ASTRONICS TEST SYSTEMS

PXIe-2461
235 MHz Frequency
Time Interval Counter

Publication No. 981038   Rev. DRAFT (07-14-2016)

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FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.
2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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DOCUMENT CHANGE HISTORY

Revision	Date	Description of Change
NA	06/14/2016	Draft review copy
NA	07/14/2016	Training review copy
NA	08/26/2016	Review Copy

Chapter 1
Overview and Features

Introduction

The PXIe-2461 Frequency Time Interval Counter (FTIC) (Figure 1-1) is a high performance, 2-channel, 235 MHz counter. The instrument is designed to be used in a PXIe compatible mainframe and conforms to PXIe bus.

The standard unit uses the PXI 'CLOCK10' as its reference. However, the user can choose between two additional reference standard sources, an internal OCXO and an external 10 MHz frequency reference connected to the front panel.

Figure 1-1 PXIe-2461 FTIC

The PXIe-2461 is designed to be controlled via the PXIe bus. No local control of the counter is possible.

To perform high performance measurements, the Counter includes one filter per channel and a selectable hysteresis.

Resolution

The PXIe-2461 offers 235 MHz frequency range measurements with a resolution going up to 10 digits per second. In time interval the resolution is 1 ns in single shot and 100 ps in averaging mode.

High Speed Time Measurment

Using Timing Error Correction (TEC) in combination with traditional recipromatic techniques minimizes measurement time without compromising performance.

Measurement Time Out

Programmable measurement time-out helps the user to optimize system performance when the input signal is missing.

High Performance Trigger

In Manual mode, the trigger level is programmable from – 5.1 V to + 5.1 V with the resolution of 2.5 mV.

When the x10 attenuator is enabled, the trigger level is programmable from -51 V to +51 V with a resolution of 25 mV.

An automatic trigger mode is also available covering a frequency range of DC and 50 Hz to 235 MHz.

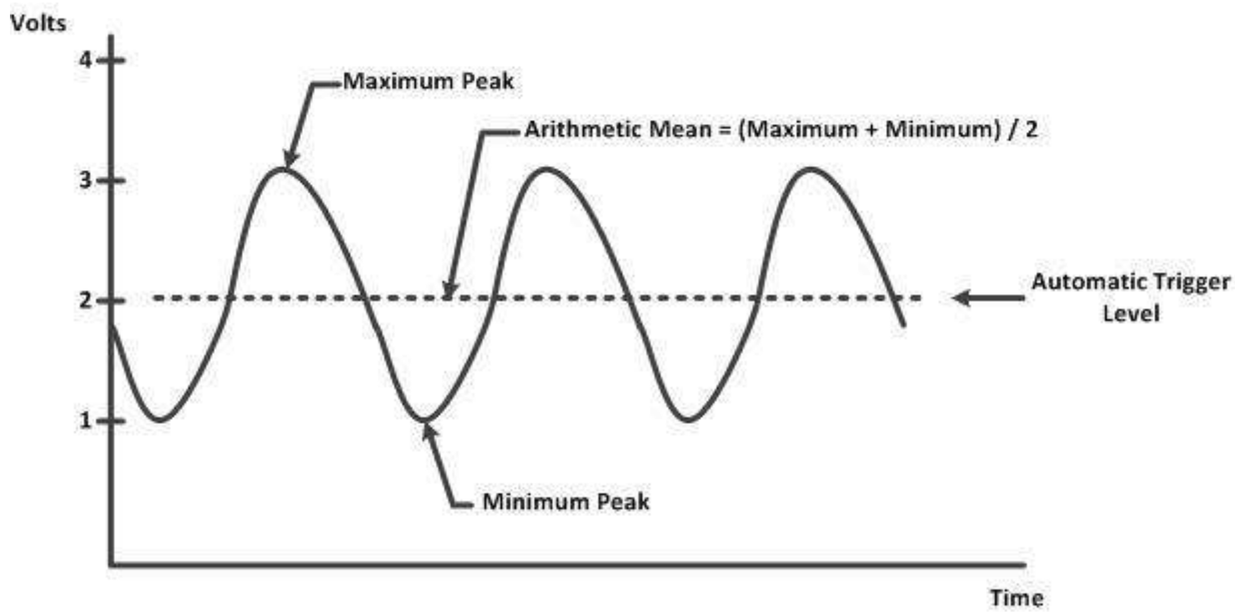

Figure 1-2 High Performance Trigger

Voltage Measurements

Automatic triggering is used to establish the peak DC voltages for setting trigger points. This feature is used to measure High, Low and Middle Voltage.

Individual Channel Filtering

The PXIe-2461 offers independent 50 kHz low pass filters on each channel to allow measurements in noisy configurations.

Selectable Sensitivity

The sensitivity of the counter can be decreased to perform measurement on a low level signal with noise. This characteristic is useful for system applications requiring measurement of signals in noisy configurations.

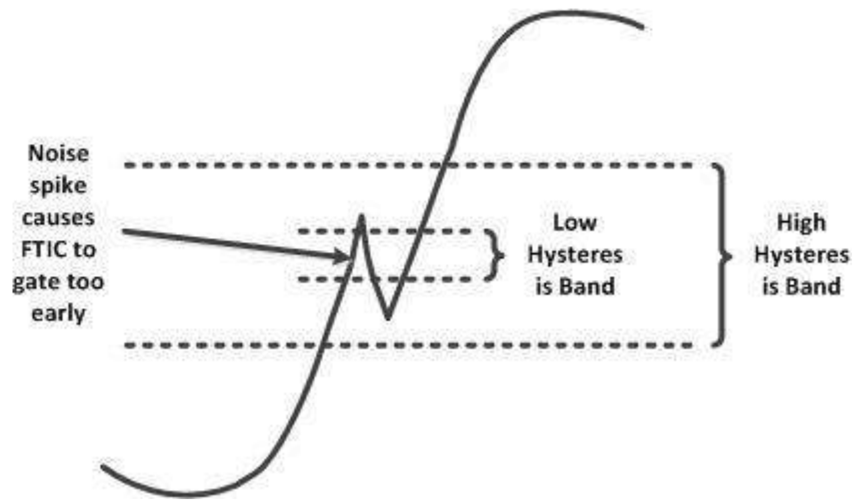

Figure 1-3 Selectable Sensitivity

Powerful Arming Capability

The PXIe-2461 FTIC offers powerful arming capability. Different modes are provided with the ability to select the arming source among the external arming input and the PXI trigger lines.

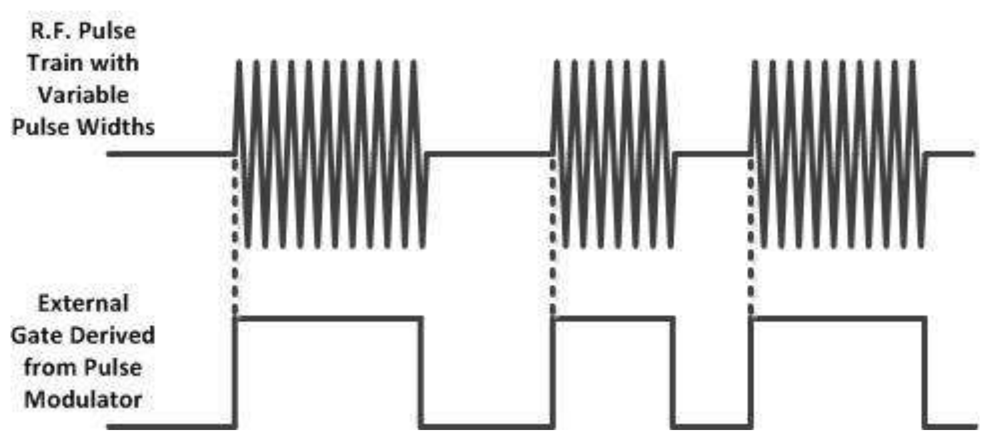

Figure 1-4 Powerful Arming Capability

Automatic Functions

The PXIe-2461 includes a collection of automatic functions that are generated from one or more standard measurements.

PXIe-2461 Inputs and Outputs

The PXIe-2461 front panel provides the hardware interface to the unit under test (UUT). Figure 1-5 illustrates the front panel; its connectors and LED indicators.

Figure 1-5 PXIe-2461 Front Panel Connectors and Indicators

Connectors

Connector	Connector Type	Description
J1 IN 1	BNC (Female)	Timer/counter channel #1
J2-VT1	MCX (Female)	Trigger level voltage output #1
J3-VT2	MCX (Female)	Trigger level voltage output #2
J4 –ARM	MCX (Female)	External ARM input

Connector	Connector Type	Description
J5 IN	MCX (Female)	External reference frequency clock input
J6 OUT	MCX (Female)	Internal reference frequency clock output
J2 IN 2	BNC (Female)	Timer/counter channel #2

Table 1-1 PXIe-2461 Front Panel Connectors

LED Indicators

LED	Indication
FAIL	Unit failure
ACC	PXIe access
T1	Counter #1 input detected
GATE	Gate input detected
T2	Counter #2 input detected

Table 1-2 PXIe-2461 LED Indicators

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Chapter 2

Getting Started

Unpacking and Inspection

WARNING

Use standard ESD procedures including ground straps and static-safe work surfaces whenever handling the PXIe-2461 module.

Remove the PXIe-2461 module and inspect it for damage. If any damage is apparent, inform the carrier immediately. Retain shipping carton and packing material for the carrier's inspection.

Verify that the pieces in the package you received contain the correct module option. Notify our Customer Support department (see front pages for contact information) if the module appears damaged in any way. Do not attempt to install a damaged module into a PXIe chassis.

The module is shipped in an anti-static bag to prevent electrostatic damage to the module. Do not remove the module from the anti-static bag unless it is in a static-controlled area.

Installing the Module into a PXIe Chassis

WARNING

The PXIe-2461 module is NOT hot-swappable. The power to the PXIe chassis must be turned off before installing a PXIe-2461. Plugging the module in before the power is off may result in damage to the electronics.

The PXIe-2461 may be installed in any PXIe chassis hybrid or PXIe slot. See Figure 2-1.

When inserting the module into the chassis, it should be gently rocked back and forth to seat the connectors into the backplane receptacles.

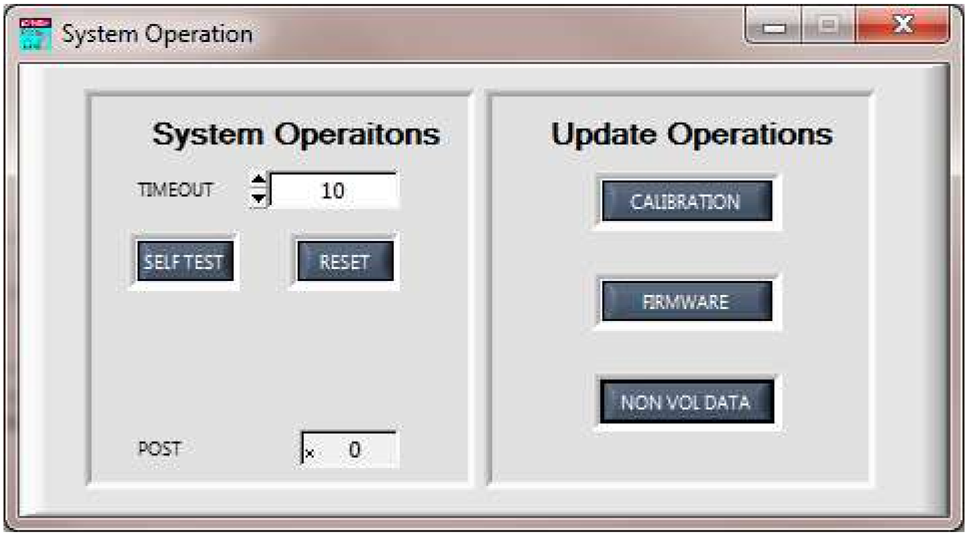
Figure 2-1 PXIe-2461 Chassis Installation

Initial Power On

1. Drivers must be installed prior to hardware installation (see Software Installation).
2. Turn off the chassis power before installing the PXIe-2461.
3. Once the module is properly installed in the chassis, turn on the chassis power.

   The FAIL LED will illuminate for ~0.5s and then turn off if the module passes the internal power on self test (POST).

   If the PXIe-2461 fails POST, the FAIL LED will continue to be illuminated. Should this happen, turn the chassis power off, re-install or make certain the PXIe-2461 is properly installed in the chassis, and turn the chassis power back on.
4. Turn on or re-start the computer connected to the chassis.
5. Run the Soft Front Panel program and depress the "**SYSTEM**" command button.



The POST value should be 0. A non-zero value indicates a failure documented in Table 2-1 below.

POST Bit Number	Failure
0	RELAYRSTn signal stuck low.
1	Not Used
2	I2C interface error with flash chip reading module segment.
3	Flash data error reading module segment.
4	DAC_UPDn signal stuck low.
5	I2C interface error with flash chip reading calibration segment.
6	Flash data error reading calibration segment.
7	SPI bus timeout.
8	I2C interface error with relay controller chip.
9	Relay controller data error.

Table 2-1 POST Error Description

Should the PXIe-2461 module or Soft Front Panel self test continue to fail, contact Customer Support.

Software Installation

Prior to hardware installation of the PXIe-2461, install the following four software drivers:

1. VISA Driver
2. C Legacy API Instrument Driver
3. LabView Instrument Driver
4. Low Level VISA Driver

VISA Driver

The C Legacy API and LabView Instrument Drivers use the VISA communication library to operate the instrument. The VISA library must be installed prior to installing the instrument driver and is supplied by the PCI Express interface manufacturer.

Installing the VISA Driver

Follow the manufactures setup instructions.

C API Instrument Driver

The C API instrument driver links the communication interface and an application development environment (ADE). It provides a high level, abstract view of the instrument. It also provides ADE-specific information that supports the capabilities of the ADE, such as a graphical representation.

Listed below are some of the ADEs that are recommend for use with this driver:

- Agilent Technologies Agilent VEE
- Microsoft Visual Basic
- Microsoft Visual C/C++
- Microsoft Visual C#/.Net
- National Instruments LabWindows/CVI

Included with the instrument driver is the Soft Front Panel (SFP) software. The soft front panel is a graphical user interface for the PXIe-2461. Use it to verify communications and functionality when the PXIe-2461 is first integrated into the system.

Download the C API Instrument driver from:

http://www.ni.com/gate/gb/GB_EVALTLKTFTICASTRONICS/US

Installing the Legacy API Driver

1. Open the file ri2461e_vXYZ.zip on the computer with the PCI Express interface. The XYZ refers to the driver version Z.YZ. For example, ri2461e_v100.zip is version 1.00 of the API driver.
2. Double-click the "setup.exe" file to execute the installer.
3. Follow the setup directions.

The following files are installed into the directory determined by the VXIPNPPATH windows environment variable.

- ANSI C source code for the Instrument Driver and Soft Front Panel, i.e., .c and .h files.
- MS Windows 32 bit DLL library, i.e., ri2461e_32.dll file.
- Microsoft 32 bit DLL import library, i.e., ri2461e.lib file.

- LabWindows/CVI function panel file, i.e., ri2461e.fp file.
- Driver help file, i.e., ri2461e.doc file.

LabView Instrument Driver

The LabView instrument driver supports LabView 2014 and later. Contact customer support for information on driver support for earlier versions of LabView.

Download the LabView Instrument driver from:

http://www.ni.com/gate/gb/GB_EVALTLKTFTICASTRONICS/US

Installing the LabView Instrument Driver

1. Open the download file on the computer with the PCI Express interface.
2. Double-click the "setup.exe" file to execute the installer.
3. Follow the setup directions.

Listed below are the example vi's included with the LabView Driver in the Examples folder of the installation directory.

- ri2461e Main.vi – Soft Front Panel application.
- ri2461e Example configure and read 5 measurements.vi
- ri2461e Example Positive Pulsewidth Measurement.vi

Low Level VISA Driver

A low level VISA driver is required for the specific PCI Express interface. The NI-VISA low level driver is automatically installed with the LabView instrument driver installation.

Contact customer service if the PCI Express interface is not supported by NI-VISA

Installing the Low Level VISA Driver

1. Follow the instructions for the LabView Instrument Driver installation.

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Chapter 3
Theory of Operation

Functional Systems

The PXIe-2461 card comprises three functional systems as follows:

1. The Analog System
2. The Measurement System
3. The Digital System

Analog System

The Analog System comprises two channels that process the signals applied to front panel IN1 and IN2 respectively to produce differential pairs of signals that are fed to the measurement system. A block diagram is given in Figure 3-1.

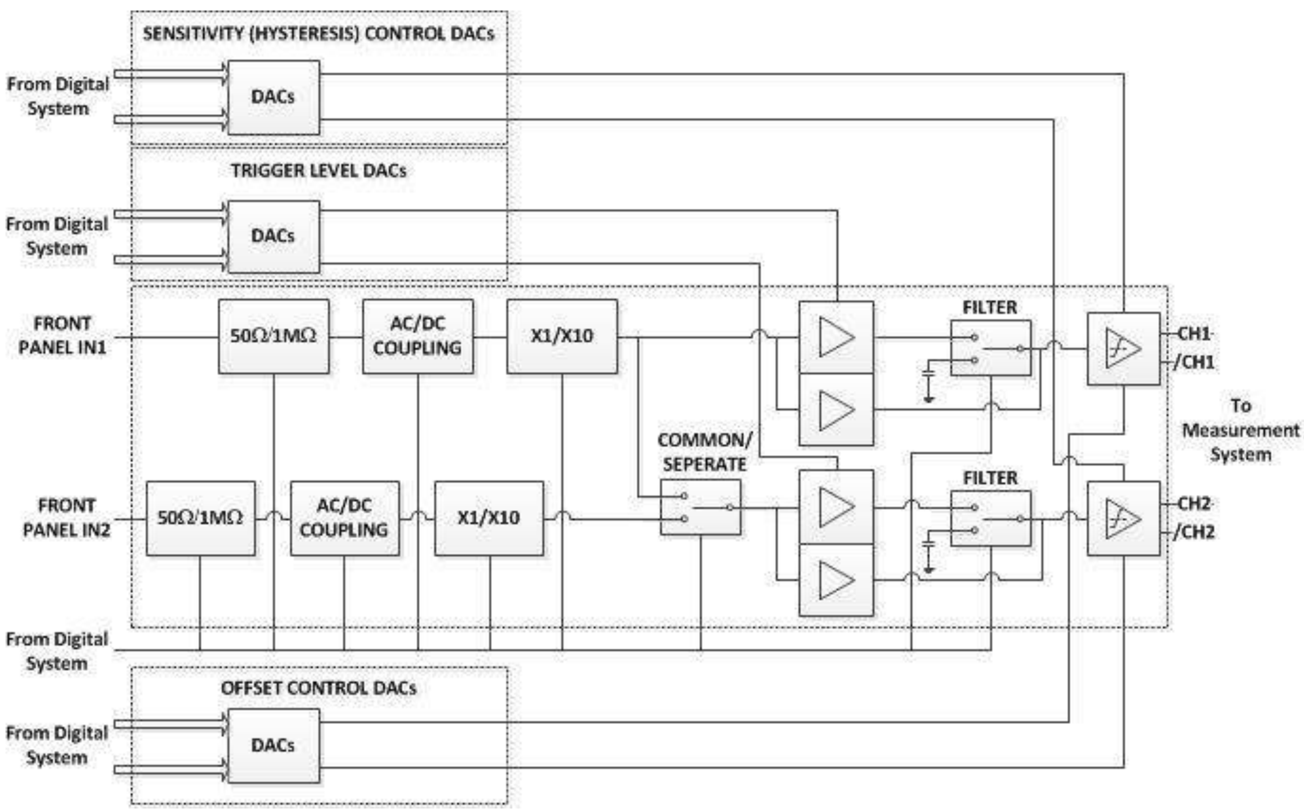


Figure 3-1 Analog System Block Diagram

Each channel includes relay-controlled circuits which allow selection of 50Ω/1MΩ input impedance, AC/DC coupling, X1/X10 input attenuation and 50 kHz filter. An additional relay allows the user to choose between SEPARATE and COMMON modes of operation. In SEPARATE mode the signal on IN1 is fed to the channel 1 active circuits and the signal on IN2 is fed to the channel 2 active circuits. In COMMON mode, the signal on IN1 is fed to both the channel 1 and channels 2 active circuits. In this mode signals on IN2 are disconnected from the channel 2 active circuits, but remain connected to the 50Ω/1MΩ, AC/DC and X1/X10 selection circuits.

Each channel features separate high frequency and low frequency paths whose outputs in normal operation are recombined with a crossover frequency of 5kHz nominal. With the FILTER enabled, the high frequency path is disabled, and the bandwidth of the low frequency path set to 50 kHz nominal. The buffered signals from each channel drive separate ground-referenced Schmitt trigger output stages.

Trigger levels for the two channels are derived independently in the TRIGGER LEVEL DAC (Digital to Analog Converter) System and applied independently to each input channel. These trigger levels are also made available at the front panel (buffered by 10kΩ nominal resistance). The TRIGGER LEVEL DAC System incorporates separate trimming DACs which are used to calibrate the trigger level offset and gain. The OFFSET CONTROL DAC System allows channel 1 and channel 2 offset voltage correction. The SENSITIVITY (HYSTERESIS) CONTROL DAC System allows control of channels 1 and 2 sensitivity/hysteresis levels. Control of all DAC Systems is via the digital system. DAC calibration values are stored in non-volatile memory.

Control signals for the relays are supplied by the digital system.

Measurement System

The Measurement System is mainly implemented within a Field Programmable Gate Array (FPGA). The Timing Error Correction (TEC) circuit is external to this.

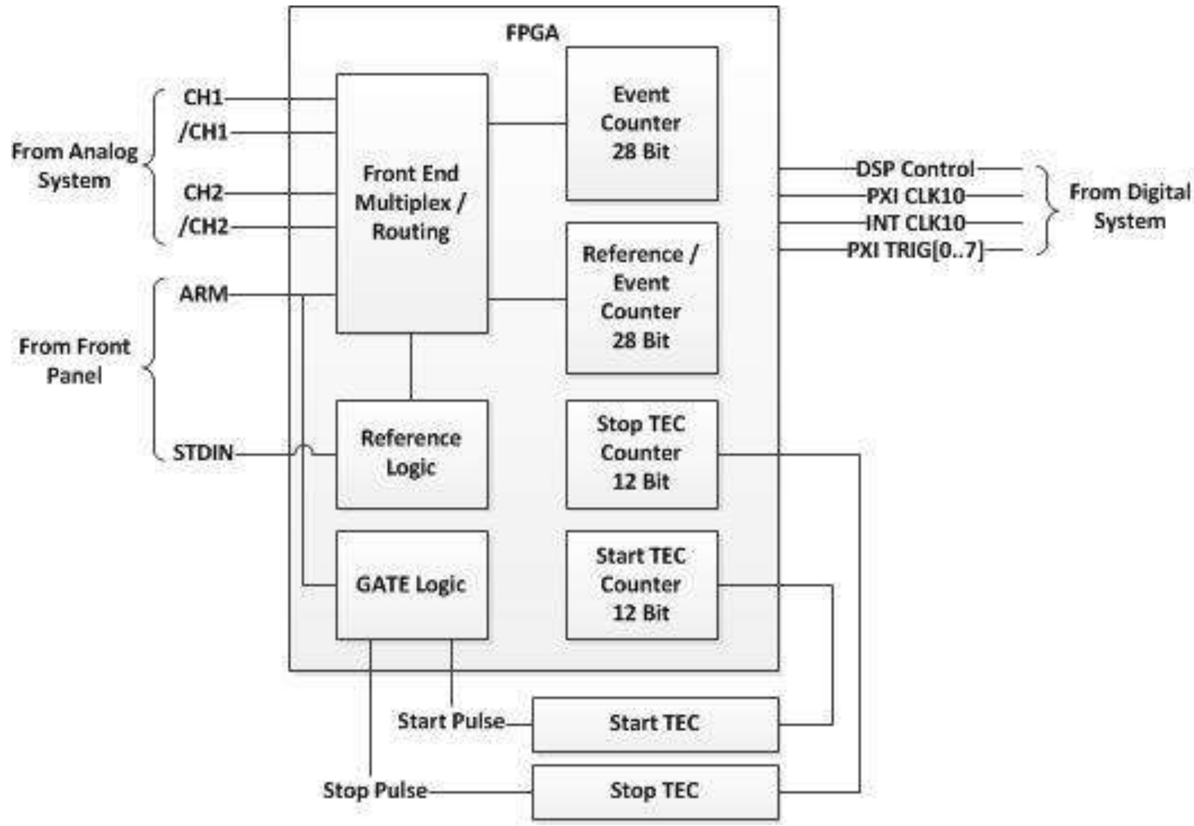


Figure 3-2 Measurement System Block Diagram

Referring to Figure 3-2, the measurement block consists of a high speed mux and router front end which takes in channel 1 & 2 after conditioning by the analog system. This front end is controlled by the digital system to allow the DSP to configure the measurement system for the type of measurement to be taken. The DSP can also drive the measurement process by controlling the arming of the start and stop of the measurement.

