note that this operation can take a little while.



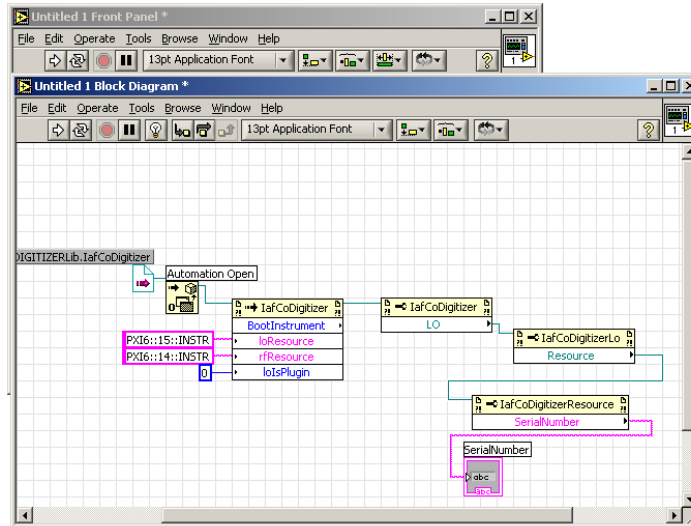
- 8 Select the afComDigitizer type library from the list.
- 9 Tick the 'Show Creatable Objects Only' tick box.
- 10 Expand the afCoDigitizer entry
- 11 Select IafCoDigitizer.
- 12 Press the **OK** button



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



- 14 To access sub-objects, for example afDigitizer.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 afDigitizerDll exports a C style interface that can be used directly from within C or C++ projects.
- The afDigitizerCpp C++ wrapper, provided in source code form, provides a convenient way of accessing the above from C++ projects.
- The afComDigitizer library provides a COM component which can be used from C or C++.

The use of the C interface exported by afDigitizerDll 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 afDigitizer dll either directly or indirectly via the C++ wrapper, the dll must first be loaded. Do this implicitly by linking your project against afDigitizerDll.lib (installed by default in *C:\Program Files\Aeroflex\Pxi\Library*) or explicitly using the Microsoft Windows API function 'LoadLibrary' and specifying 'afDigitizerDll_32.dll' as the dll name.

All of the functions exported from the afDigitizer 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 afDigitizer components, do the following:

- 1 Include the afDigitizerDll.h header file:

```
#include "afDigitizerDll.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 afDigitizer object:

```
afDigitizerInstance_t afDigitizer1;
```

- 3 Create the afDigitizer object:

```
afDigitizerDll_CreateObject(&afDigitizer1);
```

- 4 Start using the afDigitizer object.

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

```
double maxFrequency;
afDigitizerDll_BootInstrument(afDigitizer1,
                              "PXI6::15::INSTR",
                              "PXI6::14::INSTR",
                              AF_FALSE);
afDigitizerDll_RF_CentreFrequencyMax_Get(afDigitizer1, &maxF
requeency);
afDigitizerDll_RF_CentreFrequency_Set(afDigitizer1,
maxFrequency);
afDigitizerDll_RF_FrontEndMode_Set(afDigitizer1,
                                   afDigitizerDll_femAuto);
afDigitizerDll_RF_RFInputLevel_Set(afDigitizer1, 0.0);
```

- 5 Destroy the afDigitizer object:

```
afDigitizerDll_DestroyObject(afDigitizer1);
```

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

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

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

- 1 Add the C++ wrapper source to your project.

Copy the afDigitizerCpp.cpp file to your project directory. By default, this file is found in *C:\Program Files\Aeroflex\Pxi\Src*.

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

- 3 Include the afDigitizerCpp.h header file.

```
#include "afDigitizerCpp.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 afDigitizerCpp namespace

```
using namespace AfDigitizerCpp;
```

- 5 Declare a variable to hold a handle to your afDigitizer object:

```
AfDigitizer afDigitizer1;
```

- 6 Start using the afDigitizer object.