After a measurement has taken place, the DSP reads the relevant values from the counters. Interrupts are used to communicate the various events that occur in the measurement system (gate open, gate closed, counter rollover, etc.).

The measurement technique employed is known as the recipromatic measurement technique. In this technique the signal and reference are counted simultaneously. This has the advantage that for signals of less than 10 MHz, accuracy is maintained because of the large number of counts in the reference counter. In addition, the opening and closing of the gate is synchronized to the signal which, together with the Timing Error Correction (TEC) circuit allows higher resolution equivalent to a 1GHz reference.

In this system, the first edge of the incoming frequency to be measured (after the **Start Arm** signal has enabled the start of measurement), opens the gate and simultaneously allows the signal through to the **Event Counter** and the frequency reference through to the **Reference/Event** counter. Both signals are now counted for the duration of the gate time. The length of the gate time is set internally or externally. The internal setting is made by the DSP using an on-board timer programmed by the user. The external setting is set by the ARM input.

At the end of the gate time, the **Stop Arm** signal enables the end of measurement and the next edge of the input signal closes the gate and the two counters stop.

In the above description, there are two points at which resolution is limited by the 10 MHz reference, the opening of the gate and the closing illustrated by the red and blue highlights in Figure 3-3.

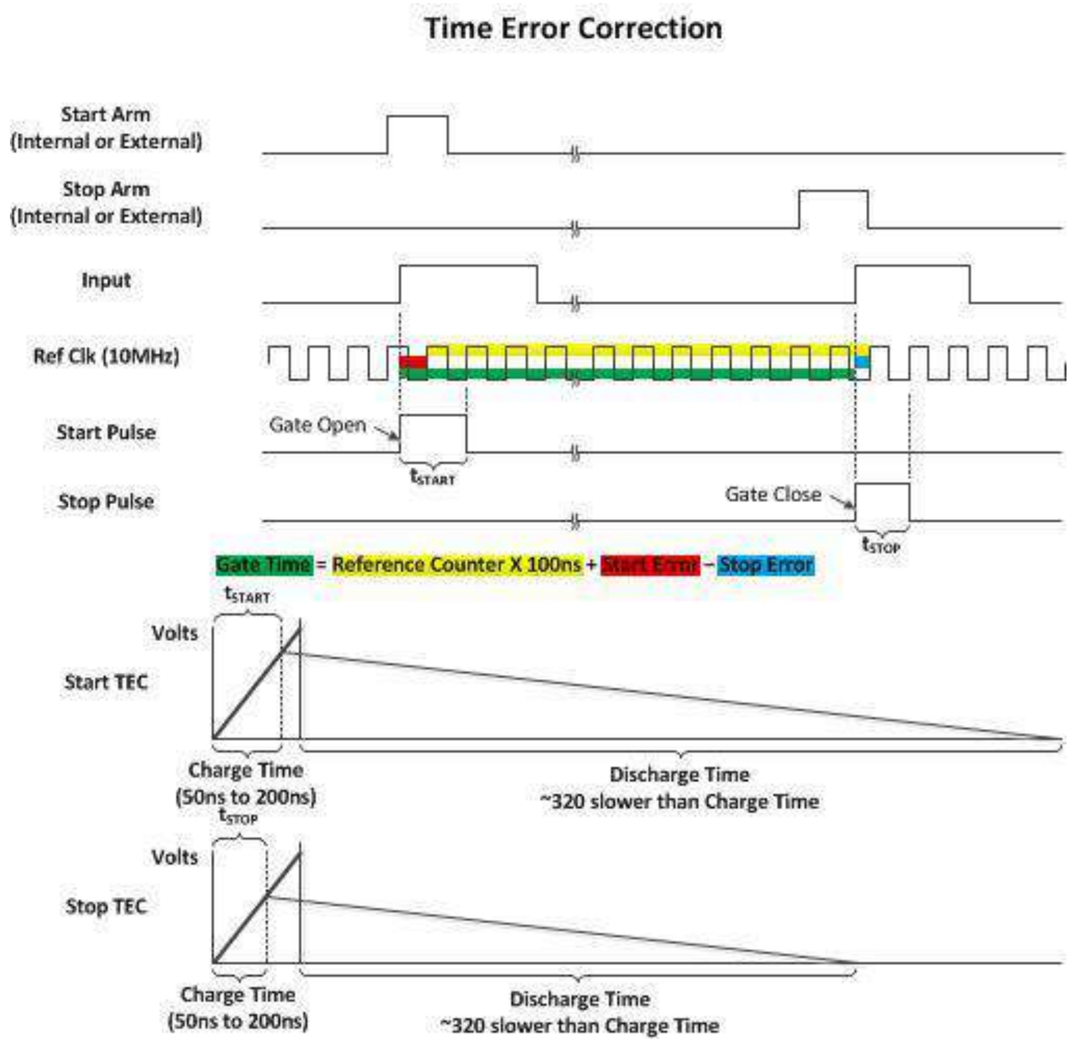


Figure 3-3 Time Error Correction

To overcome this limitation, logic gates detect the time between the signal opening the gate and the second edge of the reference, and a pulse of width proportional to this time is generated. This pulse (**Start Pulse**) is now used to charge a capacitor from a constant current source so the charge on the capacitor is proportional to the time error. The time error charge is then discharged at a much slower rate. The discharging signal is counted in the **Start TEC Counter** until completely dischagred. When the capacitor is discharged then the count in the **Start TEC Counter** represents the error between the opening of the gate and the next counting edge of the reference (See Figure 3-2).

This process is repeated at the closure of the gate by a separate TEC and counting circuit (**Stop TEC Counter**).

After the measurement results have been read out of all counters, calibrated pulses derived from the reference are fed to the TEC circuits. This is done for two pulse widths for both start and stop circuits. The resultant counts are then used to calibrate the TEC circuits. Once these are calibrated the value of the frequency of the input can be calculated to a much greater resolution.

Digital System

Referring to Figure 3-4, the Digital System is based on a DSP design which controls the input conditioning relays, calibration DACs, trigger level DACs and ARM level DAC.

In addition, the DSP programes the measurement system and performs the necessary calculations to produce a result which is then stored in dual port memory for access by the PCI Express interface.

The DSP used has both a number of static I/O ports in addition to an externally available address and data base. This mixture of I/O allows memory mapped I/O for fast peripherals such as the measurement system while the static I/O ports are used control of relays, standards, etc.

Firmware is stored in serial FLASH while non-volatile constants are stored in a serial EEPROM. Address decode and further I/O is performed in the FPGA along with the measurement system.

After power up the DSP reads calibration data from the serial EEPROM and the 8x8 bit DAC are initialized. The measurement system, trigger level DACs, ARM DAC and input conditioner relays, are set to their default values. The system will now wait for an initiate command, sent via the PCI Express interface, before a measurement sequence will commence. Alternately, the operator may command alternative measurement functions or input conditions via the PCI Express interface.

Any type of command from the PCI Express will be passed to the DSP via the **PCI Interface** logic. The command passed will cause the DSP to change various conditions, measurement functions, or trigger one or more measurement cycles.

Each successful measurement cycle will result in a measurement result which is transferred to the **PCI Interface** as soon as it is calculated and before the next measurement cycle commences.

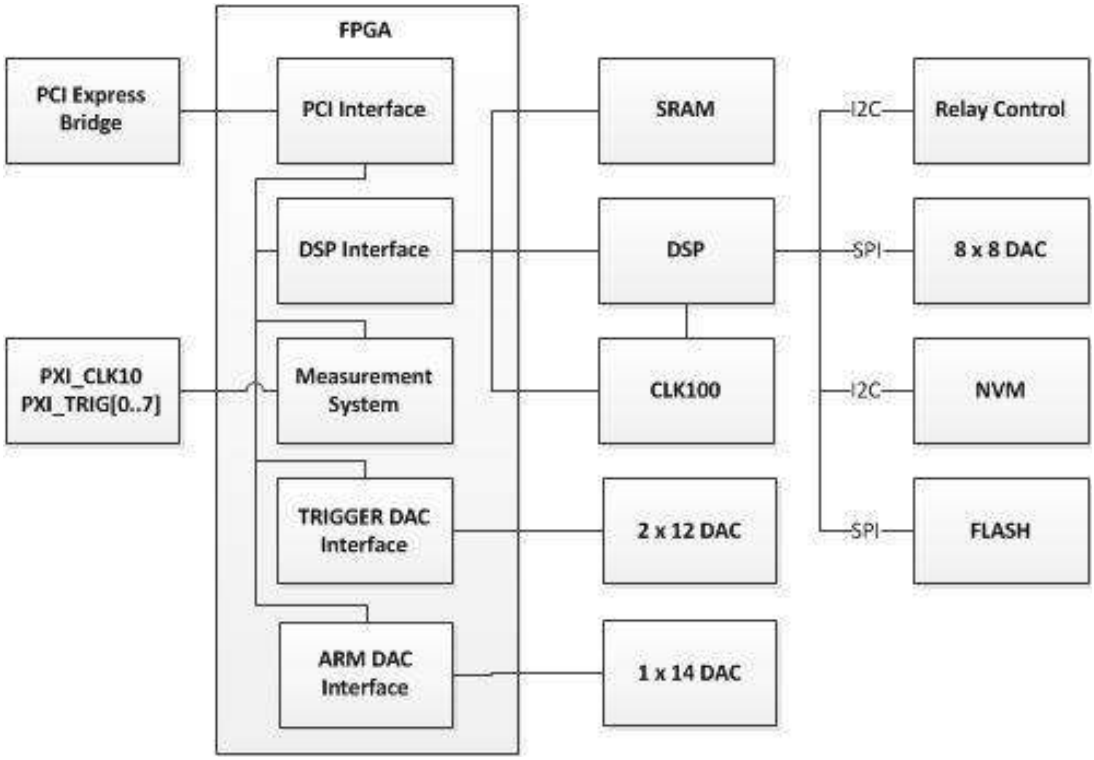


Figure 3-4 DSP System Block Diagram

Measurement Functions

Two types of measurement functions are provided, standard and automatic. Standard functions are those that generate a result directly from the hardware counters. Automatic functions are generated by controlling the input settings and performing one or more standard functions.

Standard Functions

The following table lists the standard functions available along with the description of how the measurement is calculated.

Standard Function	Measurement Calculation
Frequency 1	Event counter set to IN1 with specified slope. $Result = \frac{event\ counter}{gate\ time}$
Frequency 2	Event counter set to IN2 with specified slope. $Result = \frac{event\ counter}{gate\ time}$
Period 1	Event counter set to IN1 with specified slope. $Result = \frac{gate\ time}{event\ counter}$

Standard Function	Measurement Calculation
Period 2	Event counter set to IN2 with specified slope. $$Result = \frac{gate\ time}{event\ counter}$$
Time Interval 1 to 2	Specified slope of IN1 opens gate and specified slope of IN2 closes gate. $$Result = gate\ time$$
Time Interval 2 to 1	Specified slope of IN2 opens gate and specified slope of IN1 closes gate. $$Result = gate\ time$$
Totalize 1 by 2	Event counter set to IN1 with Specified slope. Specified slope of IN2 enables event counter and opposite slope disables. $$Result = event\ counter$$
Totalize 2 by 1	Event counter set to IN2 with Specified slope. Specified slope of IN1 enables event counter and opposite slope disables. $$Result = event\ counter$$
Manual Totalize 1	Event counter set to IN1 with Specified slope. Event counter is enabled and disabled by API commands. $$Result = event\ counter$$
Manual Totalize 2	Event counter set to IN2 with Specified slope. Event counter is enabled and disabled by API commands. $$Result = event\ counter$$
Ratio 1 over 2	Event counter set to IN1 with Specified slope. Reference / Event counter set to IN2 with specified slope. $$Result = \frac{event\ counter}{reference/event\ counter}$$

Table 3-1 Standard Function List

Automatic Functions

The following table lists the automatic functions available along with the description of how the measurement is calculated.

Automatic Function	Standard Measurement
Phase 1 to 2	Set IN1 to POSITIVE slope Set IN2 to POSITIVE slope Perform Ratio 1 over 2 to verify input frequencys are within 10% of each other. $$Result = \frac{Period\ 1}{Time\ Interval\ 1\ to\ 2} * 360$$

Phase 2 to 1	Set IN1 to POSITIVE slope Set IN2 to POSITIVE slope Perform Ratio 1 over 2 to verify input frequencys are within 10% of each other. $Result = \frac{Period\ 2}{Time\ Interval\ 2\ to\ 1} * 360$
Rise 1	Set IN MODE to common. Set IN1 to POSITIVE slope Set IN2 to POSITIVE slope Perform autotrigger IN1 to determine 10% and 90% levels. Set trigger level CH1 to 10% level. Set trigger level CH2 to 90% level. $Result = Time\ Interval\ 1\ to\ 2$
Fall 1	Set IN MODE to common. Set IN1 to NEGATIVE slope Set IN2 to NEGATIVE slope Perform autotrigger IN1 to determine 10% and 90% levels. Set trigger level CH1 to 90% level. Set trigger level CH2 to 10% level. $Result = Time\ Interval\ 1\ to\ 2$
Positive Pulse 1	Set IN MODE to common. Set IN1 to POSITIVE slope Set IN2 to NEGATIVE slope Perform autotrigger IN1 to determine 50% level. Set trigger level CH1 and CH2 to 50% level. $Result = Time\ Interval\ 1\ to\ 2$
Negative Pulse 1	Set IN MODE to common. Set IN1 to NEGATIVE slope Set IN2 to POSITIVE slope Perform autotrigger IN1 to determine 50% level. Set trigger level CH1 and CH2 to 50% level. $Result = Time\ Interval\ 1\ to\ 2$
Duty Cycle 1	Set IN MODE to common. Set IN1 to POSITIVE slope Set IN2 to NEGATIVE slope Perform autotrigger IN1 to determine 50% level. Set trigger level CH1 and CH2 to 50% level. $Result = \frac{Time\ Interval\ 1\ to\ 2}{Period\ 1} * 100$.

Table 3-2 Automatic Functions

Chapter 4
Programming

This Chapter provides information for programming the PXIe-2461 module via the API driver.

The Chapter includes:

- Soft Front Panel Description
- API Library
- Examples of Use

Using the Soft Front Panel

The soft front panel allows the operator interactive control over the PXIe-2461 to allow instrument operation. All major functions are provided.

Starting the Soft Front Panel

The soft front panel (SFP) is installed with the API function driver and is located in the “ri2461e” folder in the VXI*plug&play* framework directory.

The VXI*plug&play* framework directory is the subdirectory for a framework in the VXI*plug&play* root directory. This location is <VXIPNPPATH>\<Framework>, where <VXIPNPPATH> is the path to the <ProgramFilesDir>\IVI Foundation\VISA\ directory and <Framework> is the system framework to which the instrument driver applies. For example:

C:\Program Files (x86)\IVI Foundation\VISA\WinNT

The SFP can be started from a Windows Explorer window or from the VXIPNP program group.

If two or more PXIe-2461 modules are found by the software, then a module selection panel will display.

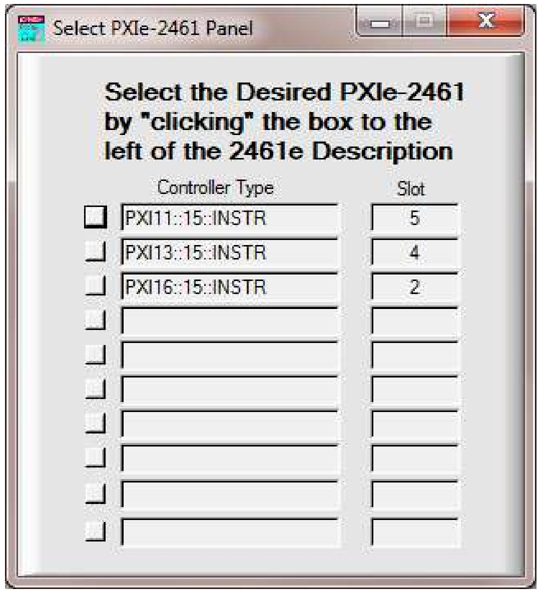


Figure 4-1 SFP Select Panel

The operator should select the desired PXIe-2461 to use. The main PXIe-2461 panel will now appear and the title bar will contain the resource description of the selected PXIe-2461.

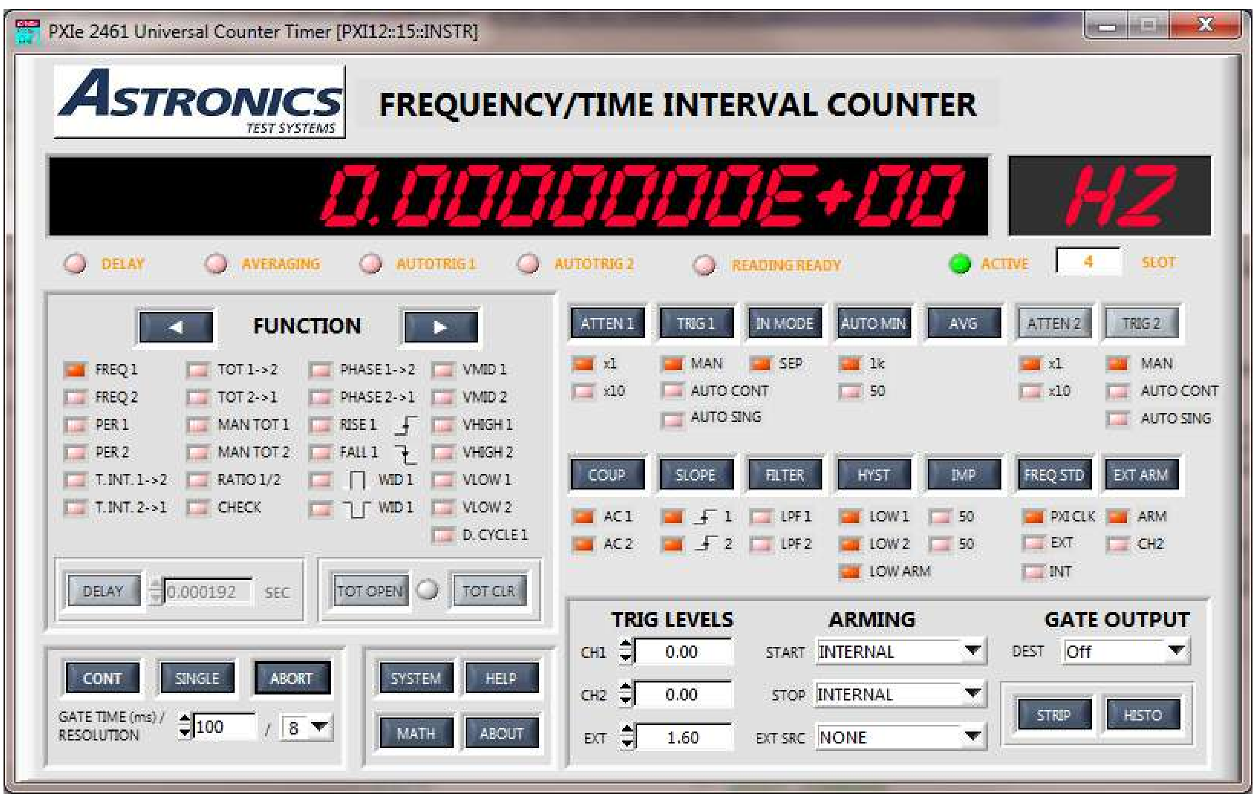


Figure 4-2 SFP Main Panel

Soft Front Panel Indicators

The SFP main panel has a set seven indicators, six LEDs and one numeric.

Figure 4-3 SFP Indicators

The six LEDs are:

DELAY This indicator illuminates when the time interval/totalize gate close delay is enabled.

AVERAGING This indicator illuminate when averaging mode is enabled.

AUTOTRIG 1 This indicator illuminates when the channel 1 trigger mode is set to one of the autotrigger settings.

AUTOTRIG 2 This indicator illuminates when the channel 1 trigger mode is set to one of the autotrigger settings.

READING READY This indicator flashes off and then on when a new measurement is displayed in the result control.

ACTIVE This indicator illuminates when the SFP is communicating to a module and not in demo mode.

The numeric indicator "**SLOT**" indicate the chassis slot number of the connected module.

Company Information

Clicking the company logo in the top left corner of the main panel will display the information panel.

Figure 4-4 SFP Info Panel

This panel displays company address, phone number and web page link.

Module Information

Clicking the "**ABOUT**" command button will display the About panel.

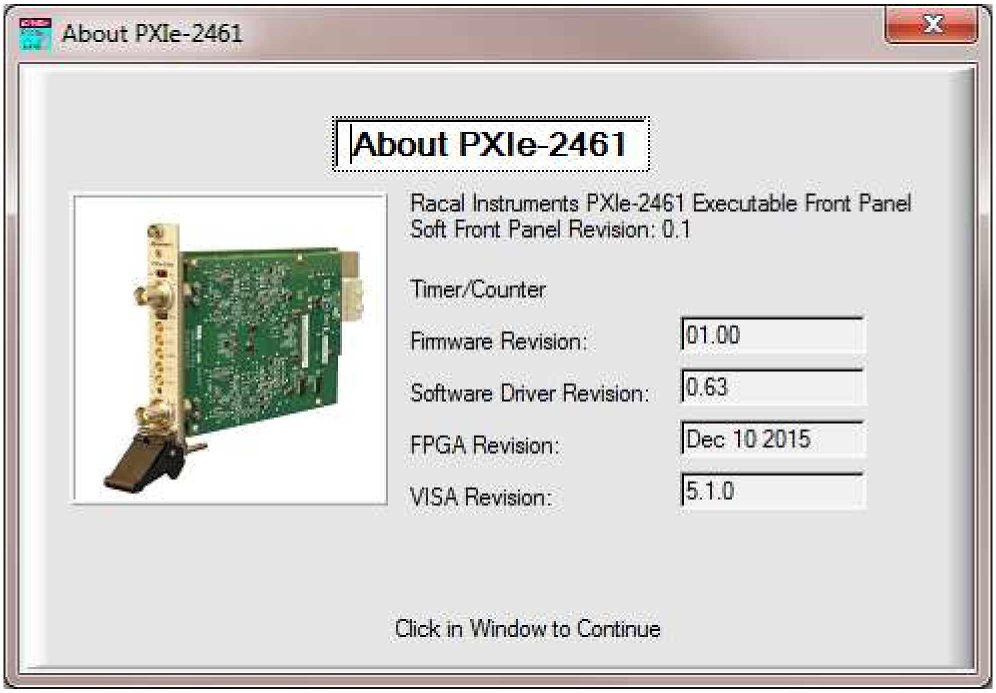


Figure 4-5 SFP About Panel

This panel displays the firmware, API driver, FPGA and VISA revision levels.