For example, to set a 0 dBm maximum input level at the maximum center frequency:

```
afDigitizer1.BootInstrument( "PXI6::15::INSTR" ,  
                             "PXI6::14::INSTR" ,  
                             AF_FALSE );  
  
afDigitizer1.RF.CentreFrequency =  
afDigitizer1.RF.CentreFrequencyMax;  
afDigitizer1.RF.FrontEndMode = afDigitizerDll_femAuto;  
afDigitizer1.RF.RFInputLevel(0.0);
```

Appendix A

DATA timing

Data transmission for generic modulation mode

In this mode, the IQ data is resampled to produce IQ data at a rate of between 1 and 16384 times the bit rate, up to a maximum of 85.00 MHz (3030A/3035) or 50 MHz (3030). The timing relationships for the DATA interface is as shown in Fig. A-1. Note that the CLK_OUT signal is continuous and that the frequency of the clock remains fixed at 103.68 MHz (3030A/3035) or 61.44 MHz (3030). It is possible to define any relationship between the data rate and the clock frequency of 103.68 MHz: in this example, the chosen decimated data rate of 51.84 Ms/s means that the ratio of clock to data rate is 2.

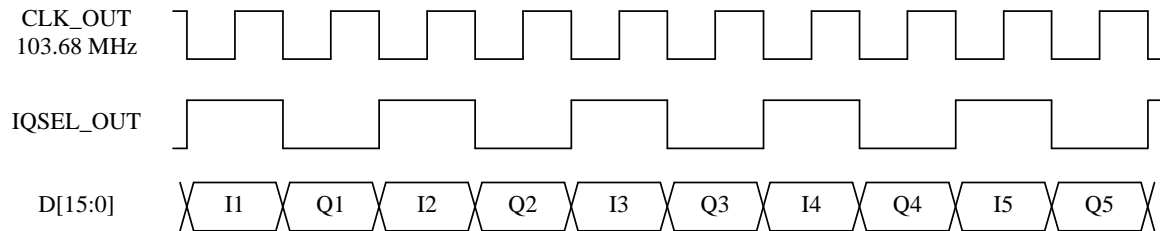


Fig. A-1 DATA timing for generic modulation

Data timing for UMTS modulation mode and decimation ratio of 2

The ADC in the module is clocked at a rate of 103.68 Ms/s (3030A/3035). The module's soft front panel allows both the modulation mode and the decimation ratio to be selected. If UMTS is selected as the modulation mode and a decimation rate of two is selected, the IQ

data rate is 30.72 Ms/s. The ratio of ADC clock rate to IQ sample rate is $\frac{103.68 \text{ MHz}}{30.72 \text{ MHz}} =$

3.375, a non-integer value that means that data is output sometimes on the 3rd clock pulse and sometimes on the 4th. Therefore the number of clock cycles between IQSELECT_OUT being asserted varies. When configured in this way, the timing relationships for the DATA interface are as shown in

Fig. A-2.

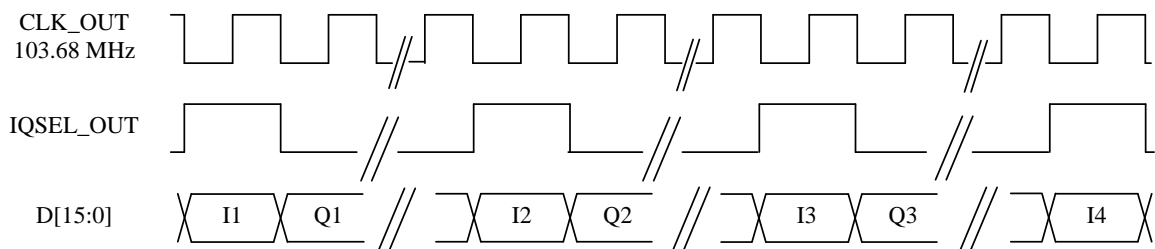


Fig. A-2 DATA timing for UMTS mode and decimate by 2

Data timing for UMTS modulation mode and decimation ratio of 4

The timing relationships for the DATA interface are as shown in Fig. A-3. The CLK_OUT signal is continuous and remains fixed at 103.68 MHz (3030A/3035), irrespective of the modulation mode and the decimation rate. IQSELECT_OUT is toggled only when an IQ data pair is being transmitted. The ratio of ADC clock rate to IQ sample rate is $\frac{103.68 \text{ MHz}}{15.36 \text{ MHz}} = 6.75$, a non-integer value that means that data is output sometimes on the 6th clock pulse and sometimes on the 7th. Therefore the number of clock cycles between IQSELECT_OUT being asserted varies.