System and Update Operations

System and Update operations are accessed by clicking the "**SYSTEM**" command button.

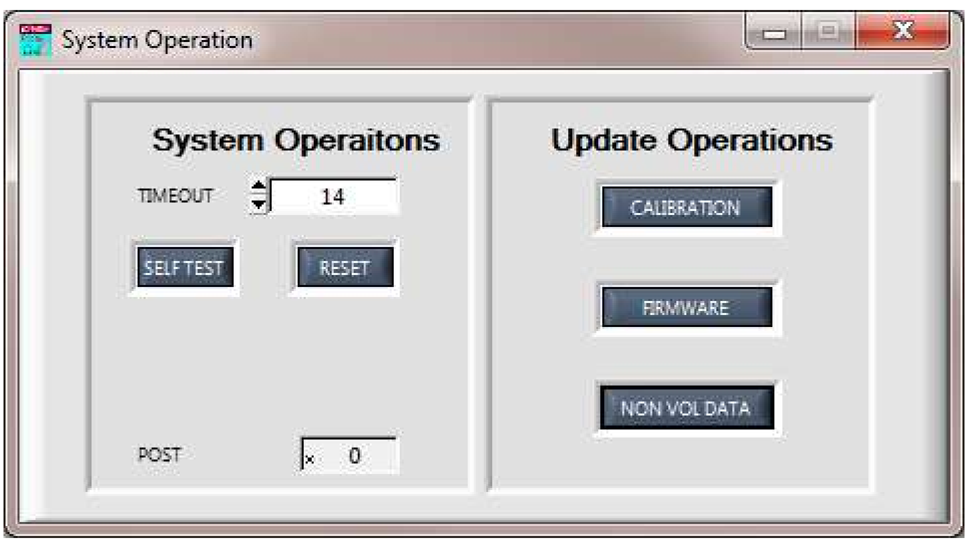


Figure 4-6 SFP System and Update Panel

The system operations include the following:

TIMEOUT This value determines the amount of time that the API driver will wait for a response before aborting. This value must be larger that the gate/measurement time. Averaging increases the measurement time by a factor of 100, e,g, a frequency reading with a gate time of 1s and averaging off requires a timeout of >1s whereas with averging on requires a timeout of >100s.

SELF TEST This command button calls the counter self test API function and returns the following if an error is detected.

Figure 4-7 SFP Self Test Fail Popup

RESET This command button calls the reset API function.

POST This displays the power on self test results, see Table 2-1.

The update operations include the following:

CALIBRATION This command button displays the calibration panel if enabled. The calibration panel requires a factory supplied code to enableand is for factory use only.

The calibration panel allows the operator to view/update the calibration data.

FIRMWARE This command button displays a file select popup and allows for field updates of the firmware.

NON VOL DATA This command button displays the non volatile data panel.

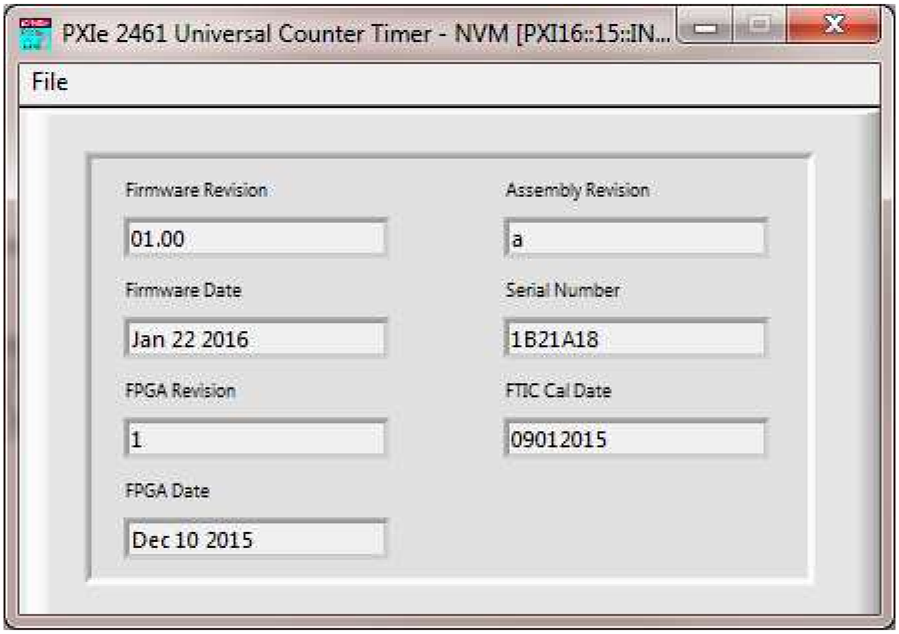


Figure 4-8 SFP Non Vol Data Panel

Editing and saving the non volatile data can only be enabled from a factory supplied code.

API Help

Clicking the "**HELP**" command button opent the API online help.

Setting the Math Function

The math function allows the operator to specifiy an offset and a scale that will be applied to the measurement result.

Clicking the "**MATH**" command button displays the Math Panel. From this panel you can specify the offset value, scale value and enable the math operation with the "**MATH**" command button.

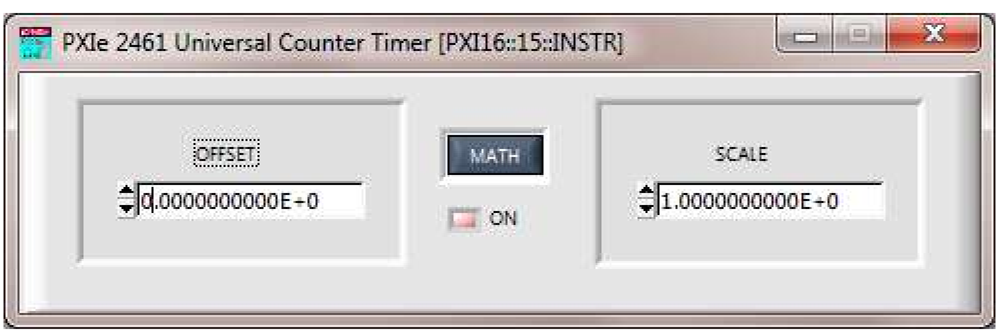


Figure 4-9 SFP Math Panel

The following equeation represents the math equation:

$$Result = \frac{Measurement - OFFSET}{SCALE}$$

The valid range for OFFSET is: -1e10 to 1e10

The valid range for SCALE is: -1e10 to 1e10, Zero not allowed.

The Math Function is not available on CHECK, PHASE , VMID, VHIGH, VLOW.

Setting the Function

The current function is indicated with an active LED in the function display area shown in Figure 4-10. Right mouse clicking over a function name selects the function. The left and right command buttons scroll through the functions.

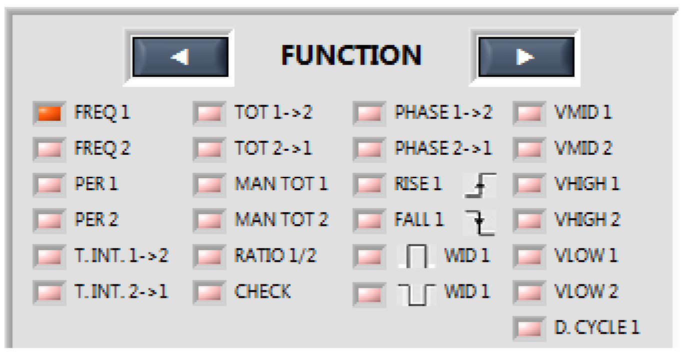


Figure 4-10 SFP Function Display

Frequency IN1	Totalize IN1 by IN2	Phase IN1 to IN2	Voltage Middle IN1
Frequency IN2	Totalize IN2 by IN1	Phase IN2 to IN1	Voltage Middle IN2
Period IN1	Manual Totalize IN1	Rise Time IN1	Voltage High IN1
Period IN2	Manual Totalize IN2	Fall Time IN1	Voltage High IN2
Time Interval IN1 to IN2	Ratio IN1 over IN2	Positive Pulse IN1	Voltage Low IN1
Time Interval IN2 to IN1	Check Reference	Negative Pulse IN1	Voltage Low IN2
			Duty Cycle IN1

When a new function is selected, relevant controls will be enabled and non-relevant controls will be dimmed. For example, when the function is changed from FREQ 1 to T.INT 1->2 the "DELAY" and delay time controls are enabled.

Setting the Input Mode

The input mode can be set to separate or common by clicking the "**IN MODE**" command button. The separate setting connects the front panel IN2 signal to the channel 2 comparator path while the common setting connects IN1 to the channel 2 comparator path. When in COMMON mode, IN2 is isolated from the measurement system but is still connected to the impedance, coupling and attenuation logic. The IN2 attenuation setting is automatically set to X10 when common is selected.

Figure 4-11 SFP Input Mode Control

Setting the Impedance

The imepedance can be set for IN1 or IN2 to either 1MΩ or 50Ω by clicking the "**IMP**" command button. The upper LED is the IN1 setting and the lower LED is the IN2 setting. An illuminated LED indicates that 50Ω is selected. When in COMMON mode, IN2 is isolated from the measurement system but is still connected to the impedance, coupling and attenuation logic.

Figure 4-12 SFP Impedance Control

Setting the Coupling Mode

The coupling mode can be set for IN1 or IN2 to either AC or DC by clicking the "**COUP**" command button. The upper LED is the IN1 setting and the lower LED is the IN2 setting. An illuminated LED indicates that AC is selected. When in COMMON mode, IN2 is isolated from the measurement system but is still connected to the impedance, coupling and attenuation logic.

Figure 4-13 SFP Impedance Control

Setting the Attenuation

The attenuation can be set to either X1 or X10 by clicking the "**ATTEN <n>**" command button for the specified channel. Programming the attenuator setting automatically sets the trigger mode to manual.

Figure 4-14 SFP Attenuation Channel 1

Figure 4-15 SFP Attenuation Channel 2

Setting The Low Pass Filter

The low pass filter is set by clicking the "**FILTER**" command button. The upper LED is the IN1 setting and the lower LED is the IN2 setting. An illuminated LED indicates that filter is selected. The low pass filter is separate for both inputs even in common mode.

Figure 4-16 SFP Filter Control

Setting the Hysteresis

The hysteresis for IN1, IN2 and ARM inputs is set by clicking the "**HYST**" command button. The upper LED is the IN1 setting, the middle LED is the IN2 setting and the lower LED is the ARM setting. An illuminated LED indicates that the low hysteresis is selected. The hysteresis is separate for both inputs even in common mode.

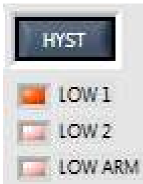


Figure 4-17 SFP Hysteresis Control

Setting the Frequency Standard

The frequency standard source is set by clicking the "**FREQ STD**" command button. The selection will toggle between the PXI CLK, EXTernal and INTernal selections. An illuminated LED indicates which source is selected.

Figure 4-18 SFP Frequency Standard Control

Setting the Trigger Mode

The trigger mode selection is set by clicking the “**TRIG <n>**” command button of the selected channel. The trigger mode will toggle between manual, automatic continuous and automatic single. An illuminated LED indicates which mode is selected. In COMMON mode, the trigger mode of both inputs is programmed by the IN1 setting.

Figure 4-19 SFP Trigger Mode Input 1 Control

Figure 4-20 SFP Trigger Mode Input 2 Control

The AUTO CONT mode executes an autotrigger search before each measurement. The AUTO SING mode executes an autotrigger search once.

Setting the Auto Trigger Minimum Frequency

The auto trigger minimum frequency is set by clicking the “**AUTO MIN**” command button. The AUTO MIN frequency will toggle between 1Khz and 50Hz. An illuminated LED indicates which setting is selected.

Figure 4-21 SFP Auto Trigger Minimum Frequency Control

This setting determines the time that each step of the auto trigger sequence takes. The 1KHz setting takes 1ms per step while the 50Hz setting takes 20ms.

Setting the Trigger Levels

The trigger levels can be set by entering the value in the numeric entry control for channel 1 (CH1), channel 2 (CH2) or the external arm (EXT).

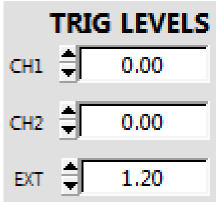


Figure 4-22 SFP Trigger Level Controls

The valid range for CH1 and CH2 depends on the attenuator setting,

X1 -5.1V to +5.1V

X10 -51.0V to +51.0V

The valid range for EXT is,

-5V to +5V

Programming the CH1 or CH2 level automatically sets the trigger mode to manual

The CH1 and CH2 level is also output to the front panel connectors VT1 and VT2 respectively. When the X10 attenuator is selected then the trigger level divided by 10 will be output, i.e., X10 trigger level of +20.5V will be +2.05V at the front panel output.

Setting the Input Slopes

The input slops are set by clicking the “**SLOPE**” command button. The slope will toggle between positive and negative. The upper LED is the IN1 setting and the lower LED is the IN2 setting. An illuminated LED indicates that slope is positive. The slope specifies the active edge for the counting and gateing logic, positive is rising edge and negative is falling edge.

Figure 4-23 SFP Input Slope Control

Setting the Arming

The arming settings are set from the three pull down selection controls. The arming settings consist of three items,

1. External Source
2. Start Selection
3. Stop Selection

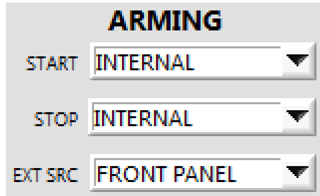


Figure 4-24 SFP Arming Control

The arming external source is programmed by setting the "**EXT SRC**" control to the following:

Arming External Source (EXT SRC)
None
Front Panel
PXI_TRIG0
PXI_TRIG1
PXI_TRIG2
PXI_TRIG3
PXI_TRIG4
PXI_TRIG5
PXI_TRIG6
PXI_TRIG7

Table 4-1 SFP External Arm Source Control

The arming start selection is programmed by setting the "**START**" control to the following:

Arming Start
Internal
External Positive Slope
External Negative Slope

Table 4-2 SFP Arming Start Control

The arming stop selection is programmed by setting the "**STOP**" control to the following:

Arming Stop
Internal
External Positive Slope
External Negative Slope

Table 4-3 SFP Arming Stop Control

Arming is used to enable the start and stop of the standard measurement functions (automatic functions default to internal arming).

When the start or stop is set to external then the measurement will not complete until the specified slope of the external signal has occurred.

Before setting the start or stop to external, the “**EXT SRC**” control must be set to a selection other than “NONE”.

If the “**EXT SRC**” control is set to “FRONT PANEL” then the “**EXT ARM**” control must be set to “ARM”.

Setting the External Arm Mode

The external arm mode is set by clicking the “**EXT ARM**” command button. The external arm mode will toggle between “ARM” and “CH2”. An illuminated LED indicates that current arm mode setting.

Figure 4-25 SFP External Arming Control

The front panel arm input can be used as an arming signle (ARM selection) or it can replace the channel two input in the FPGA (CH2 setting). The slope specifies the active edge for the counting and gateing logic, positive is rising edge and negative is falling edge.

Setting the Gate Output Destination

The gate output destination is set from the “**DEST**” pull down selection control.

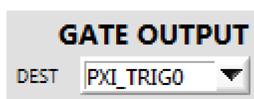


Figure 4-26 SFP Gate Output Destination Control

The gate output signal destination control can be set to the following:

Gate Output Destination
Off
PXI_TRIG0
PXI_TRIG1
PXI_TRIG2
PXI_TRIG3
PXI_TRIG4
PXI_TRIG5
PXI_TRIG6
PXI_TRIG7

Table 4-4 SFP Gate Output Destination Source

The gate output signal is an active low signal. The falling edge indicates the gate open and the rising edge indicates the gate close.

Measurement Controls

The following sections decribes the SFP controls and panels used to configure settings, initiate measurements and analyze data.

Gate Close Delay

These controls are used to enable and set a delay value that holds off the gate close event until the delay is done. The delay is triggered from the gate open event.

Figure 4-27 SFP Gate Close Delay Controls

The “**DELAY**” command button will toggle the delay on and off. The numeric value represents the delay value. The delay value range is:

192µs to 1.048560s with a resolution of 16 µs.

The “DELAY” led indicator will be illuminated when the delay is enabled.

Applicable Functions:

- Time Interval 1 to 2
- Time Interval 2 to 1
- Totalize 1 by 2
- Totalize 2 by 1

Manual Totalize

These controls are used to open and close the totalize gate as well as clear the totalize count.

Figure 4-28 SFP Manual Totalize Controls

The “**TOT OPEN**” command button will open the totalize gate and the command button text will toggle to “**TOT CLOSE**”. The “**TOT CLOSE**” command button will close the totalize gate. The “**TOT CLR**” command button will reset the totalize count to zero.

The led indicator will be illuminated when the totalize gate is open.

Applicable Functions:

- Manual Totalize 1

- Manual Totalize 2

Gate Time/Resolution

These controls are used to set the internal gate time and resolution for the applicable functions. The longer the gate time the higher the resolution and vise versa, the higher the resolution the longer the gate time.

Figure 4-29 SFP Gate Time/Resolution Controls

The "**GATE TIME(ms)**" numeric control sets the gate time to the specified value and adjusts the resolution accordingly. The gate time value range is:

1ms to 100000ms.

The following table lists the resolution setting based on the gate time value.

Gate Time	Resolution
1-9	6
10-99	7
100-999	8
1000-9999	9
10000-100000	10

Table 4-5 SFP Gate Time to Resolution

The "**RESOLUTION**" numeric control sets the resolution to the specified value and adjusts the gate time accordingly. The resolution value range is:

3 to 10.

The following table lists the resolution setting based on the gate time value.

Resolution	Gate Time
3	1ms
4	1ms
5	1ms
6	1ms
7	10ms
8	100ms
9	1s
10	10s

Table 4-6 SFP Resolution to Gate Time

Applicable Functions:

- Frequency 1

- Frequency 2
- Period 1
- Period 2
- Ratio 1 over 2
- Duty Cycle 1

Averaging

This control is used to set the averaging mode state. The averaging mode makes one hundred measurments and returns the average value.

Figure 4-30 SFP Averaging Mode Control

The "**AVG**" command button will toggle the avereaging mode on and off.

The led indicator will be illuminated when the averaging mode is on.

Applicable Functions:

- Frequency 1
- Frequency 2
- Period 1
- Period 2
- Time Interval 1 to 2
- Time Interval 2 to 1
- Ratio ½
- Phase 1 relative 2
- Phase 2 relative 1
- Rise Time
- Fall Time
- Positive Pulse Width
- Negative Pulse Width
- Duty Cycle 1

Continuous

This control enables the continuous mode. Countinuous mode initiates the selected function and then continouslyfetches and displays the result.

Figure 4-31 SFP Continuous Mode Control

Clicking the "**CONT**" command button enables the continuous mode and the "**SINGLE**" or "**ABORT**" command button disables the continuous mode.

Single

This control enables the single mode. Single mode initiates the selected function and then fetches and displays the result.

Figure 4-32 SFP Single Mode Control

Strip Chart

The "**STRIP**" command button will display the strip chart panel. If the continuous mode is enabled the measurement data will be displayed in the strip chart.

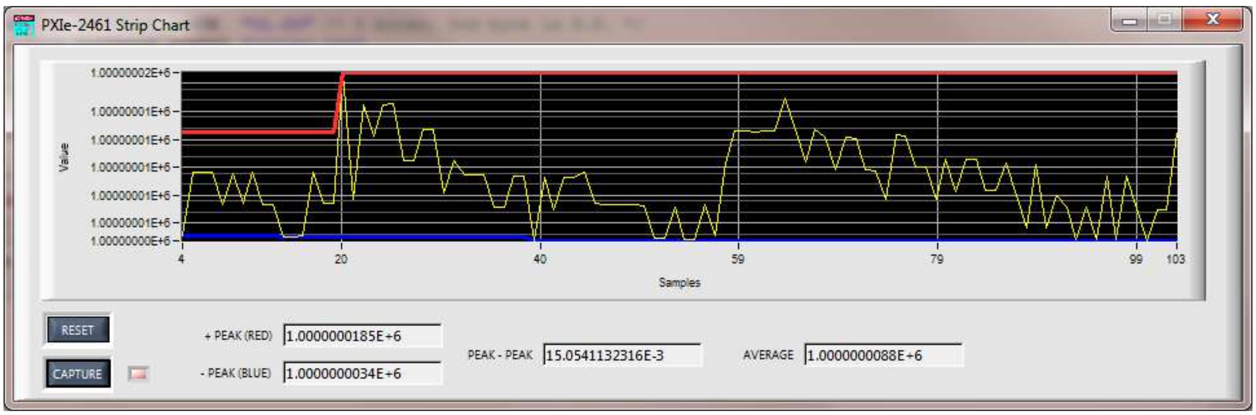


Figure 4-33 SFP Strip Chart Panel

Three traces are displayed on the graph;

1. RED = Maximum measurement value
2. YELLOW = Measurement value
3. BLUE = Minimum measurement value

Four numeric indicators display the following;

1. + PEAK = Maximum measurement value
2. - PEAK = Minimum measurement value
3. PEAK - PEAK = Measurement range (precision)
4. AVERAGE = Sum of measurements divided by the number of measurements.

The "**RESET**" command button will clear the four numeric indicators as well as the strip chart.

Figure 4-34 SFP Strip Chart Reset Control

The "CAPTURE" command button will open the capture panel if data logging is currently disabled (LED off) or disable data logging if currently enabled (LED on).

Figure 4-35 SFP Strip Chart Capture Control

The capture panel allows the operator to enable data logging of the strip chart data. In addition to the data, the operator can include header data and time data by selecting the appropriate check box. The “BROWSE” command button can be used to specify the file and path. The log data will be appended if the specified file exists.

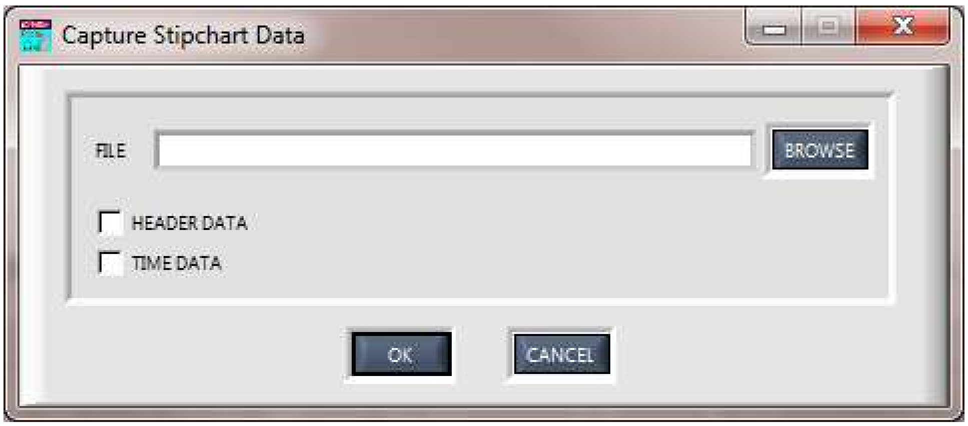
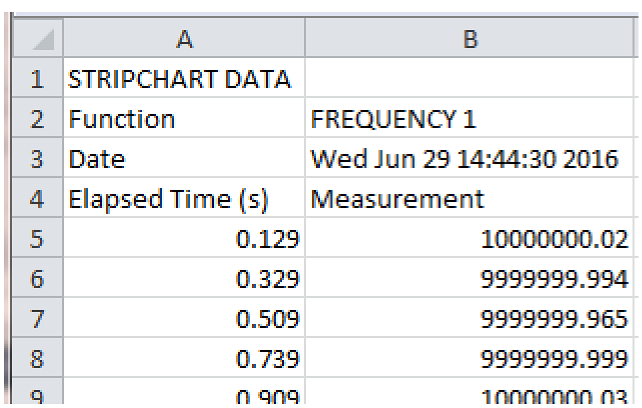


Figure 4-36 SFP Capture Panel

The file is stored as a comma separated ASCII file and is saved with a “csv” extension.

The following illustrates the file format of the capture file with the header and the time data.



	A	B
1	STRIPCHART DATA	
2	Function	FREQUENCY 1
3	Date	Wed Jun 29 14:44:30 2016
4	Elapsed Time (s)	Measurement
5	0.129	10000000.02
6	0.329	9999999.994
7	0.509	9999999.965
8	0.739	9999999.999
9	0.909	10000000.03

Figure 4-37 SFP Strip Chart Capture File Format

The header data consists of rows 1 through 4. Not selecting “**HEADER DATA**” check box will cause the header data to be omitted from the file.

The time data consists of column A starting at row 5. Not selecting “**TIME DATA**” check box will cause the time data and header to be omitted from the file.

Hystogram

The "**HISTO**" command button will display the histogram panel. The number of samples for the histogram can be set from 10 to 1000 (100 default). The "**NEW**" command button initiates a histogram run. The number of samples will be collected and the histogram will be displayed with ten intervals.

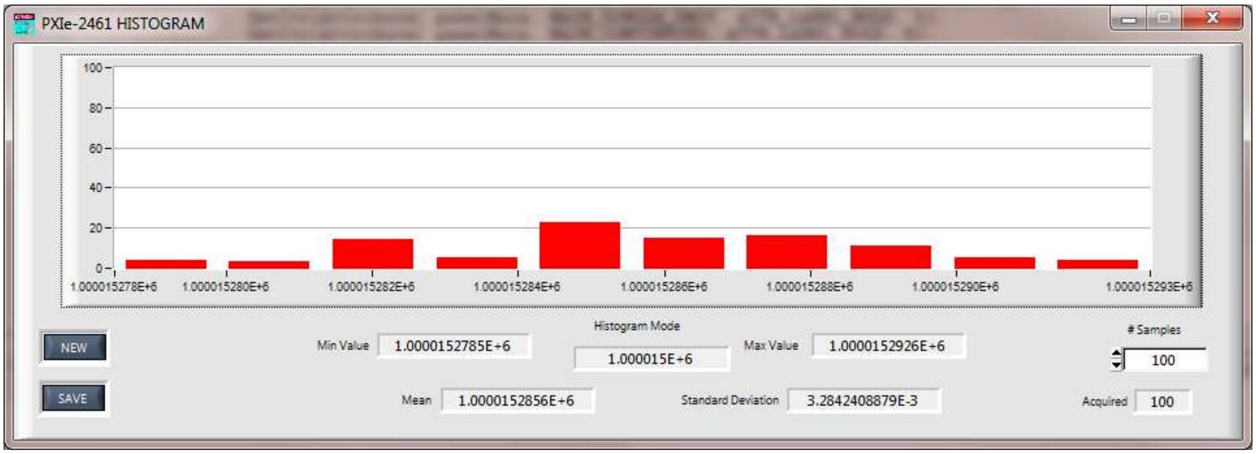


Figure 4-38 SFP Histogram Panel

Six numeric indicators display the following;

1. Min Value = Minimum measurement value
2. Max Value = Maximum measurement value
3. Mean = Average of all the measurement samples
4. Standard Deviation = Amount of variation or dispersion of the measurement samples
5. Hystogram Mode = Value that appears most often in the measurement samples
6. Acquired = Running total of the number of samples measured.

The "SAVE" command button will open a file select panel to save the histogram data. The file is stored as a comma separated ASCII file and is saved with a "csv" extension.

The following illustrates the file format of the histogram file.

	A	B	C	D	E	F
1	Data	Min	Mean	Max	StdDev	Mode
2	1000000.0118850000	1.0000000000E+06	1.0000000092E+06	1.0000000178E+06	3.6076562920E-03	1.0000000062E+06
3	1000000.0090200000					
4	1000000.0118600000					
5	1000000.0089960000					
6	1000000.0089840000					
7	1000000.0118250000					
8	1000000.0060290000					

Figure 4-39 SFP Histogram File Format

LabVIEW vi's and API Library

This chapter describes the LabVIEW vi's and also shows the equivalent prototype functions of the C API library. The LabVIEW and API Library is segmented into the following hierarchical classes.

Class	Description
Root	Contains the initialize and close functions used to initiate and close a communication session.
Capability	This class is included for legacy compatability only.
Action,Status	This class and functions are included for legacy compatability only. The functions will return the warning "RI2461E_WARN_FUNCTION_STUB".
Function Card Select	This class and functions are included for legacy compatability only. The functions will return the warning "RI2461E_WARN_FUNCTION_STUB".
Measure	Contains class to read result data.
Read Operations	Contains functions to fetch and read result data.
Counter Operations	Contains functions to reset and test the module and classes to configure and control counter functions.
Configuration Functions	Contains classes to program and query input and measurement data.
Counter Configure	Contains functions to program the FTIC input and measurement settings.
Counter Query	Contains functions to query the FTIC input and measurement settings.
Counter Capability Functions	Contains classes to control the manual totalize and trigger the the FTIC.
Manual Toalize	Subclass functions to control manual totalize operation.
Trigger	Subclass functions to control trigger operation.
Interrupt Settings	This class and functions are included for legacy compatability only. The functions will return the warning "RI2461E_WARN_FUNCTION_STUB".
Calibration Functions	Contains functions to program and query the non-volatile data.
Utility Functions	Contains utility functions and classes test and query module information as well as load new firmware.

Table 4-7 LabVIEW vi and API Class Heirarchy

Default Conditions

The default conditions are the settings that the module will adopt when powered up or reset.

Parameter	Power on/Reset Value
Configure Functions	
Input Conditioning (both channels) Impedance Coupling Low Pass Filter Input Mode	 1MΩ AC Disabled Separate
Input Hysteresis (both channels) Level	 Minimum (LOW)
Input Triggering (both channels) Attenuator Trigger Level Input Mode	 X1 0.0V Separate
Input Slopes (both channels)	Positive
Minimum Auto Trigger Frequency	1 KHz
Auto Trigger Mode (both channels)	Manual
Arming Level	1.6V (TTL)
External Arm Mode	Arm Input
External Arm Hysteresis	LOW
Time Interval/Totalize Delay	192µs
Measurement	Frequency 1
Measurement Resolution	8
Frequency Standard Source	PXI CLK10
Output Gate	Disabled
Math Scale	 1.0

Parameter	Power on/Reset Value
Offset Enable	0.0 Disabled
Counter Capability Manual Totalize Functions	
Open/Close Gate	Closed
Counter Capability Trigger Functions	
Continuous	Disabled

Table 4-8 Power on/Reset Defaults

LabVIEW vi Descriptions

The LabVIEW parameter list follows the description with the defaults and valid ranges belonging to the parameters. The following parameter types are used in the parameter lists to describe the parameter types.

Type	Details
I/O	Input I/O stream
I16	2-byte (16 bit) signed short input
I16	2-byte (16 bit) signed short output
I32	4-byte (32 bit) signed long input
I32	4-byte (32 bit) signed long output
	Enumerated type input
TF	Boolean type (true or false) input
TF	Boolean type (true or false) output
DBL	Double precision floating point input
DBL	Double precision floating point output
abc	String input
abc	String output

C API Descriptions

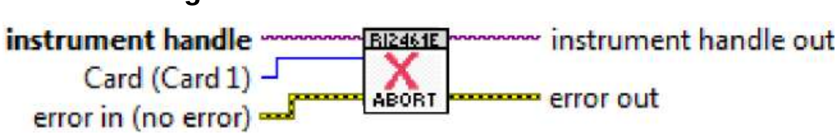
The C API driver uses the VISA library to communicate with the module. The following VISA parameter types are used (defined in visatype.h header):

Type	Details
ViSession	4-byte (32 bit) unsigned long
ViPSession	reference variable (pointer) to a 4-byte (32 bit) unsigned long
ViRsrc	reference variable (pointer) to a 1-byte (8 bit) signed char
ViInt32	4-byte (32 bit) signed long
ViUInt32	4-byte (32 bit) unsigned long
ViPInt32	reference variable (pointer) to a 4-byte (32 bit) signed long
ViPUInt32	reference variable (pointer) to a 4-byte (32 bit) unsigned long
ViInt16	2-byte (16 bit) signed short
ViUInt16	2-byte (16 bit) unsigned short
ViPInt16	reference variable (pointer) to a 2-byte (16 bit) signed short
ViPUInt16	reference variable (pointer) to a 2-byte (16 bit) unsigned short
ViChar	1-byte (8 bit) signed char
ViReal64	8-byte (64 bit) floating point
ViPReal64	reference variable (pointer) to a 8-byte (64 bit) floating point
ViBoolean	2-byte (16 bit) unsigned short
ViPBoolean	reference variable (pointer) to a 2-byte (16 bit) unsigned short
ViString | ViChar	reference variable (pointer) to a 1-byte (8 bit) signed char
ViStatus	4-byte (32 bit) signed long

All functions use the standard calling conventions (stdcall or WINAPI). Every function returns the ViStatus (type: 32-bit integer). A negative value corresponds to an error. After a successful completion, the return status is VI_SUCCESS, which corresponds to a 0. A positive value indicates a warning. The status codes are defined in section xxx.

ri2461e Abort.vi

LabVIEW Diagram:



Description:

This vi is provided for backwards compatibility only. This vi has no affect on the instrument.

Parameters:

Name	Type	Description	Value
Instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Card	I16	Which card if there are more than one cards installed.	Card1

C Function Prototype Form: ViStatus ri2461e_abort (ViSession instrumentHandle, ViInt16 card);

ri2461e Abort Measurement.vi

LabVIEW Diagram:

Description:

Abort the present measurement cycle. Use ri2461 Initiate Trigger Sequence.vi to initiate a new measurement.

Parameters:

Name	Type	Description	Value
Instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_abortMeasurement (ViSession instrumentHandle);

ri2461e Clear Instrument.vi

LabVIEW Diagram:

Description:

Sets the measurement result to 0.0 and resets the number of samples available to 0.

Parameters:

Name	Type	I/O	Description	Value
Instrument handle	I/O	in	Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_clear (ViSession instrumentHandle);

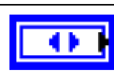
ri2461e Clear Accumulated Count.vi

LabVIEW Diagram:

Description:

Clears the accumulated count in Manual Totalize mode.

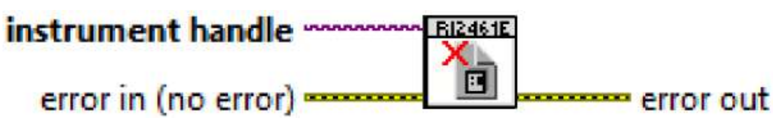
Parameters:

Name	Type	Description	Value
Instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Input		Channel selection	1 = Input 1 2 = Input 2

C Function Prototype Form: ViStatus ri2461e_clearAccCount (ViSession instrumentHandle, ViInt16 input);

ri2461e Close.vi

LabVIEW Diagram:



Description:

Closes the instrument and deallocates the resources allocated by the initialization vi. Use ri2461e Close.vi once for every instrument handle returned by the initialize vi prior to terminating any application program.

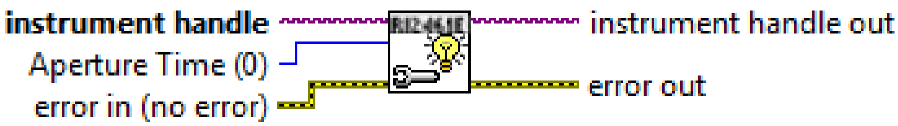
Key Parameters:

Name	Type	Description	Value
Instrument handle		Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_close (ViSession instrumentHandle);

ri2461e Configure Aperture.vi

LabVIEW Diagram:



Description:

Configure the aperture time.

Parameters:

Name	Type	Description	Value
Instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Aperture Time(0)	I32	Aperture time in ms	1 to 100000

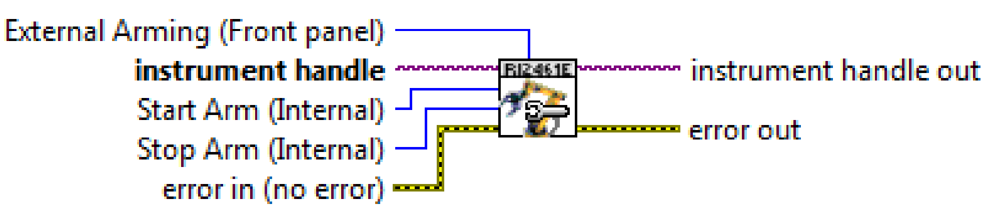
.

Programming the aperture time also updates the resolution setting.

Aperture Time (ms)	Resolution
1-9	6
10-99	7
100-999	8
1000-9999	9
10000-100000	10

ri2461e Configure Arming.vi

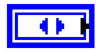
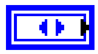
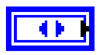
LabVIEW Diagram:



Description:

Configure the trigger arming parameters.

Key Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Start Arm (Internal)		Start ARM source	0 - Internal 1 - External with positive slope 2 - External with negative slope
Stop Arm (Internal)		Stop ARM source	0 - Internal 1 - External with positive slope 2 - External with negative slope
External Arming (Front Panel)		External ARM source	0 - PXI_TRIG0 1 - PXI_TRIG1 2 - PXI_TRIG2 3 - PXI_TRIG3 4 - PXI_TRIG4 5 - PXI_TRIG5 6 - PXI_TRIG6 7 - PXI_TRIG7 8 - Front Panel 9 - No External ARM

C Function Prototype Form: ViStatus ri2461e_confArming (ViSession instrumentHandle, ViInt16 startArm, ViInt16 stopArm, ViInt16 externalArming);

ri2461e Configure Arming Level.vi

LabVIEW Diagram:

Description:

Configure the external ARM input comparator level.

Key Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Arm Level	DBL	ARM input comparator level	-5.0 to +5.0

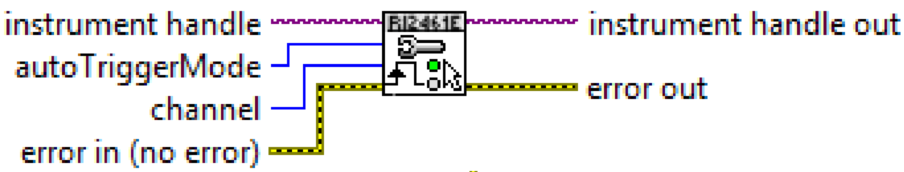
There are three threshold levels available, ECL (-1.3V), GND(0.0V) and TTL (1.6V).

Values in the range from -5.0 to -0.999 sets the threshold level for ECL (-1.3V)
Values in the range from -1.0 to +1.0 sets the threshold level for GND (0.0V)
Values in the range from +1.001 to +5.0 sets the threshold level for TTL (1.6V)

C Function Prototype Form: ViStatus ri2461e_confArmingLevel (ViSession strumentHandle, ViReal64 armLevel);

ri2461e Configure AutoTrig Mode.vi

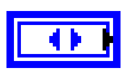
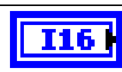
LabVIEW Diagram:



Description:

Configure the auto trigger mode of the specified input.

Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
channel		Channel selection	1 - Input 1 2 - Input 2
autoTriggerMode		ARM input comparator level	0 - Sets auto-trigger mode off 1 - Sets auto-trigger mode on continuous 2 - Sets auto-trigger mode on single

In the manual setting, the trigger level and attenuation are set by the user.

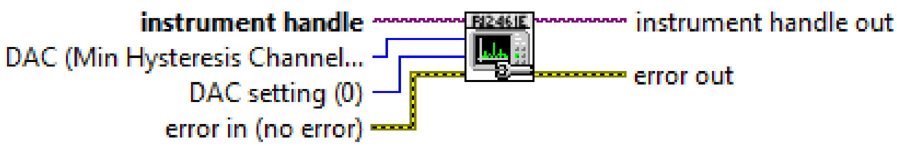
In the auto continuous setting, the trigger level and attenuation setting are calculated before each measurement.

In the auto single setting, the trigger level and attenuation setting are calculated before the first measurement only.

C Function Prototype Form: ViStatus ri2461e_confAutoTrigMode (ViSession instrumentHandle, ViInt16 input, ViInt16 autoTriggerMode);

ri2461e Configure Calibration DAC.vi

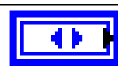
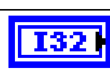
LabVIEW Diagram:



Description:

Configure the calibration DAC levels.

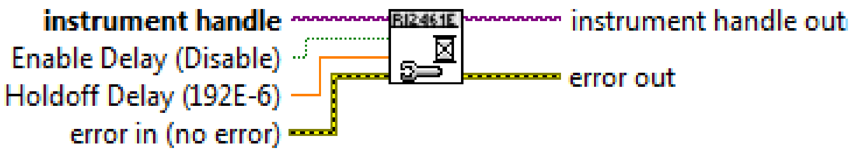
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
DAC (Min Hysteresis Channel…)		Calibration DAC	1=CH1 min hysteresis mode 0 (RI2461E_IN1_DAC_MODE0_MIN) 2= CH1 max hysteresis mode 0 (RI2461E_IN1_DAC_MODE0_MAX) 3= CH1 min hysteresis mode 1 (RI2461E_IN1_DAC_MODE1_MIN) 4= CH1 max hysteresis mode 1 (RI2461E_IN1_DAC_MODE1_MAX) 5=CH1 Comparator Offset (RI2461E_IN1_DAC_OFFSET) 6=CH1 Trigger Offset (RI2461E_IN1_DAC_TRIGGER_OFFSET) 7=CH1 Trigger Reference (RI2461E_IN1_DAC_TRIGGER_REF) 8=CH2 min hysteresis mode 0 (RI2461E_IN2_DAC_MODE0_MIN) 9= CH2 max hysteresis mode 0 (RI2461E_IN2_DAC_MODE0_MAX) 10= CH2 min hysteresis mode 1 (RI2461E_IN2_DAC_MODE1_MIN) 11= CH2 max hysteresis mode 1 (RI2461E_IN2_DAC_MODE1_MAX) 12=CH2 Comparator Offset (RI2461E_IN2_DAC_OFFSET) 13=CH2 Trigger Offset (RI2461E_IN2_DAC_TRIGGER_OFFSET) 14=CH2 Trigger Reference (RI2461E_IN2_DAC_TRIGGER_REF)
DAC Setting		Calibration value	0 to 255

C Function Prototype Form: ViStatus ri2461e_confCalibrationDAC (ViSession instrumentHandle, ViInt16 DAC, ViInt16 DACSetting);

ri2461e Configure Delay.vi

LabVIEW Diagram:



Description:

Enable or disable and set the value of the gate close holdoff delay used in the Time Interval and Totalize functions.

Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Enable Delay (Disable)	TF	Delay enable	0=Disable delay 1=Enable delay
Holdoff Delay (192e-6)	DBL	Delay value	192e-6 to 1.04856

C Function Prototype Form: ViStatus ri2461e_confDelay (ViSession instrumentHandle, ViBoolean enableDelay, ViReal64 holdoffDelay);

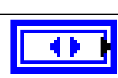
ri2461e Configure Ext Arm Hysteresis.vi

LabVIEW Diagram:

Description:

Set the front panel ARM input hysteresis.

Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
hysteresis		Hysteresis setting	0=Low (RI2461E_DATA_EXT_ARM_HYST_LOW)

Name	Type	Description	Value
			1=High (RI2461E_DATA_EXT_ARM_HYST_HIGH)

C Function Prototype Form: ViStatus ri2461e_confExtArmHysteresis (ViSession instrumentHandle, ViInt16 hysteresis);

ri2461e Configure External Arm Mode.vi

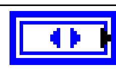
LabVIEW Diagram:

Description:

Select EXT ARM mode. The EXT ARM can be selcted to act as an ARM input or as the CH2 input.

When selected as the CH2 input, the input conditioning and comparator are bypassed.

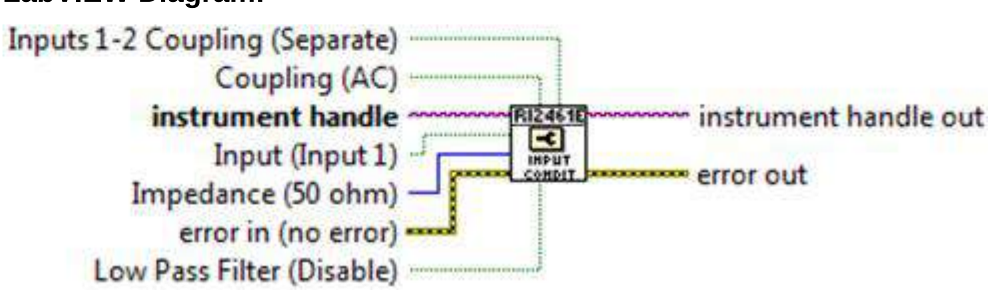
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
mode		EXT ARM mode	0=ARM input (RI2461E_DATA_EXT_ARM_ARM_IN) 1=CH2 Input (RI2461E_DATA_EXT_ARM_CH2)

C Function Prototype Form: ViStatus ri2461e_confExtArmMode (ViSession instrumentHandle, ViInt16 mode);

ri2461e Configure Input Conditioning.vi

LabVIEW Diagram:



Description:

Program the input conditioning of the selected channel as well as the input mode.