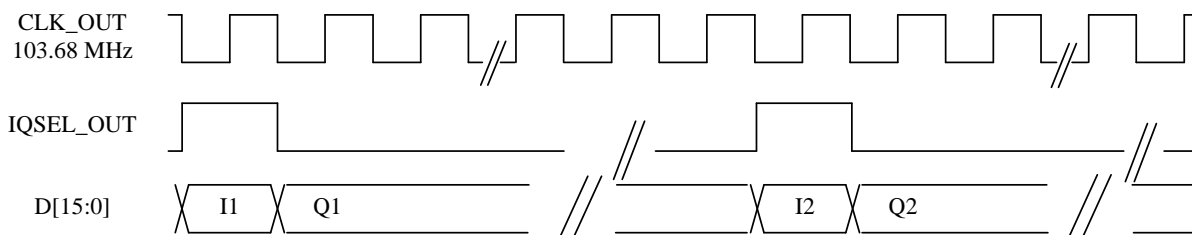


Fig. A-3 DATA timing for UMTS mode and decimate by 4

Data timing for UMTS modulation mode and decimation ratio of 8

The timing relationships for the DATA interface are as shown in Fig. A-4. The CLK_OUT signal is continuous and remains fixed at 103.68 MHz (3030A/3035), irrespective of the modulation mode and the decimation rate.

The ratio of ADC clock rate to IQ sample rate is $\frac{103.68 \text{ MHz}}{7.68 \text{ MHz}} = 13.5$. Therefore the number of clock cycles between IQSELECT_OUT being asserted varies. IQSELECT_OUT is toggled only when an IQ data pair is being transmitted.

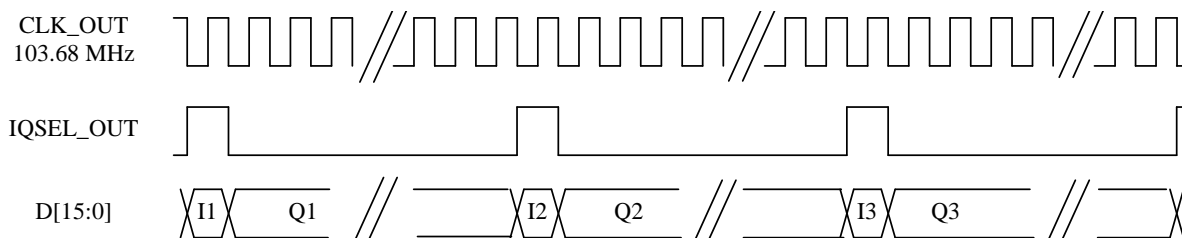


Fig. A-4 DATA timing for UMTS mode and decimate by 8

In addition, for decimation ratios of 8 or greater, IQ data can be 32-bit. In this mode data is transmitted as two 16-bit words, MSW then LSW for I then Q, as shown in Fig. A-5.

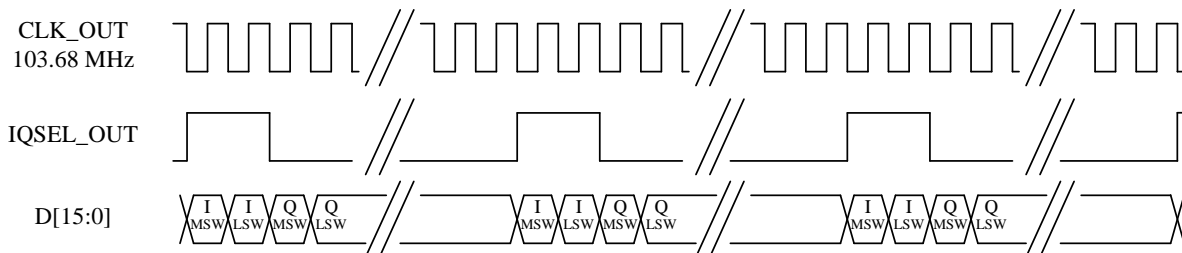


Fig. A-5 DATA timing for 32 bit IQ, UMTS mode and decimate by 8

Data timing for CDMA2000 1X modulation mode

If a modulation mode of CDMA2000 1X and a decimation value of 1 are both selected, IQ data is generated at eight times the CDMA2000 1X chip rate. As the chip rate is 1.2288 MHz, this gives an IQ sample rate of 9.8304 Ms/s. There is no longer an integer relationship between the clock rate of 103.68 MHz (3030A/3035) and the 9.8304 Ms/s data rate.

The number of clock cycles between IQSELECT_OUT being asserted is not fixed but varies. This is true for all CDMA mode decimation ratios.

The timing relationship for the DATA interface is shown in Fig. A-6. Note that the CLK_OUT signal is continuous and remains fixed at 103.68 MHz, irrespective of the modulation mode and the decimation rate. IQSELECT_OUT is toggled only when an IQ data pair is being transmitted.

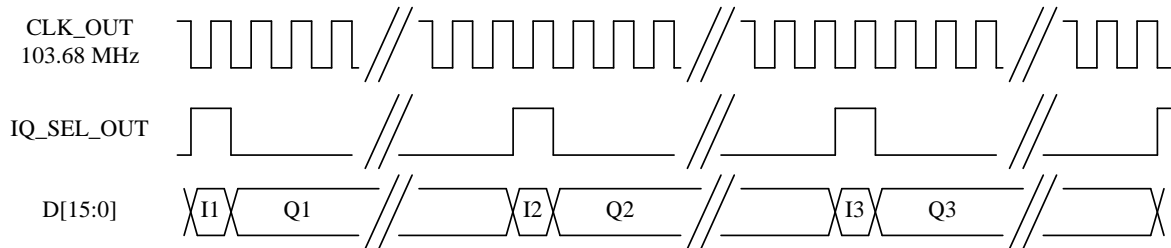


Fig. A-6 DATA timing for CDMA2000 1X

DATA TIMING

The module's soft front panel allows the CDMA decimation ratio to be 1, 2, 4, or 8. Table A-1 shows the corresponding oversample ratios for each decimation ratio.

Table A-1 Variation in CDMA decimation modes

Decimation	Oversample ratio (Ms/s)
1	9.8304 (= 8 * 1.2288)
2	4.9152 (= 4 * 1.2288)
4	2.4576 (= 2 * 1.2288)
8	1.2288

Data transmission for GSM modulation mode and a decimation ratio of 1

In this mode, the IQ data is resampled to produce IQ data at 16 times the GSM symbol rate of 270.83 kHz, that is, 4.333 Ms/s. The timing relationships for the DATA interface is as shown in Fig. A-7. Note that the CLK_OUT signal is continuous and that the frequency of the clock remains fixed at 103.68 MHz (3030A/3035). IQSELECT_OUT is toggled only when an IQ data pair is being transmitted. There is no integer relationship between the data rate of 4.33 MHz and the clock frequency of 103.68 MHz. Therefore the number of clock cycles between IQSELECT_OUT being asserted is no longer fixed but varies. This is true for all GSM mode decimation ratios.

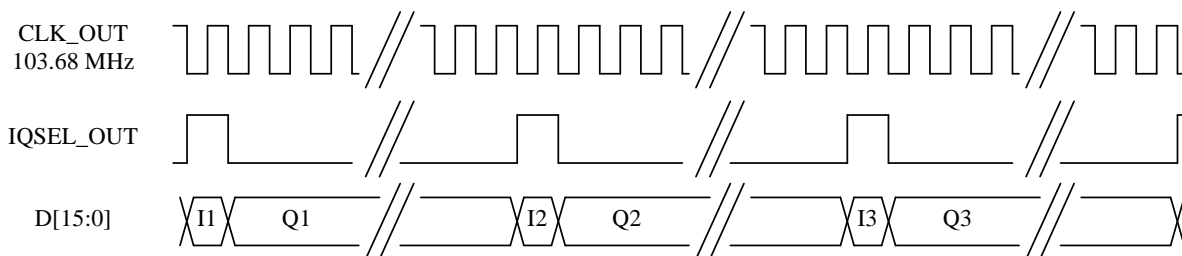


Fig. A-7 DATA timing for GSM

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