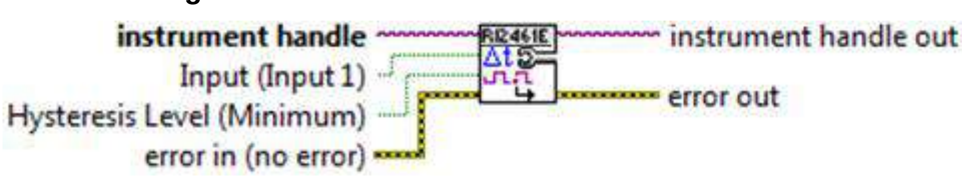
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
input	TF	Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
imp		Input impedance	0=1MΩ (RI2461E_HI_IMP) 1=50Ω (RI2461E_LO_IMP)
coup	TF	Input coupling	0=AC (RI2461E_AC) 1=DC (RI2461E_DC)
filter	TF	Input filter	0=Disabled (RI2461E_DIS_FILTER) 1=Enabled (RI2461E_ENA_FILTER)
mode	TF	Input mode	0=Separate (RI2461E_SEP_INPUT) 1=Common (RI2461E_COM_INPUT)

C Function Prototype Form: ViStatus ri2461e_confInputConditioning (ViSession instrumentHandle, ViInt16 input, ViInt16 impedance, ViBoolean coupling, ViBoolean lowPassFilter, ViBoolean inputMode);

ri2461e Configure Input Hysteresis.vi

LabVIEW Diagram:



Description:

Select the hysteresis level for the selected input comparator.

Hysteresis is programmed in the comparator to prevent unwanted rapid switching. This and similar techniques are used to compensate for noise in the input signal.

Parameters:

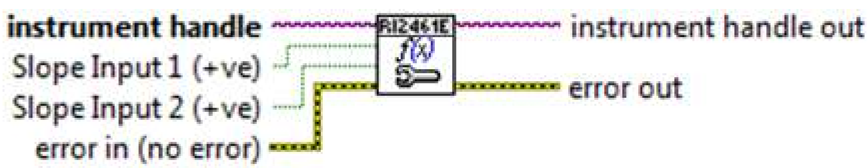
Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
input	TF	Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)

hysteresis	TF	Hysteresis setting	0=Low (RI2461E_MIN_HYST) 1=High (RI2461E_MAX_HYST)

C Function Prototype Form: ViStatus ri2461e_confInputHysteresis (ViSession instrumentHandle, ViInt16 input, ViBoolean hysteresisLevel);

ri2461e Configure Trigger Slopes.vi

LabVIEW Diagram:



Description:

Set the trigger slope for inputs 1 and 2.

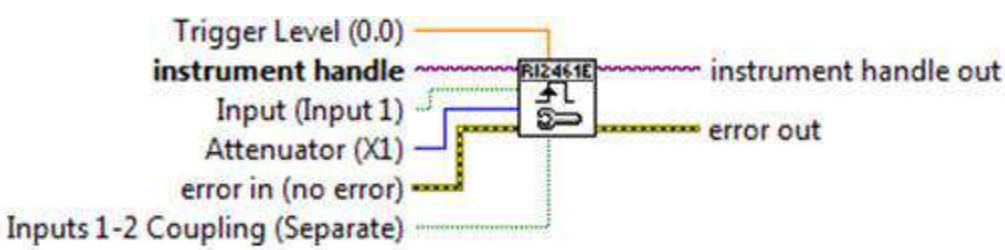
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
input1	TF	Input 1 slope	0=CH1 Positive (RI2461E_POS_SLOPE) 1=CH1 Negative (RI2461E_NEG_SLOPE)
Input2	TF	Input 2 slope	0=CH2 Positive (RI2461E_POS_SLOPE) 1=CH2 Negative (RI2461E_NEG_SLOPE)

C Function Prototype Form: ViStatus ri2461e_confInputSlopes (ViSession instrumentHandle, ViBoolean slopeInput1, ViBoolean slopeInput2);

ri2461e Configure Trigger Conditions.vi

LabVIEW Diagram:

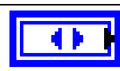


Description:

Program the trigger settings of the specified channel.

Note: Use of this vi forces the trigger mode to "Manual" regardless of previous state.

Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
input	TF	Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
atten		Attenuation	0=X1 (RI2461E_X1_ATTEN) 1=X10 (RI2461E_X10_ATTEN)
level	DBL	Trigger level	See below
mode	TF	Input mode	0=Separate (RI2461E_SEP_INPUT) 1=Common (RI2461E_COM_INPUT)

The valid range for the trigger level is based on the attenuation setting,

X1: -5.1 to +5.1

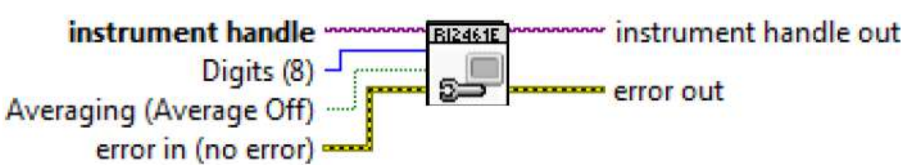
X10 -51.0 to +51.0

The attenuation setting for input 2 is not set if the input mode is set common. In common mode, input 1 and input 2 shares the same attenuation setting and the input 2 attenuator is set to X10.

C Function Prototype Form: ViStatus ri2461e_confInputTriggering (ViSession instrumentHandle, ViInt16 input, ViInt16 attenuator, ViReal64 triggerLevel, ViBoolean inputs12Coupling);

ri2461e Configure Resolution.vi

LabVIEW Diagram:



Description:

Program the measurement resolution in digits of resolution (3 to 10) and select whether to enable averaging.

Averaging can give improved resolution by taking an average over 100 measurements. The resolution obtained will be 1 digit more than without averaging (but with the maximum resolution remaining at 10 digits).

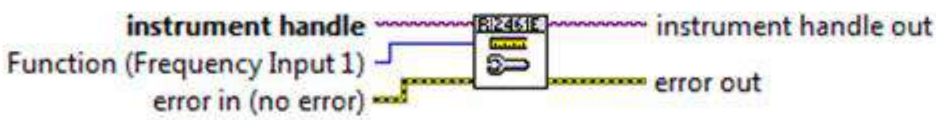
Parameters:

Name	Type	Description	Value
Digits	I16	Resolution selection	0=gate time unchanged 3=gate time set to 1ms 4=gate time set to 1ms 5=gate time set to 1ms 6=gate time set to 1ms 7=gate time set to 10ms 8=gate time set to 100ms 9=gate time set to 1s 10=gate time set to 10s
Averaging	TF	Averaging state	0 = Averaging off 1= Averaging on

C Function Prototype Form: ViStatus ri2461e_confMeasRes (ViSession instrumentHandle, ViInt16 resolution, ViBoolean averaging);

ri2461e Configure Measurement.vi

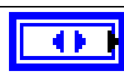
LabVIEW Diagram:



Description:

Program the measurement function.

Parameters:

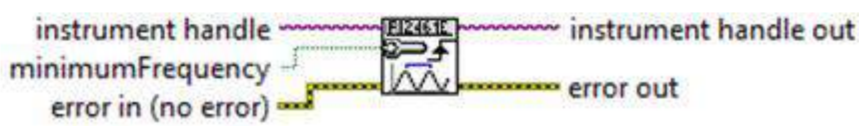
Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
function		Function selection	0=Frequency CH1 (RI2461E_FREQUENCY_1) 1=Frequency CH2 (RI2461E_FREQUENCY_2) 2=Period CH1 (RI2461E_PERIOD_1) 3=Period CH2 (RI2461E_PERIOD_2) 4=Time Interval CH1 to CH 2 (RI2461E_TIME_INT_1_2) 5= Time Interval CH2 to CH1 (RI2461E_ TIME_INT_2_1) 6=Totalize CH1 by CH2 (RI2461E_TOTAL_1_2)

Name	Type	Description	Value
			7=Totalize CH2 by CH1 (RI2461E_TOTAL_2_1) 8=Manual Totalize CH1 (RI2461E_MANUAL_TOTAL_1) 9=Manual Totalize CH2 (RI2461E_MANUAL_TOTAL_2) 10=Ratio CH1 over CH2 (RI2461E_RATIO_1_2) 11=Check (RI2461E_CHECK) 12=Phase CH1 relative CH2 (RI2461E_PHASE_1_2) 13=Phase CH2 relative CH1 (RI2461E_PHASE_2_1) 14=Risetime CH1 (RI2461E_RISETIME) 15=Falltime CH1 (RI2461E_FALLTIME) 16=Positive Pulse CH1 (RI2461E_POS_PWIDTH) 17=Negative Pulse CH1 (RI2461E_NEG_PWIDTH) 18=Voltage Middle CH1 (RI2461E_VOLTS_MID_1) 19= Voltage Middle CH2 (RI2461E_ VOLTS_MID_2) 20= Voltage Maximum CH1 (RI2461E_VOLTS_MAX_1) 21= Voltage Maximum CH2 (RI2461E_ VOLTS_MAX_2) 22= Voltage Minimum CH1 (RI2461E_ VOLTS_MIN_1) 23= Voltage Minimum CH2 (RI2461E_ VOLTS_MIN_2) 24=Duty Cycle CH1 (RI2461E_DUTY_CYCLE_1)

C Function Prototype Form: ViStatus ri2461e_confMeasurement (ViSession instrumentHandle, ViInt16 function);

ri2461e Configure Minimum Auto Trig Frequency.vi

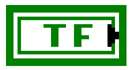
LabVIEW Diagram:



Description:

Select the minimum frequency that the auto-trigger algorithm will detect reliably.

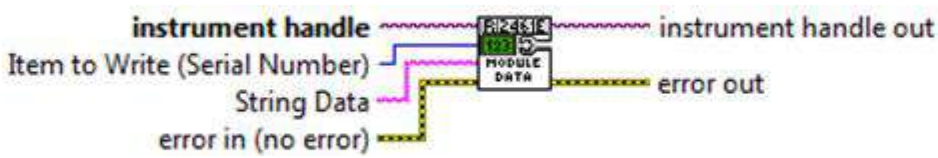
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
frequency		Minimum frequency	0 = 1 kHz 1 = 50 Hz

C Function Prototype Form: ViStatus ri2461e_confMinAutoTrigFreq (ViSession instrumentHandle, ViBoolean minimumFrequency);

ri2461e Configure Module Data.vi

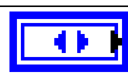
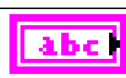
LabVIEW Diagram:



Description:

Program the specified module data to volatile memory. The ri2461e Write Module Data vi must be used to write the volatile module data to nonvolatile memory.

Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Item to Write		Item to write	1=Serial Number (RI2461E_SERIAL_NUMBER_DATA) 2=Assembly revision (RI2461E_ASSEMBLY_REVISION_DATA) 3=Calibration date (RI2461E_CALIBRATION_DATE)
String Data		Data to write	NULL terminated 15 characters max.

C Function Prototype Form: ViStatus ri2461e_confModuleData (ViSession instrumentHandle, ViInt16 itemToWrite, ViChar _VI_FAR stringData[]);

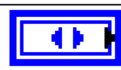
ri2461e Configure Standard.vi

LabVIEW Diagram:

Description:

Select the frequency standard to be used by the FTIC.

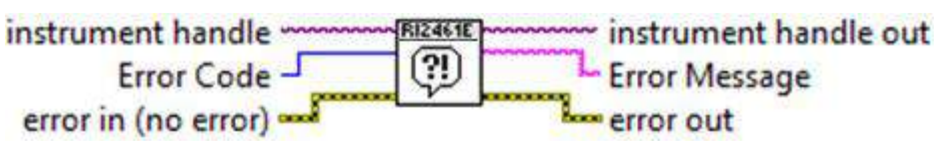
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
source		Frequency standard source	0=PXI CLK10 (RI2461E_REF_10MHZ) 1=External Front Panel (RI2461E_REF_EXT_STD) 2=Internal (RI2461E_REF_INT_STD)

C Function Prototype Form: ViStatus ri2461e_confStandard (ViSession instrumentHandle, ViInt16 standardSource);

ri2461e Error Message.vi

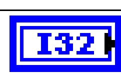
LabVIEW Diagram:



Description:

Convert a numeric error code returned by any of the vi's into a descriptive error message string.

Parameters:

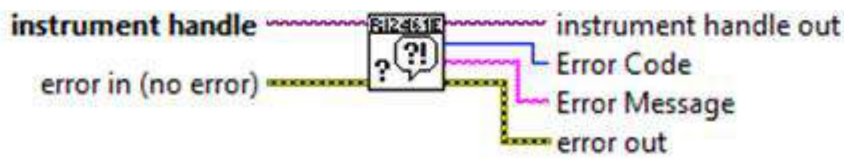
Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Error Code		The error code returned by one of the functions in this instrument driver whose description is being sought.	0 to 2^{32}-1

Name	Type	Description	Value
Error Message	abc	A text error message, which corresponds to the error code entered in the "statusCode" variable.	256 characters min.

C Function Prototype Form: ViStatus ri2461e_error_message (ViSession instrumentHandle, ViStatus statusCode, ViChar _VI_FAR errorMessage[]);

ri2461e Error-Query.vi

LabVIEW Diagram:



Description:

This vi is provided for backwards compatibility only. This vi has no affect on the instrument.

This vi returns “VI_WARN_NSUP_ERROR_QUERY” status.

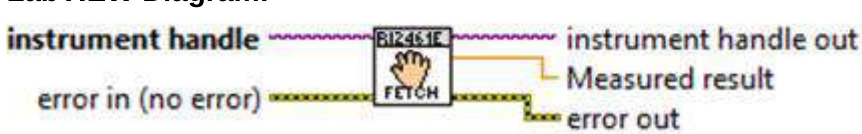
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Error Code	I32	Instrument error code	0
Error Message	abc	Instrument error message	Empty string

C Function Prototype Form: ViStatus ri2461e_error_query (ViSession instrumentHandle, ViPInt32 errorCode, ViChar _VI_FAR errorMessage[]);

ri2461e Fetch.vi

LabVIEW Diagram:



Description:

This vi returns the last initiated measurement.
(See "Set System Timeout" vi panel for note regarding timeout warnings.).

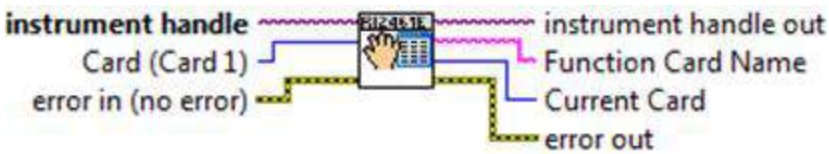
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 232-1
Measured result	DBL	This control contains the result of the fetch. A timeout will return a result of 99.0e+36.	-Inf to +Inf

C Function Prototype Form: ViStatus ri2461e_fetch (ViSession instrumentHandle, ViPReal64 measuredResult);

ri2461e Fetch Function Card.vi

LabVIEW Diagram:

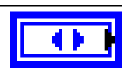


Description:

This vi is provided for backward compatibility only. This vi has no effect on the instrument.

This vi returns "RI2461E_WARN_FUNCTION_STUB" status.

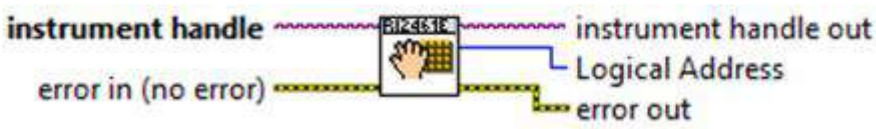
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
card		Parameter stub	0 to 2^{16}-1
name	abc	Card name	"2461e Timer/Counter"
current	I16	Current card selected	0

C Function Prototype Form: ViStatus ri2461e_fetchFunctionCard (ViSession instrumentHandle, ViInt16 card, ViChar _VI_FAR functionCardName[], ViPInt16 currentCard);

ri2461e Fetch Logical Address.vi

LabVIEW Diagram:



Description:

This vi is provided for backward compatibility only. It has no effect on the instrument.

This vi returns "RI2461E_WARN_FUNCTION_STUB" status.

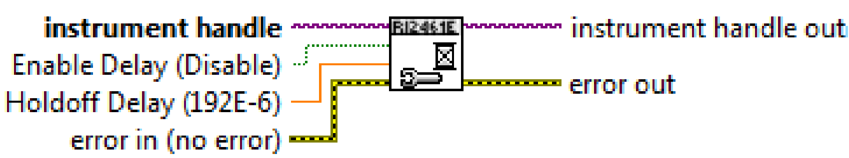
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Logical Address		Parameter stub not used by this vi	0 to 2^{16}-1

C Function Prototype Form: ViStatus ri2461e_fetchLogAddress (ViSession instrumentHandle, ViPInt16 logicalAddress);

ri2461e_fetchSerNum (vi, sn)

LabVIEW Diagram:

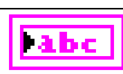


Description:

This vi is provided for backward compatibility only. It has no effect on the instrument.

This vi returns "RI2461E_WARN_FUNCTION_STUB" status.

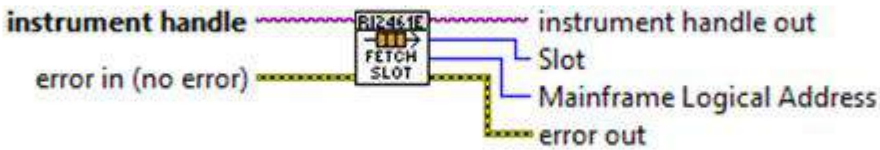
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
sn		Serial number	"N/A"

C Function Prototype Form: ViStatus ri2461e_fetchSerNum (ViSession instrumentHandle, ViChar _VI_FAR serialNumber[]);

ri2461e Fetch Slot.vi

LabVIEW Diagram:



Description:

This vi is provided for backward compatibility only. It has no effect on the instrument.

This vi returns the “RI2461E_WARN_FUNCTION_STUB” status.

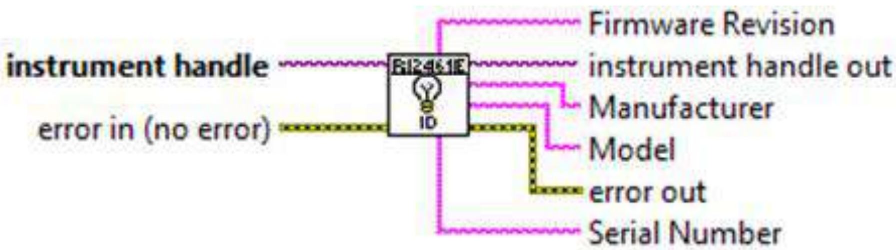
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
slot	I32	Parameter stub	0
mainframe	I32	Parameter stub	0

C Function Prototype Form: ViStatus ri2461e_fetchSlot (ViSession instrumentHandle, ViPInt32 slot, ViPInt32 mainframeLogicalAddress);

ri2461e Identify.vi

LabVIEW Diagram:



Description:

Return the manufacturer, model name, serial number, and firmware revision. This matches the information that would normally be returned by a "*IDN?" query for a message-based device.

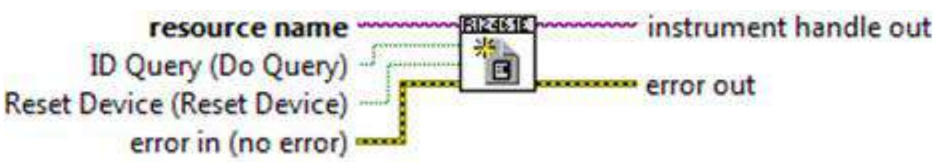
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
manufacturer	abc	Manufacturer	"Astronics Test Systems Inc."
model	abc	Model	“2461e”
sn	abc	Serial Number	NULL terminated 15 characters max.
rev	abc	Revision	NULL terminated 15 characters max.

C Function Prototype Form: ViStatus ri2461e_identify (ViSession instrumentHandle, ViChar _VI_FAR manufacturer[], ViChar _VI_FAR model[], ViChar _VI_FAR serialNumber[], ViChar _VI_FAR firmwareRevision[]);

ri2461e Initialize.vi

LabVIEW Diagram:



Description:

Initialize the instrument and return an "instrument handle". The instrument handle must be used with all of the other vi’s of this driver (and any function card driver associated with the 2461e configuration).

The initialize call allows the instrument to be queried to ensure that it is a 2461e. It also resets the 2461e to the power-up state if the "Reset" parameter is True (ON).

Note that for each use of ri2461e Initialize.vi, a new unique instrument handle is returned. Thus, if four calls are made to the initialize vi in succession, four unique instrument handles will be returned.

For each instrument handle returned by ri2461e Initialize.vi, ri2461e Close.vi should be used to free up the resources allocated by ri2461e Initialize.vi. The use(s) of ri2461e Close.vi should be made before the LabVIEW program terminates.

Parameters:

Name	Type	Description	Value
resource	I/O	Specifies with which remote instrument to establish a communication session. Based on the syntax of the Resource Name, the Initialize function configures the I/O interface and generates an Instrument Handle. The grammar for the Resource Name is shown below. Optional parameters are shown in square brackets ([]). The default value is PXI bus 4 device 14. PXI[bus]::device[::function][::INSTR] Default Value: "PXI4::14::INSTR" Bus and device numbers can be viewed from the resource manager display.	0 to 2^{32}-1
id	TF	Specifies whether an ID Query is sent to the instrument during the initialization procedure.	0=No 1=Yes
reset	TF	Specifies whether the instrument is to be reset to its power-on settings during the initialization procedure.	0=No 1=Yes
handle	I/O	The Instrument Handle is used to identify the unique session or communication channel between the driver and the instrument. If more than one instrument of the same model type is used, this Handle will be used to differentiate between them.	0 to 2^{32}-1

The syntax for the “resource” parameter is shown below. Optional segments are shown in square brackets ([]).

PXI INSTR PXI[bus]::device[::function][::INSTR]

The default values for optional parameters are shown below.

Bus 0

Function 0

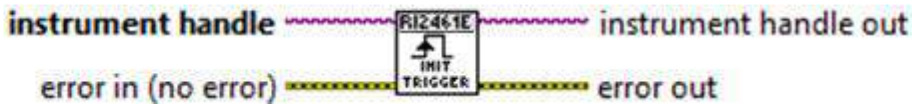
Example Resource Strings:

PXI::15::INSTR PXI device number 15 on bus 0 with implied function 0.

C Function Prototype Form: ViStatus ri2461e_init (ViRsrc resourceName, ViBoolean IDQuery, ViBoolean resetDevice, ViPSession instrumentHandle);

ri2461e Initiate Trigger Sequence.vi

LabVIEW Diagram:



Description:

Trigger the FTIC to perform the previously defined measurement function.

Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_initiateTrigger (ViSession instrumentHandle);

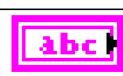
ri2461e Load New Firmware.vi

LabVIEW Diagram:

Description:

Update the instrument firmware from the file.

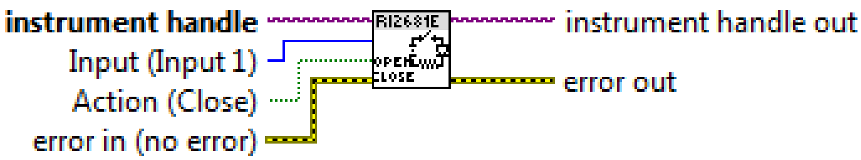
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
file		The path and name to the file that contains the new firmware image	NULL terminated 1024 characters max.

C Function Prototype Form: ViStatus ri2461e_loadFirmware (ViSession instrumentHandle, ViChar _VI_FAR filePath[]);

ri2461e Gate Open Close.vi

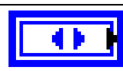
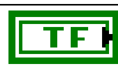
LabVIEW Diagram:



Description:

Close/open the gate in Manual Totalize mode.

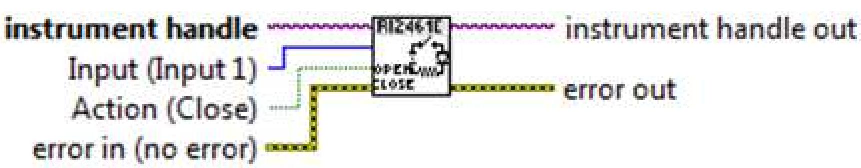
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
input		Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
action		Close or open the gate for Manual Totalize function	0=Close gate (RI2461E_CLOSE_GATE) 1=Open gate (RI2461E_OPEN_GATE)

C Function Prototype Form: ViStatus ri2461e_openCloseGate (ViSession instrumentHandle, ViInt16 input, ViBoolean action);

ri2461e Configure Gate Output.vi

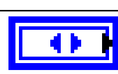
LabVIEW Diagram:



Description:

Route the gate open state onto one of the PXI_TRIG lines.

Parameters:

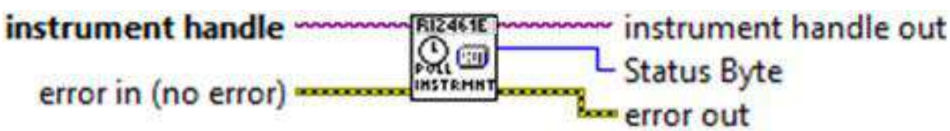
Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Trigger Destination (Off)		Destination selection	0=PXI_TRIG0 (RI2461E_PXITRG0)

Name	Type	Description	Value
			1=PXI_TRIG1 (RI2461E_PXITRG1) 2=PXI_TRIG2 (RI2461E_PXITRG2) 3=PXI_TRIG3 (RI2461E_PXITRG3) 4=PXI_TRIG4 (RI2461E_PXITRG4) 5=PXI_TRIG5 (RI2461E_PXITRG5) 6=PXI_TRIG6 (RI2461E_PXITRG6) 7=PXI_TRIG7 (RI2461E_PXITRG7) 8=Disable output (RI2461E_DIS_GATE)

C Function Prototype Form: ViStatus ri2461e_outputGate (ViSession instrumentHandle, ViInt16 triggerDestination);

ri2461e Poll Instrument.vi

LabVIEW Diagram:



Description:

This vi is provided for backwards compatibility only. This vi has no affect on the instrument.

This vi returns “RI2461E_WARN_FUNCTION_STUB” status.

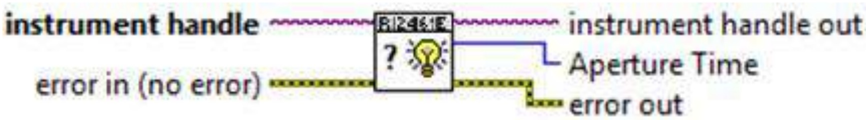
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Status Byte		Parameter stub	0

C Function Prototype Form: ViStatus ri2461e_poll (ViSession instrumentHandle, ViPInt16 statusByte);

ri2461e Query Aperture.vi

LabVIEW Diagram:



Description:

Query the aperture time.

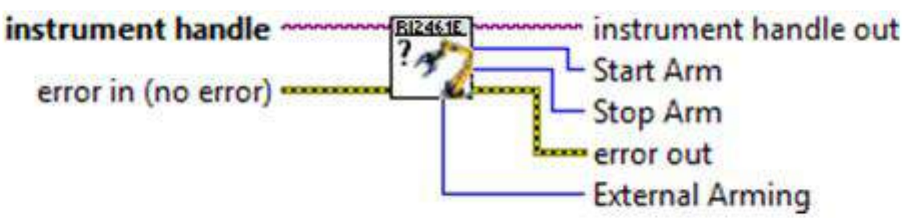
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Aperture Time		Aperture time in ms	1 to 100000

C Function Prototype Form: ViStatus ri2461e_queryAperture (ViSession instrumentHandle, int *apertureTime_ms);

ri2461e Query Arming.vi

LabVIEW Diagram:



Description:

Query the trigger arming parameters.

Parameters:

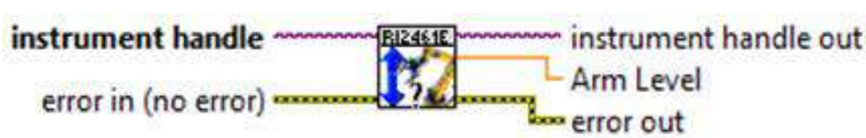
Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Start Arm		Start ARM source	0=Internal (RI2461E_INT_ARM) 1=External Positive (RI2461E_EXT_POS_ARM) 2=External Negative (RI2461E_EXT_NEG_ARM)

Name	Type	Description	Value
Stop Arm	I16	Stop ARM source	0=Internal (RI2461E_INT_ARM) 1=External Positive (RI2461E_EXT_POS_ARM) 2=External Negative (RI2461E_EXT_NEG_ARM)
External Arming	I16	External ARM source	0=PXI_TRIG0 (RI2461E_PXITRG0) 1=PXI_TRIG1 (RI2461E_PXITRG1) 2=PXI_TRIG2 (RI2461E_PXITRG2) 3=PXI_TRIG3 (RI2461E_PXITRG3) 4=PXI_TRIG4 (RI2461E_PXITRG4) 5=PXI_TRIG5 (RI2461E_PXITRG5) 6=PXI_TRIG6 (RI2461E_PXITRG6) 7=PXI_TRIG7 (RI2461E_PXITRG7) 8=Front Panel (RI2461E_FRONT_EXT_CON) 9=No External ARM

C Function Prototype Form: ViStatus ri2461e_queryArming (ViSession instrumentHandle, ViPInt16 startArm, ViPInt16 stopArm, ViPInt16 externalArming);

ri2461e Query Arming Level.vi

LabVIEW Diagram:



Description:

Query the external ARM input comparator level.

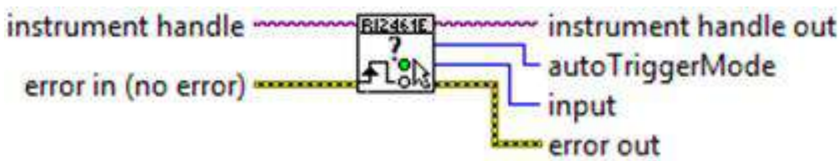
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Arm Level	DBL	ARM input comparator level	-1.3 or 0.0 or +1.6

C Function Prototype Form: ViStatus ri2461e_queryArmingLevel (ViSession instrumentHandle, ViPReal64 armLevel);

ri2461e Query Auto Trig Mode.vi

LabVIEW Diagram:



Description:

Query the auto trigger mode of the specified input.

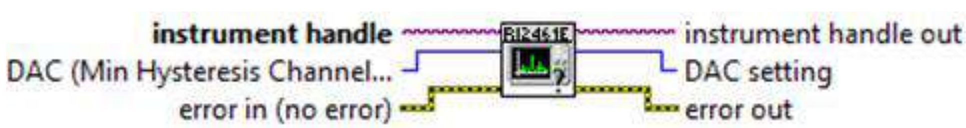
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
input	I16	Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
autoTriggerMode	I16	ARM input comparator level	0=Manual (RI2461E_TRIG_MANUAL) 1=Auto Continuous (RI2461E_CONT_AUTO) 2=Auto Single (RI2461E_SING_AUTO)

C Function Prototype Form: ViStatus ri2461e_queryAutoTrigMode (ViSession instrumentHandle, ViInt16 input, ViPInt16 autoTriggerMode);

ri2461e Query Calibration DAC.vi

LabVIEW Diagram:

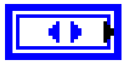


Description:

Query the calibration DAC levels.

Parameters:

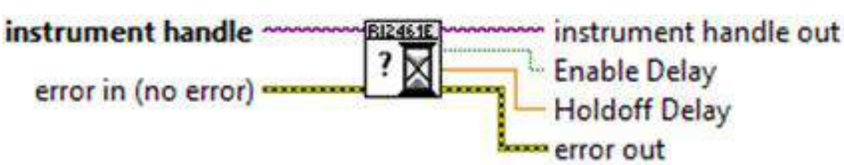
Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1

Name	Type	Description	Value
DAC (Min Hysteresis Channel...)		Calibration DAC	1=CH1 min hysteresis mode 0 (RI2461E_IN1_DAC_MODE0_MIN) 2= CH1 max hysteresis mode 0 (RI2461E_IN1_DAC_MODE0_MAX) 3= CH1 min hysteresis mode 1 (RI2461E_IN1_DAC_MODE1_MIN) 4= CH1 max hysteresis mode 1 (RI2461E_IN1_DAC_MODE1_MAX) 5=CH1 Comparator Offset (RI2461E_IN1_DAC_OFFSET) 6=CH1 Trigger Offset (RI2461E_IN1_DAC_TRIGGER_OFFSET) 7=CH1 Trigger Reference (RI2461E_IN1_DAC_TRIGGER_REF) 8=CH2 min hysteresis mode 0 (RI2461E_IN2_DAC_MODE0_MIN) 9= CH2 max hysteresis mode 0 (RI2461E_IN2_DAC_MODE0_MAX) 10= CH2 min hysteresis mode 1 (RI2461E_IN2_DAC_MODE1_MIN) 11= CH2 max hysteresis mode 1 (RI2461E_IN2_DAC_MODE1_MAX) 12=CH2 Comparator Offset (RI2461E_IN2_DAC_OFFSET) 13=CH2 Trigger Offset (RI2461E_IN2_DAC_TRIGGER_OFFSET) 14=CH2 Trigger Reference (RI2461E_IN2_DAC_TRIGGER_REF)
DAC setting		Calibration value	0 to 255

C Function Prototype Form: ViStatus ri2461e_queryCalibrationDAC (ViSession instrumentHandle, ViInt16 DAC, ViPInt16 DACSetting);

ri2461e Query Delay.vi

LabVIEW Diagram:



Description:

Query the enable and gate close holdoff delay used in the Time Interval and Totalize functions.

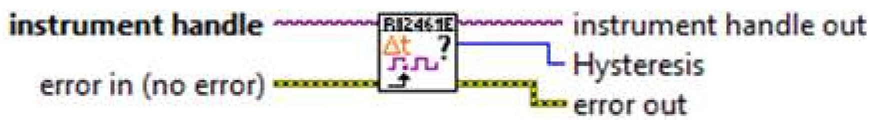
Parameters:

Name	Type	I/O	Description	Value
instrument handle	I/O	in	Identifier to a device I/O session	0 to 2^{32}-1
enable	ViPBoolean	out	Delay enable	0=Disabled 1=Enabled
delay	ViPReal64	out	Delay value	192e-6 to 1.04856

C Function Prototype Form: ViStatus ri2461e_queryDelay (ViSession instrumentHandle, ViPBoolean enableDelay, ViPReal64 holdoffDelay);

ri2461e Query Ext Arm Hysteresis.vi

LabVIEW Diagram:



Description:

Query the front panel ARM input hysteresis.

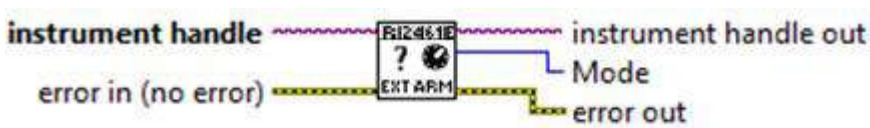
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Hysteresis	I16	Hysteresis setting	0=Low (RI2461E_DATA_EXT_ARM_HYST_LOW) 1=High (RI2461E_DATA_EXT_ARM_HYST_HIGH)

C Function Prototype Form: ViStatus ri2461e_queryExtArmHysteresis (ViSession instrumentHandle, ViPInt16 hysteresis);

ri2461e Query External ARM Mode.vi

LabVIEW Diagram:



Description:

Query EXT ARM mode.

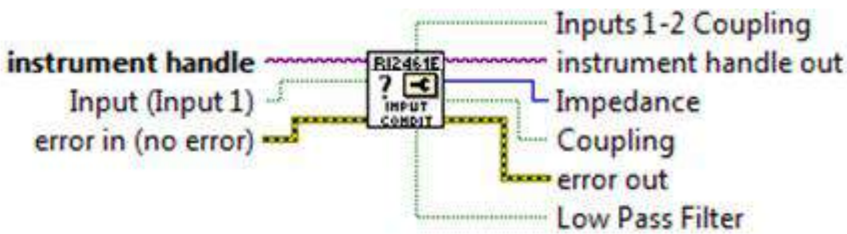
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
mode	I16	EXT ARM mode	0=ARM input (RI2461E_DATA_EXT_ARM_ARM_IN) 1=CH2 Input (RI2461E_DATA_EXT_ARM_CH2)

C Function Prototype Form: ViStatus ri2461e_queryExtArmMode (ViSession instrumentHandle, ViPInt16 mode);

ri2461e Query Input Conditioning.vi

LabVIEW Diagram:



Description:

Query the input conditioning of the selected channel as well as the input mode.

Parameters:

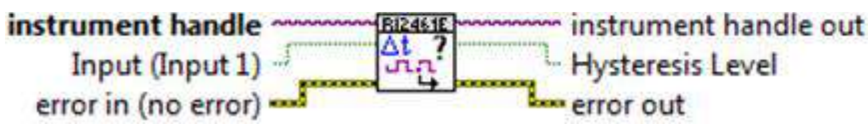
Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Input (Input 1)	TF	Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
Impedance	I16	Input impedance	0=1MΩ (RI2461E_HI_IMP) 1=50Ω (RI2461E_LO_IMP)
Coupling	TF	Input coupling	0=AC (RI2461E_AC) 1=DC (RI2461E_DC)
Low Pass Filter	TF	Input filter	0=Disabled (RI2461E_DIS_FILTER) 1=Enabled (RI2461E_ENA_FILTER)
Inputs 1-2 Coupling	TF	Input mode	0=Separate (RI2461E_SEP_INPUT)

Name	Type	Description	Value
			1=Common (RI2461E_COM_INPUT)

C Function Prototype Form: ViStatus ri2461e_queryInputConditioning (ViSession instrumentHandle, ViInt16 input, ViPInt16 impedance, ViPBoolean coupling, ViPBoolean lowPassFilter, ViPBoolean inputs12Coupling);

ri2461e Query Input Hysteresis.vi

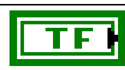
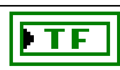
LabVIEW Diagram:



Description:

Query the hysteresis level for the selected input comparator.

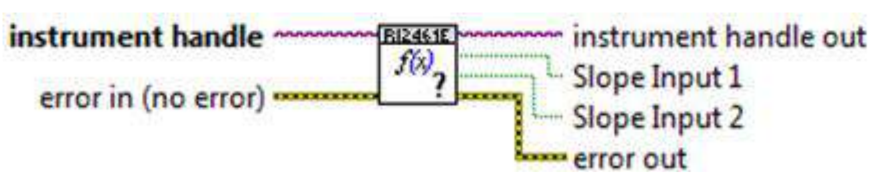
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
input		Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
hysteresis		Hysteresis setting	0=Low (RI2461E_MIN_HYST) 1=High (RI2461E_MAX_HYST)

C Function Prototype Form: ViStatus ri2461e_queryInputHysteresis (ViSession instrumentHandle, ViInt16 input, ViPBoolean hysteresisLevel);

ri2461e Query Trigger Slopes.vi

LabVIEW Diagram:



Description:

Query the trigger slope for inputs 1 and 2.

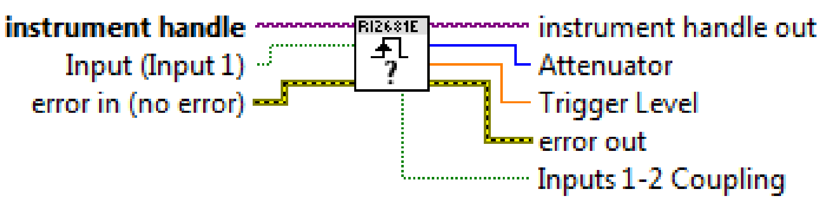
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Slope Input 1	TF	Input 1 slope	0=CH1 Positive (RI2461E_POS_SLOPE) 1=CH1 Negative (RI2461E_NEG_SLOPE)
Slope Input 2	TF	Input 2 slope	0=CH2 Positive (RI2461E_POS_SLOPE) 1=CH2 Negative (RI2461E_NEG_SLOPE)

C Function Prototype Form: ViStatus ri2461e_queryInputSlopes (ViSession instrumentHandle, ViPBoolean slopeInput1, ViPBoolean slopeInput2);

ri2461e Query Trigger Conditions.vi

LabVIEW Diagram:



Description:

Query the trigger settings of the specified channel.

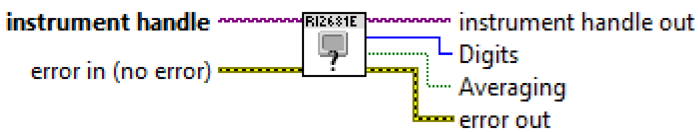
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Input (Input 1)	TF	Channel selection	1=CH1 (RI2461E_IN1) 2=CH2 (RI2461E_IN2)
Attenuator	I16	Attenuation	0=X1 (RI2461E_X1_ATTEN) 1=X10 (RI2461E_X10_ATTEN)
Trigger Level	DBL	Trigger level	See below
Inputs 1-2 Coupling	TF	Input mode	0=Separate (RI2461E_SEP_INPUT) 1=Common (RI2461E_COM_INPUT)

C Function Prototype Form: ViStatus ri2461e_queryInputTriggering (ViSession instrumentHandle, ViInt16 input, ViPInt16 attenuator, ViPReal64 triggerLevel, ViPBoolean inputs12Coupling);

ri2461e Query Resolution.vi

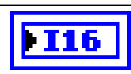
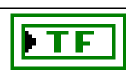
LabVIEW Diagram:



Description:

Query the measurement resolution in digits of resolution (3 to 10) and averaging state.

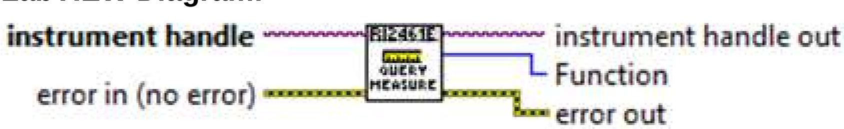
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
resolution		Resolution selection	0=gate time unchanged 3=gate time set to 1ms 4=gate time set to 1ms 5=gate time set to 1ms 6=gate time set to 1ms 7=gate time set to 10ms 8=gate time set to 100ms 9=gate time set to 1s 10=gate time set to 10s
averaging		Averaging state	0=Disabled (RI2461E_DIS_AVERAGE) 1=Enabled (RI2461E_ENA_AVERAGE)

C Function Prototype Form: ViStatus ri2461e_queryMeasRes (ViSession instrumentHandle, ViPInt16 digits, ViPBoolean averaging);

ri2461e Query Measurement.vi

LabVIEW Diagram:



Description:

Query the measurement function.

Parameters:

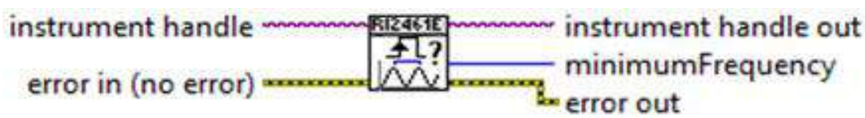
Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
function	I16	Function selection	0=Frequency CH1 (RI2461E_FREQUENCY_1) 1=Frequency CH2 (RI2461E_FREQUENCY_2) 2=Period CH1 (RI2461E_PERIOD_1) 3=Period CH2 (RI2461E_PERIOD_2) 4=Time Interval CH1 to CH 2 (RI2461E_TIME_INT_1_2) 5= Time Interval CH2 to CH1 (RI2461E_ TIME_INT_2_1) 6=Totalize CH1 by CH2 (RI2461E_TOTAL_1_2) 7=Totalize CH2 by CH1 (RI2461E_TOTAL_2_1) 8=Manual Totalize CH1 (RI2461E_MANUAL_TOTAL_1) 9=Manual Totalize CH2 (RI2461E_MANUAL_TOTAL_2) 10=Ratio CH1 over CH2 (RI2461E_RATIO_1_2) 11=Check (RI2461E_CHECK) 12=Phase CH1 relative CH2 (RI2461E_PHASE_1_2) 13=Phase CH2 relative CH1 (RI2461E_PHASE_2_1) 14=Risetime CH1 (RI2461E_RISETIME) 15=Falltime CH1 (RI2461E_FALLTIME) 16=Positive Pulse CH1 (RI2461E_POS_PWIDTH) 17=Negative Pulse CH1 (RI2461E_NEG_PWIDTH) 18=Voltage Middle CH1 (RI2461E_VOLTS_MID_1) 19= Voltage Middle CH2 (RI2461E_ VOLTS_MID_2) 20= Voltage Maximum CH1 (RI2461E_VOLTS_MAX_1) 21= Voltage Maximum CH2 (RI2461E_ VOLTS_MAX_2) 22= Voltage Minimum CH1 (RI2461E_ VOLTS_MIN_1)

Name	Type	Description	Value
			23= Voltage Minimum CH2 (RI2461E_ VOLTS_MIN_2) 24=Duty Cycle CH1 (RI2461E_DUTY_CYCLE_1)

C Function Prototype Form: ViStatus ri2461e_queryMeasurement (ViSession instrumentHandle, ViPInt16 function);

ri2461e Query Min Auto Trig Freq.vi

LabVIEW Diagram:



Description:

Query the minimum frequency the auto-trigger algorithm will detect reliably.

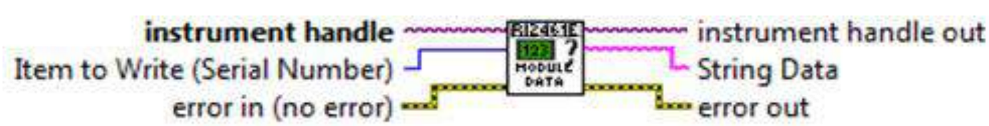
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
frequency	I16	Minimum frequency	0 = 1 kHz (RI2461E_MAX_AUTOFREQ) 1 = 50 Hz (RI2461E_MIN_AUTOFREQ)

C Function Prototype Form: ViStatus ri2461e_queryMinAutoTrigFreq (ViSession instrumentHandle, ViPBoolean minimumFrequency);

ri2461e Query Module Data.vi

LabVIEW Diagram:



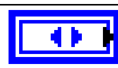
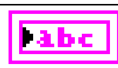
Description:

Query the specified module data from volatile memory.

Item	Value	Defined Constant
Serial Number	1	RI2461E_SERIAL_NUMBER_DATA
Assembly Revision	2	RI2461E_ASSEMBLY_REVISION_DATA
Calibration Date	3	RI2461E_CALIBRATION_DATE

Firmware Revision	5	RI2461E_FIRMWARE_REVISION
Firmware Date	6	RI2461E_FIRMWARE_DATE
FPGA Revision	7	RI2461E_FPGA_REVISION
FPGA Date	8	RI2461E_FPGA_DATE

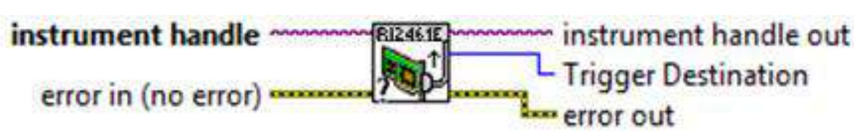
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Item to Write		Item to query	1=Serial Number (RI2461E_SERIAL_NUMBER_DATA) 2=Assembly revision (RI2461E_ASSEMBLY_REVISION_DATA) 3=Calibration date (RI2461E_CALIBRATION_DATE) 5= Firmware revision (RI2461E_FIRMWARE_REVISION) 6= Firmware date (RI2461E_FIRMWARE_DATE) 7=FPGA revision (RI2461E_FPGA_REVISION) 8= FPGA date (RI2461E_FPGA_DATE)
String Data		Query data	NULL terminated 15 characters max.

C Function Prototype Form: ViStatus ri2461e_queryModuleData (ViSession instrumentHandle, ViInt16 itemToWrite, ViChar _VI_FAR stringData[]);

ri2461e Query Gate Output.vi

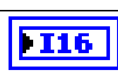
LabVIEW Diagram:



Description:

Query the gate open destination.

Parameters:

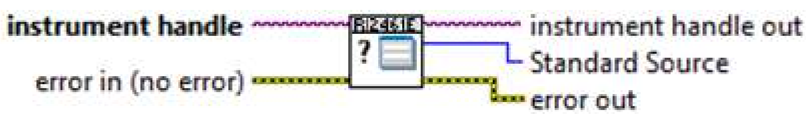
Name	Type	I/O	Description	Value
instrument handle		in	Identifier to a device I/O session	0 to 2^{32}-1
destination		out	Destination selection	0=PXI_TRIG0 (RI2461E_PXITRG0)

Name	Type	I/O	Description	Value
				1=PXI_TRIG1 (RI2461E_PXITRG1) 2=PXI_TRIG2 (RI2461E_PXITRG2) 3=PXI_TRIG3 (RI2461E_PXITRG3) 4=PXI_TRIG4 (RI2461E_PXITRG4) 5=PXI_TRIG5 (RI2461E_PXITRG5) 6=PXI_TRIG6 (RI2461E_PXITRG6) 7=PXI_TRIG7 (RI2461E_PXITRG7) 8=Disable output (RI2461E_DIS_GATE)

C Function Prototype Form: ViStatus ri2461e_queryOutputGate (ViSession instrumentHandle, ViPInt16 triggerDestination);

ri2461e Query Standard.vi

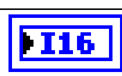
LabVIEW Diagram:



Description:

Query the frequency standard used by the FTIC.

Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
source		Frequency standard source	0=PXI CLK10 (RI2461E_REF_10MHZ) 1=External Front Panel (RI2461E_REF_EXT_STD) 2=Internal (RI2461E_REF_INT_STD)

C Function Prototype Form: ViStatus ri2461e_queryStandard (ViSession instrumentHandle, ViPInt16 standardSource);

ri2461e Read.vi

LabVIEW Diagram:

Description:

This vi initiates a new measurement and fetches the result from the instrument. (See "Set System Timeout" vi panel for note regarding timeout warnings.).

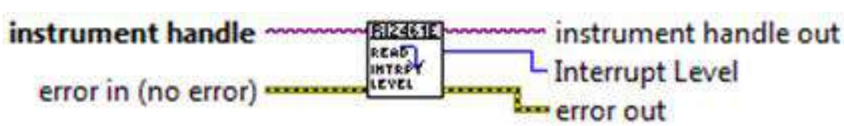
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Measured result	DBL	This control contains the result of the fetch. A timeout will return a result of 99.0e+36	-Inf to +Inf

C Function Prototype Form: ViStatus ri2461e_read (ViSession instrumentHandle, ViPReal64 measuredResult);

ri2461e Read Interrupt Level.vi

LabVIEW Diagram:



Description:

This vi is provided for backwards compatibility only. This vi has no affect on the instrument.

This vi returns “RI2461E_WARN_FUNCTION_STUB” status.

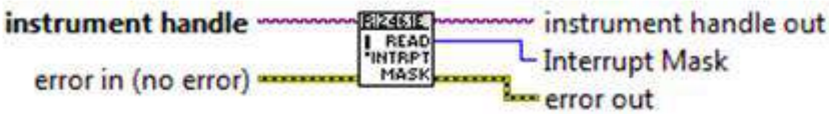
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
level	I16	Parameter stub	0

C Function Prototype Form: ViStatus ri2461e_ReadInterruptLevel (ViSession instrumentHandle, ViPInt16 interruptLevel);

ri2461e Read Interrupt Mask.vi

LabVIEW Diagram:



Description:

This vi is provided for backwards compatibility only. This vi has no affect on the instrument.

This vi returns “RI2461E_WARN_FUNCTION_STUB” status.

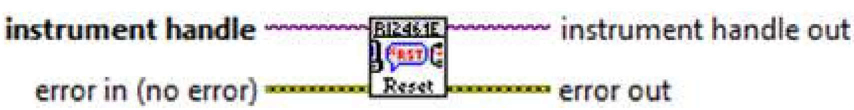
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
mask		Parameter stub	0

C Function Prototype Form: ViStatus ri2461e_ReadInterruptMask (ViSession instrumentHandle, ViPInt16 interruptMask);

ri2461e Reset.vi

LabVIEW Diagram:



Description:

Reset the counter to the power-up state. See Default Conditions.

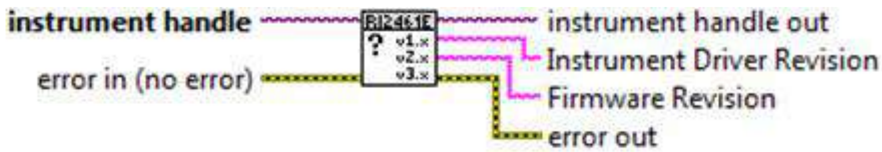
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_reset (ViSession instrumentHandle);

ri2461e Revision Query.vi

LabVIEW Diagram:



Description:

Return the revision of the instrument driver and the firmware of the instrument being used.

Revisions are returned in strings. The revision information for this instrument takes the form:

"<XX>.<YY>"

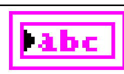
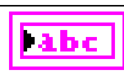
where:

<XX> is a 1 or 2-digit number representing the major revision number.

<YY> is a 1 or 2-digit number representing the minor revision number (typically "1")

Example:
"13.1" 13 = major revision, 1 = minor.

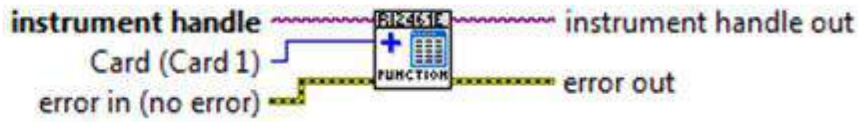
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Instrument Driver Revision		Driver revision. Can pass VI_NULL if this information not required	NULL terminated 15 characters max
Firmware Revision		Firmware revision. Can pass VI_NULL if this information not required	NULL terminated 15 characters max

C Function Prototype Form: ViStatus ri2461e_revision_query (ViSession instrumentHandle, ViChar _VI_FAR instrumentDriverRevision[], ViChar _VI_FAR firmwareRevision[]);

ri2461e Select Function Card.vi

LabVIEW Diagram:

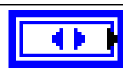


Description:

This vi is provided for backward compatibility only. This vi has no affect on the instrument.

This vi returns “RI2461E_WARN_FUNCTION_STUB” status.

Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Card (Card 1)		Parameter stub	0 to 2^{16}-1

C Function Prototype Form: ViStatus ri2461e_selectFunctionCard (ViSession instrumentHandle, ViInt16 card);

ri2461e Select UCT.vi

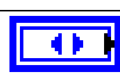
LabVIEW Diagram:

Description:

This vi is provided for backwards compatibility only. This vi has no effect on the instrument.

This vi returns “RI2461E_WARN_FUNCTION_STUB” status.

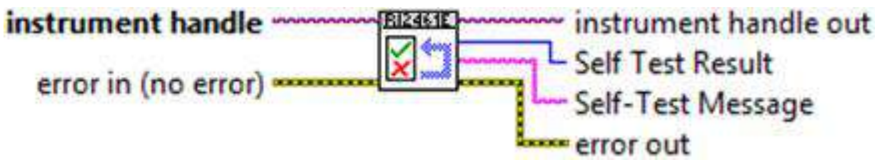
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
card		Parameter stub	0 to 2^{16}-1

C Function Prototype Form: ViStatus ri2461e_selectUCT (ViSession instrumentHandle, ViInt16 card);

ri2461e Self-Test.vi

LabVIEW Diagram:



Description:

Cause the instrument to perform a self-test and return the result of that self-test.

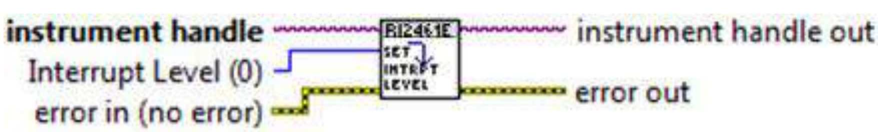
Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Self Test Result	I16	Self test result	0=Pass 1=Fail
Self-Test Message	abc	Self test result message	"Self Tests Passed" or "Self Test Failure, Counter/Timer"

C Function Prototype Form: ViStatus ri2461e_self_test (ViSession instrumentHandle, ViPInt16 selfTestResult, ViChar _VI_FAR selfTestMessage[]);

ri2461e Set Interrupt Level.vi

LabVIEW Diagram:



Description:

This vi is provided for backwards compatibility only. This vi has no effect on the instrument.

This vi returns "RI2461E_WARN_FUNCTION_STUB" status.

Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Interrupt Level (0)	I16	Parameter stub	0 to 2^{16}-1

C Function Prototype Form: ViStatus ri2461e_SetInterruptLevel (ViSession instrumentHandle, ViInt16 interruptLevel);

ri2461e Set Interrupt Mask.vi

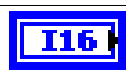
LabVIEW Diagram:

Description:

This vi is provided for backward compatibility only. It has no effect on the instrument.

This vi returns the “RI2461E_WARN_FUNCTION_STUB” status.

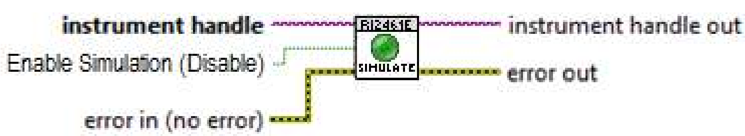
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Interrupt Mask (0)		Parameter stub	0 to 2^{16}-1

C Function Prototype Form: ViStatus ri2461e_SetInterruptMask (ViSession instrumentHandle, ViInt16 interruptMask);

ri2461e Simulate.vi

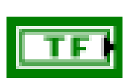
LabVIEW Diagram:



Description:

Enable or disable simulation mode for ALL instances of the driver.

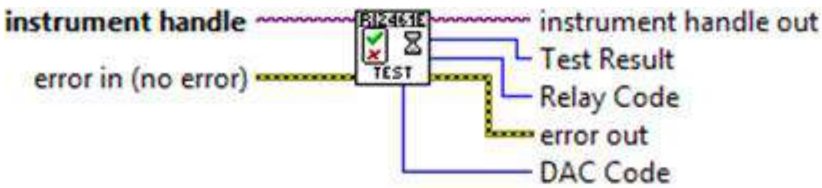
Parameters:

Name	Type	Description	Value
instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
enable		Simulation enable	0=Disable (VI_FALSE) 1=Enable (VI_TRUE)

C Function Prototype Form: ViStatus ri2461e_simulate (ViBoolean enableSimulation);

ri2461e Test Counter.vi

LabVIEW Diagram:



Description:

This vi performs a self test on the counter and returns the result in three parameters.

Result	Contains the pass/fail results.
Relay	Contains detailed results of the relay driver test fail (bit 1 of the Test Results).
DAC	Contains detailed results of the DAC interface test fail (bit 8 of the Test Results)..

Parameters:

Name	Type	Description	Value
instrument handle	I/O	Identifier to a device I/O session	0 to 2^{32}-1
Test Result	I16	Test result	0 to 2^{10}
Relay Code	I32	Relay driver test result	0 to 2^{12}
dac	I16	DAC test result	0 to 2^{10}

The following tables list the bit definitions of the “result”, “relay” and “dac” parameters. A one indicates a failure.

“result” Bit Number	Failure
0	Relay I2C interface
1	Relay driver (failing relays are returned in the Relay Code parameter
2	Control Settings Memory stuct at zero
3	Control Settings Memory stuct at one
4	Control Settings Memory march pattern
5	Block Memory stuck at zero

“result” Bit Number	Failure
6	Block Memory stuck at one
7	Block Memory march pattern
8	DAC interface (failing interfaces are returned in the DAC Code parameter
9	VXICLK10 reference
10	Internal standard reference

“relay” Bit Number	Failure
0	CH1 X10 attenuation
1	CH2 X10 attenuation
2	CH1 X4 attenuation
3	CH2 X4 attenuation
4	CH1/CH2 coupling
5	CH1 AC/DC coupleing
6	CH2 AC/DC coupleing
7	CH1 50 ohm
8	CH2 50 ohm
9	CH1 filter
10	CH2 filter
11	CH1 500K ohm
12	CH2 500K ohm

“dac” Bit Number	Failure
0	CH1 comparator offset calibration
1	CH1 comparator hysterisis
2	CH1 trigger offset calibration
3	CH1 trigger reference calibration
4	CH2 comparator offset calibration
5	CH2 comparator hysterisis
6	CH2 trigger offset calibration
7	CH2 trigger reference calibration
8	CH1 trigger level
9	CH2 trigger level
10	ARM trigger level

C Function Prototype Form: ViStatus ri2461e_testCounter (ViSession instrumentHandle, ViPInt16 testResult, ViPInt32 relayCode, ViPInt16 DACCode);

ri2461e Trigger Instrument.vi

LabVIEW Diagram:

Description:

This vi is provided for backward compatibility only. This vi has no effect on the instrument.

This vi returns “RI2461E_WARN_FUNCTION_STUB” status.

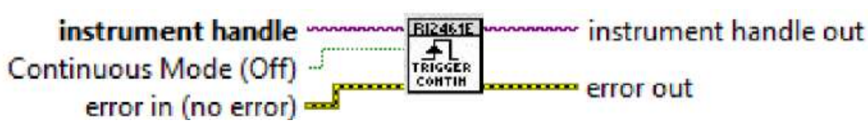
Parameters:

Name	Type	Description	Value
Instrument handle		Identifier to a device I/O session	0 to 2^{32}-1

Function Prototype Form: ViStatus ri2461e_trigger (ViSession instrumentHandle);

ri2461e Trigger Continuous.vi

LabVIEW Diagram:



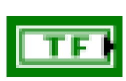
Description:

Enables or disables continuous mode.

In continuous mode, the FTIC constantly initiates new measurements. Use ri2461e Fetch.vi to return the latest result.

In triggered mode, initiate the measurement using ri2461e Initiate Trigger Sequence.vi.

Parameters:

Name	Type	Description	Value
Instrument handle		Identifier to a device I/O session	0 to 2^{32}-1
Continuous Mode (Off)		State of Continuous mode	0 = Disables continuous measurement 1 = Enables continuous measurement

Function Prototype Form: ri2461e_triggerContinuous (ViSession vi, ViBoolean enable);

ri2461e Write Counter Calibration Data.vi

LabVIEW Diagram:

Description:

Stores the present setting of calibration DACs to the instrument's nonvolatile memory. This data is automatically recalled on power-up.

Key Parameters:

Name	Type	Description	Value
Instrument handle		Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_WriteCounterCalibrationData (ViSession instrumentHandle);

ri2461e Write Module Data.vi

LabVIEW Diagram:

Description:

Stores the present values for all of the module data to the instrument's nonvolatile memory. This data is automatically recalled on power-up.

Key Parameters:

Name	Type	Description	Value
Instrument handle		Identifier to a device I/O session	0 to 2^{32}-1

C Function Prototype Form: ViStatus ri2461e_WriteModuleData (ViSession instrumentHandle);

Chapter 5
Performance Verification

This Chapter describes the procedures for checking that the FTIC Instrument conforms to its published specifications. It is recommended that these procedures are carried out at a minimum interval of one year.

The following conditions must be kept throughput the Performance Verification Procedure (PVP).

1. The ambient temperature must be 23C^{o} +/-2^{o}C.
2. The FTIC must be allowed to warm up for a least one hour before commencing the PVP.

In the following procedures, a stable count is defined as one that does not vary by more than +/- one count in the least significant digit of resolution between successive readings.

Note that these procedures check the measurement circuitry of the UCT but not the absolute accuracy. Absolute accuracies must be calculated from the expressions given in the Specifications section of this manual after finding the timebase errors that apply to the external frequency standard or CLK10 signals used by the FTIC

Test Equipment Required

1. Signal Generator, 10Hz to 235MHz 10mV$_{RMS}$ to 1V$_{RMS}$
2. DC Source +/- 8V
3. Digital Multimeter, +/- 5% Accuracy, DC to 100kHz
4. RF Millivoltmeter,
5. Various RF connectors, adapters, T-pieces and coaxial cables, as required.

Note: In the following procedures, it is recommended that all signal levels are measured with the Digital Multimeter or RF Millivoltmeter, as appropriate, and adjusted to give a level as close to its nominal value as can be achieved before being applied to the FTIC.

Input 1 Sensitivity Test

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi).
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi).
3. Select measurement FREQUENCY 1 (ri2461e Configure Measurement.vi).
4. Connect the Function Generator to the FTIC as shown in Figure 5-1.

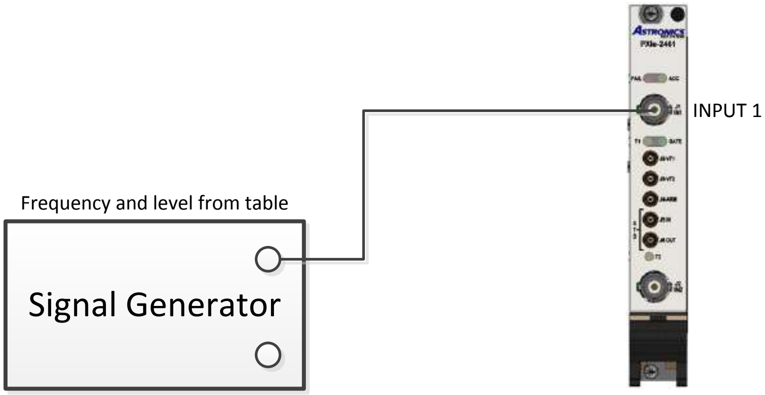


Figure 5-1 Input 1 Low Frequency Sensitivity Test Configuration

5. Apply the frequencie, signal level and resolution settings given in the following table to the FTIC. Check that the FTIC gives a stable reading within the tolerances given. Use the vi "ri2461e Configure Resolution.vi" to set the resolution and the vi "ri2461e Read.vi" to read the frequency.

Frequency	Signal level	Resolution	Tolerance
10Hz	25mV rms +/- 5%	8	± 1Hz
5kHz	25mV rms +/- 5%	8	± 0.1Hz
10kHz	25mV rms +/- 5%	8	± 0.1Hz
100kHz	25mV rms +/- 5%	8	± 0.1Hz
10MHz	25mV rms +/- 5%	8	± 1Hz
100kHz	50mV rms +/- 5%	9	± 1Hz
160MHz	75mV rms +/- 5%	9	± 1Hz
200MHz	75mV rms +/- 5%	9	± 1Hz
235MHz	125mV rms +/- 5%	9	± 1Hz

Table 5-1 Input 1 Sensitivity Frequency Performance Limits

6. Disconnect the test equipment.

Input 2 Sensitivity Test

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi)
3. Select measurement FREQUENCY 1 (ri2461e Configure Measurement.vi)
4. Connect the Function Generator to the FTIC as shown in Figure 5-2.

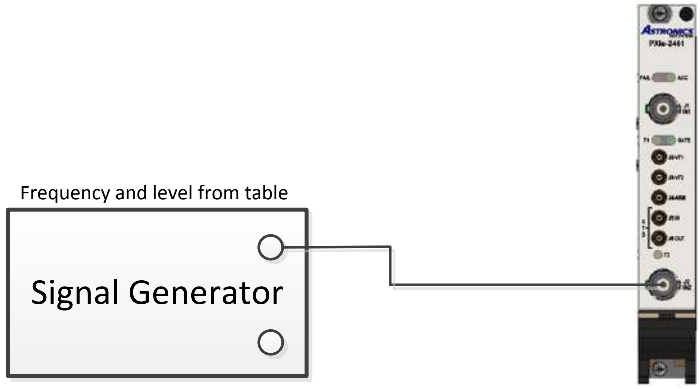


Figure 5-2 Input 2 Low Frequency Sensitivity Test Configuration

5. Apply the frequency, signal level and resolution settings given in the following table to the FTIC. Check that the FTIC gives a stable reading within the tolerances given. Use the vi “ri2461e Configure Resolution.vi” to set the resolution and the vi “ri2461e Read.vi” to read the frequency.

Frequency	Signal level	Resolution	Tolerance
10Hz	25mV rms +/- 5%	8	± 1Hz
5kHz	25mV rms +/- 5%	8	± 0.1Hz
10kHz	25mV rms +/- 5%	8	± 0.1Hz
100kHz	25mV rms +/- 5%	8	± 0.1Hz
10MHz	25mV rms +/- 5%	8	± 1Hz
100kHz	50mV rms +/- 5%	9	± 1Hz
160MHz	75mV rms +/- 5%	9	± 1Hz
200MHz	75mV rms +/- 5%	9	± 1Hz
235MHz	125mV rms +/- 5%	9	± 1Hz

Table 5-2 Input 2 Sensitivity Frequency Performance Limits

6. Disconnect the test equipment.

Time Interval 1 - 2 Test

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and common input mode for IN1 (ri2461e Configure Input Conditioning.vi)
3. Select measurement Time Interval 1 - 2 (ri2461e Configure Measurement.vi)
4. Connect the Function Generator to the FTIC as shown in Figure 5-3

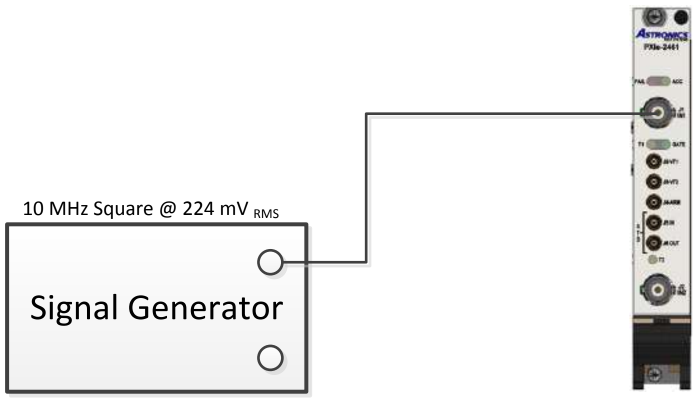


Figure 5-3 Time Interval 1-2 Test Configuration

5. Set the FTIC input trigger slopes as shown in the following table and check that the FTIC measurement results are as given in Table 5-3. Use the vi “ri2461e Configure Trigger Slopes.vi” to set the slopes and the vi “ri2461e Read.vi” to read the time interval.

Input 1 Slope	Input 2 Slope	Results	Tolerance
Positive	Positive	0ns	± 2ns
Negative	Positive	50ns	± 2ns
Negative	Negative	0ns	± 2ns
Positive	Negative	50ns	± 2ns

Table 5-3 Time Interval 1-2 Test Performance Limits

6. Disconnect the test equipment.

Totalize 1 by 2 Test

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi)
3. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi)
4. Select measurement Totalize 1 - 2 (ri2461e Configure Measurement.vi)
5. Connect the Function Generator to the FTIC as shown in Figure 5-4

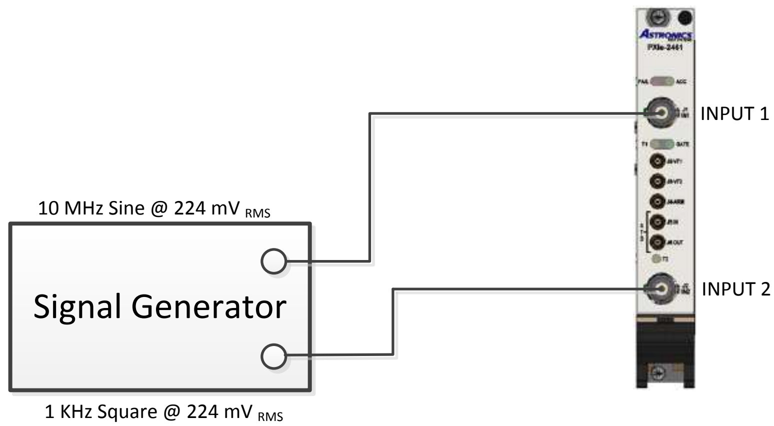


Figure 5-4 Totalize 1 by 2 Test Configuration

6. Use vi “ri2461e Read.vi” to read the totalize count and verify the measurement is 5000 +/- 1
7. Disconnect the test equipment.

Ratio 1 over 2 Test

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi)
3. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi)
4. Select measurement Ratio 1 over 2 (ri2461e Configure Measurement.vi)
5. Connect the Function Generator to the FTIC as shown in Figure 5-4

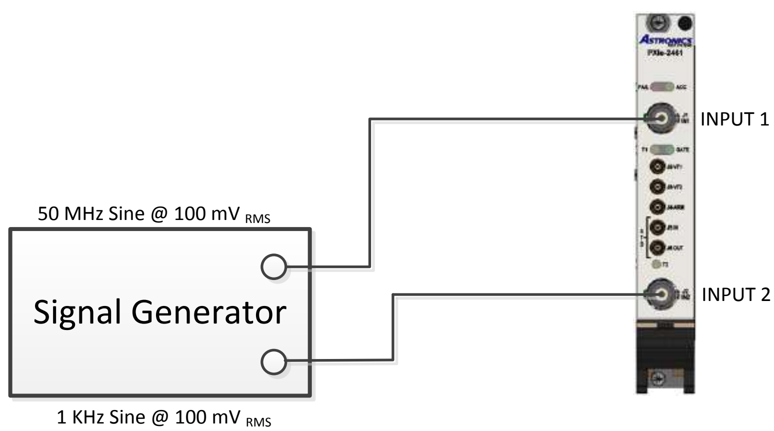


Figure 5-5 Ratio 1 over 2 Test Configuration

6. Use vi “ri2461e Read.vi” to read the ratio and verify the measurement is 50000 +/- 10.
7. Disconnect the test equipment.

Input 1 Trigger Level Accuracy Test

Equipment: DC Source

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 1MΩ impedance, DC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi)
3. Select measurement VMID 1 (ri2461e Configure Measurement.vi)
4. Connect the DC Source to the FTIC as shown in Figure 5-6

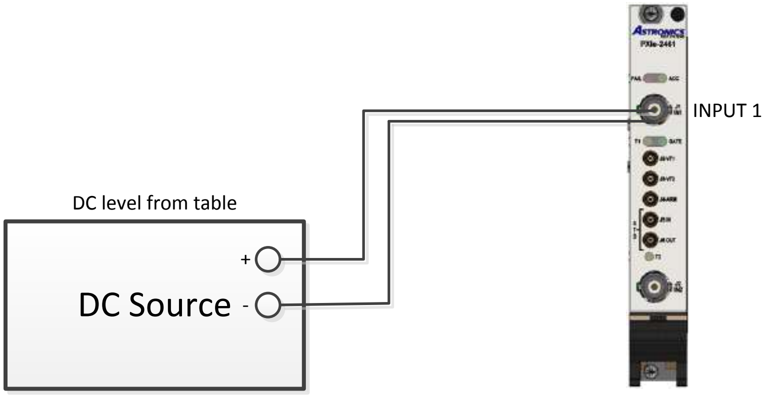


Figure 5-6 Input 1 Trigger Level Test Configuration

5. Apply the DC level given in the following table to the FTIC. Check that the FTIC gives a stable reading within the tolerances given. Use vi “ri2461e Read.vi” to read the VMID voltage.

DC Level	Tolerance
+4.000V +/- 0.001V	± 290mV
-4.000V +/- 0.001V	± 290mV
+8.000V +/- 0.001V	± 1.3V
-8.000V +/- 0.001V	± 1.3V

6. Disconnect the test equipment.

Input 2 Trigger Level Accuracy Test

Equipment: DC Source

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 1MΩ impedance, DC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi)
3. Select measurement VMID 2 (ri2461e Configure Measurement.vi)
4. Connect the DC Source to the FTIC as shown in Figure 5-7

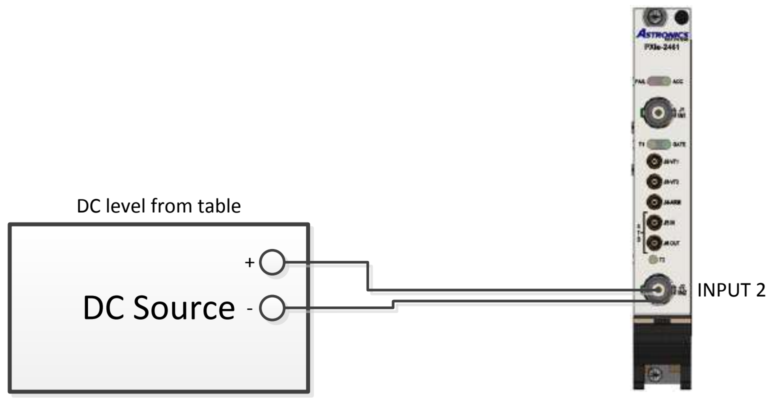


Figure 5-7 Input 2 Trigger Level Test Configuration

5. Apply the DC level given in the following table to the FTIC. Check that the FTIC gives a stable reading within the tolerances given. Use the vi “ri2461e Read.vi” to read the VMID voltage.

DC Level	Tolerance
+4.000V +/- 0.001V	± 290mV
-4.000V +/- 0.001V	± 290mV
+8.000V +/- 0.001V	± 1.3V
-8.000V +/- 0.001V	± 1.3V

6. Disconnect the test equipment.

Input 1 Filter Check

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi)
3. Select measurement FREQUENCY 1 (ri2461e Configure Measurement.vi)
4. Connect the Function Generator to the FTIC as shown in Figure 5-8

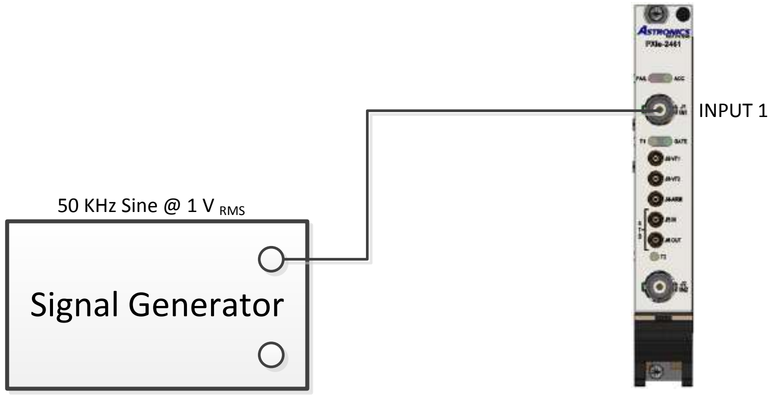


Figure 5-8 Input 1 Filter Check Configuration

5. Use “ri2461e Read.vi” to verify 50 KHz frequency.
6. Select measurement VMAX 1 (ri2461e Configure Measurement.vi)
7. Use “ri2461e Read.vi” to measure VMAX voltage and save as V_{MAX1}
8. Select measurement VMIN 1 (ri2461e Configure Measurement.vi)
9. Use “ri2461e Read.vi” to measure VMIN voltage and save as V_{MIN1}
10. Select 50Ω impedance, AC coupling, Filter enabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi)
11. Select measurement FREQUENCY 1 (ri2461e Configure Measurement.vi)
12. Use “ri2461e Read.vi” to verify 50 KHz frequency.
13. Select measurement VMAX 1 (ri2461e Configure Measurement.vi)
14. Use “ri2461e Read.vi” to measure VMAX voltage and save as V_{MAX2}
15. Select measurement VMIN 1 (ri2461e Configure Measurement.vi)
16. Use “ri2461e Read.vi” to measure VMIN voltage and save as V_{MIN2}
17. Use the following equation to verify that the signal amplitude is reduced by > 2 dB when the filter is enabled.

$$20 * \log((V_{MAX1} - V_{MIN1})/(V_{MAX2} - V_{MIN2})) > 2.0$$

18. Disconnect the test equipment.

Input 2 Filter Check

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461 Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi)
3. Select measurement FREQUENCY 2 (ri2461e Configure Measurement.vi)
4. Connect the Function Generator to the FTIC as shown in Figure 5-9

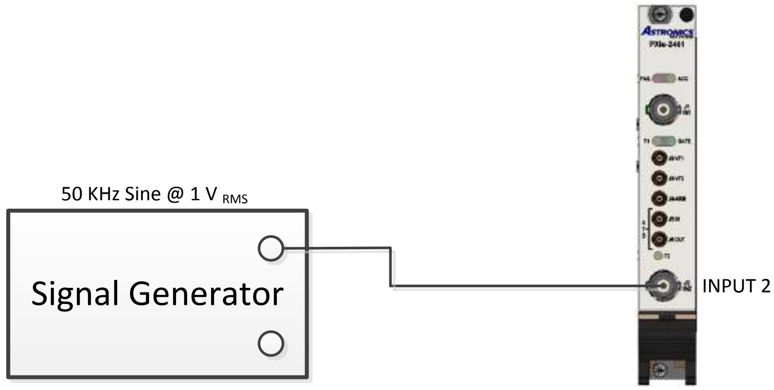


Figure 5-9 Input 2 Filter Check Configuration

5. Use “ri2461e Read.vi” to verify 50 KHz frequency.
6. Select measurement VMAX 2 (ri2461e Configure Measurement.vi)
7. Use “ri2461e Read.vi” to measure VMAX voltage and save as V_{MAX1}
8. Select measurement VMIN 2 (ri2461e Configure Measurement.vi)
9. Use “ri2461e Read.vi” to measure VMIN voltage and save as V_{MIN1}
10. Select 50Ω impedance, AC coupling, Filter enabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi)
11. Select measurement FREQUENCY 2 (ri2461e Configure Measurement.vi)
12. Use “ri2461e Read.vi” to verify 50 KHz frequency.
13. Select measurement VMAX 2 (ri2461e Configure Measurement.vi)
14. Use “ri2461e Read.vi” to measure VMAX voltage and save as V_{MAX2}
15. Select measurement VMIN 2 (ri2461e Configure Measurement.vi)
16. Use “ri2461e Read.vi” to measure VMIN voltage and save as V_{MIN2}
17. Use the following equation to verify that the signal amplitude is reduced by > 2 dB when the filter is enabled.

$$20 * \log\left(\left(V_{MAX1} - V_{MIN1}\right) / \left(V_{MAX2} - V_{MIN2}\right)\right) > 2.0$$

18. Disconnect the test equipment.

Input 1 Attenuator Check

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi)
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi)
3. Select measurement FREQUENCY 1 (ri2461e Configure Measurement.vi)
4. Connect the Function Generator to the FTIC as shown in Figure 5-10

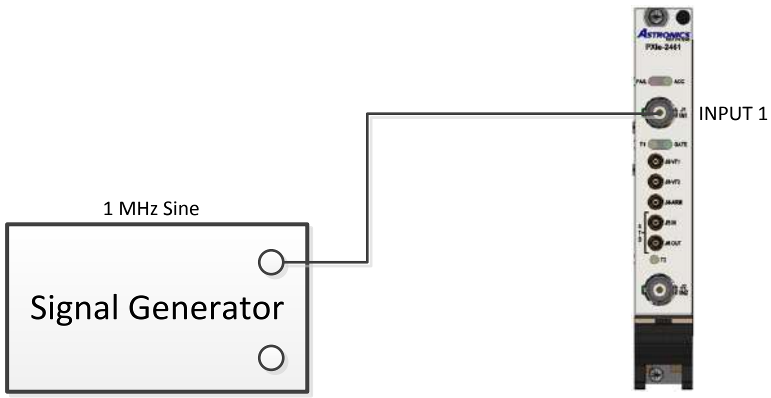


Figure 5-10 Input 1 X10 Attenuator Check Configuration

5. Set the signal generator to 1MHz, 10mV_{RMS} . Increase the signal generator output level until the FTIC gives a stable reading. Save the signal generator output level as LEVEL1. Use “ri2461e Read.vi” to measure frequency.
6. Enable the FTIC Input 1 x10 attenuator (ri2461e Configure Trigger Conditions.vi) and check that the FTIC no longer counts. Increase the signal generator until the FTIC gives a stable reading. Save the signal generator output level as LEVEL2
7. Check that this level is between 8 to 12 times the level from step 5. (8 X LEVEL1) ≥ LEVEL2 ≤ (12 X LEVEL1)
8. Disconnect the test equipment.

Input 2 Attenuator Check

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi).
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi).
3. Select measurement FREQUENCY 2 (ri2461e Configure Measurement.vi).
4. Connect the Function Generator to the FTIC as shown in Figure 5-11

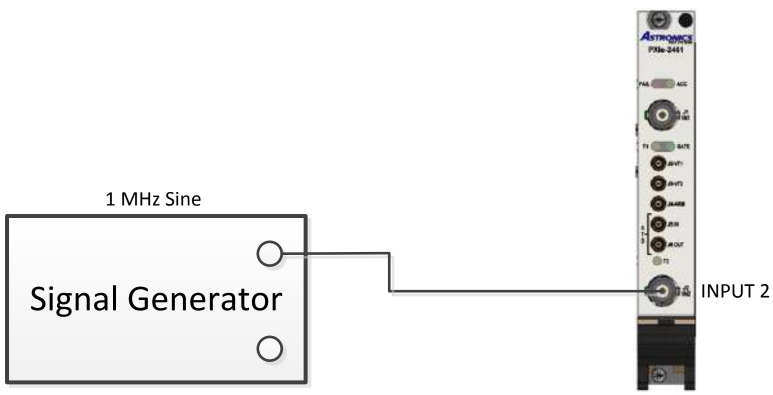


Figure 5-11 Input 2 X10 Attenuator Check Configuration

5. Set the signal generator to 1MHz, 10mV$_{RMS}$. Increase the signal generator output level until the FTIC gives a stable reading. Save the signal generator output level as LEVEL1. Use “ri2461e Read.vi” to measure frequency.
6. Enable the FTIC Input 2 x10 attenuator (ri2461e Configure Trigger Conditions.vi) and check that the FTIC no longer counts. Increase the signal generator until the FTIC gives a stable reading. Save the signal generator output level as LEVEL2
7. Check that this level is between 8 to 12 times the level from step 5. (8 X LEVEL1) ≥ LEVEL2 ≤ (12 X LEVEL1)
8. Disconnect the test equipment.

Input 1 Hysteresis Check

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi).
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN1 (ri2461e Configure Input Conditioning.vi).
3. Select measurement FREQUENCY 1 (ri2461e Configure Measurement.vi).
4. Connect the Function Generator to the FTIC as shown in Figure 5-12

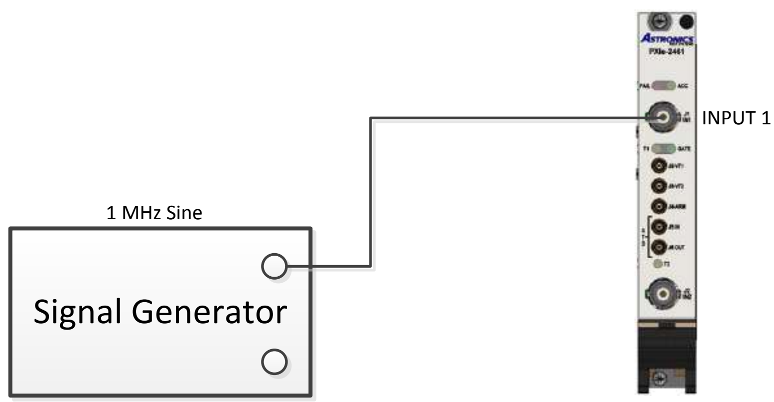


Figure 5-12 Input 1 Hysteresis Check Configuration

5. Set the signal generator to 1MHz, 15mV$_{RMS}$. Verify that the FTIC has a stable reading.
6. Set the input 1 Hysteresis to high (ri2461e Configure Input Hysteresis.vi) and verify the FTIC no longer counts.
7. Increase the signal generator output level to 30mV$_{RMS}$ and verify the FTIC has a stable reading.
8. Disconnect the test equipment.

Input 2 Hysteresis Check

Equipment: Signal Generator

Perform the following steps:

1. Return unit to default state (ri2461e Reset.vi).
2. Select 50Ω impedance, AC coupling, Filter disabled and separate input mode for IN2 (ri2461e Configure Input Conditioning.vi).
3. Select measurement FREQUENCY 2 (ri2461e Configure Measurement.vi).
4. Connect the Function Generator to the FTIC as shown in Figure 5-13

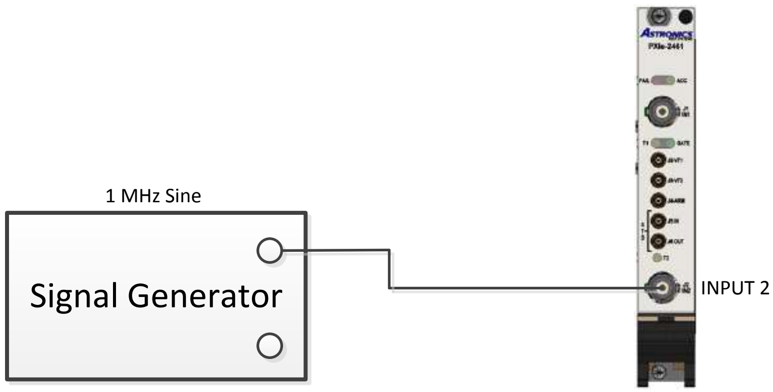


Figure 5-13 Input 2 Hysteresis Check Configuration

5. Set the signal generator to 1MHz, 15mV$_{RMS}$. Verify that the FTIC has a stable reading.
6. Set the input 2 Hysteresis to high (ri2461e Configure Input Hysteresis.vi) and verify the FTIC no longer counts.
7. Increase the signal generator output level to 30mV$_{RMS}$ and verify the FTIC has a stable reading.
8. Disconnect the test equipment.

Appendix A
Specifications

WARNING:

To ensure protection against electrical shock, the warnings detailed in the Safety Precautions page of the handbook must be observed.

Channels 1 and 2 - Input Characteristics

Channels 1 and 2 are coupled via INPUT 1 and INPUT 2 respectively. These channels can be operated independently (SEPARATE mode) or with Channel 2 buffer amplifier input commoned with Channel 1 buffer amplifier input.

Frequency Range

Channel 1	DC to 235 MHz
Channel 2	DC to 235 MHz

Signal Routing

SEPARATE mode	INPUT 1 routed through Channel 1 buffer INPUT 2 routed through Channel 2 buffer
COMMON mode	INPUT 1 routed to Channel 1 buffer and Channel 2 buffer

Input Impedance

x1 and x10 Attenuation	
INPUT 1 or 2 in SEPARATE mode	1MΩ nominal shunted by ≤ 45pF or 50Ω (DC coupled)
INPUT 1 in COMMON mode	1MΩ nominal shunted by ≤ 55pF or 50Ω (DC coupled)

Sensitivity

x1 attenuation		
Sinewave	10 Hz ≤ f ≤ 100 MHz 100 MHz < f ≤ 160 MHz 160 MHz < f ≤ 200 MHz 200 MHz < f ≤ 235 MHz *where f is the input frequency in Hz*	25mV $_{RMS}$ 50mV $_{RMS}$ 75mV $_{RMS}$ 125mV $_{RMS}$
Pulse	75mV for pulse widths down to 5ns	

Variable Sensitivity (Hysteresis)

Two selectable settings of the hysteresis level allow the sensitivity to be adjusted. The above Sensitivity figures are with the hysteresis in its most sensitive position, but the sensitivity will be reduced by a factor of 2 nominal upon selecting the other setting. The nominal hysteresis settings are:

Low	Atten x 15 mV$_{pk-pk}$
High	Atten x 45 mV$_{pk-pk}$
Range	Atten x (10 to 145 mV$_{pk-pk}$)

Dynamic Range

x1 attenuation	10 Hz ≤ *f* ≤ 50 MHz 50 MHz < *f* ≤ 160 MHz 160 MHz < *f* ≤ 200 MHz *where f is the input frequency in Hz*	5 V$_{pk-pk}$ min 2. 5 V$_{pk-pk}$ min 1.5 V$_{pk-pk}$ min
x10 attenuation	10 Hz ≤ *f* ≤ 50 MHz 50 MHz < *f* ≤ 160 MHz 160 MHz < *f* ≤ 200 MHz *where f is the input frequency in Hz*	50 V$_{pk-pk}$ min 25 V$_{pk-pk}$ min 15 V$_{pk-pk}$ min

Signal Operating Range

x1 attenuation	-5.1 VDC to +5.1 VDC

Input Attenuation

x1 or x10 selectable.

Coupling

AC or DC

Damage Level (AC or DC)

1MΩ (×1)	
DC ≤ f ≤ 2 kHz	260 V (DC + AC $_{RMS}$)
2 kHz < f ≤ 100 kHz	$\frac{5\times10^5}{f}$ V $_{RMS}$
f >100 kHz	5 V $_{RMS}$
1MΩ (×10)	
DC ≤ f ≤ 20 kHz	260 V (DC + AC $_{RMS}$)
20 kHz < f ≤ 100kHz	$\frac{5\times10^6}{f}$ V $_{RMS}$
f >100 kHz	50 V $_{RMS}$
50 Ω (×1 & ×10)	
DC ≤ f ≤ 200 MHz	5 V (DC + AC $_{RMS}$)

where f is the input frequency in Hz

Low Pass Filter

Independently selectable in Channel 1 and Channel 2.

3dB bandwidth	50kHz nominal
Attenuation rate	20dB per decade nominal

Input Connection

BNC female

Crosstalk

> 36 dB separation between channels 1 & 2

(measured at 100 MHz in a 50 Ω system, x1 attenuation).

Trigger Slope

Independently selectable positive or negative.

Manual Trigger

1. Trigger Level Range

x1 attenuation	-5.1 V to +5.1 VDC
x10 attenuation	-51 V to +51 VDC

2. Trigger Level Resolution

x1 attenuation	2.5 mV nominal
x10 attenuation	25 mV nominal

3. Trigger Level Accuracy

×1	± 1% reading ±30 mV
×10	± 1% reading ±300 mV

4. Trigger Level Output
Independent buffered outputs representing the trigger level.

Range	±5.1 VDC irrespective of attenuator setting. For X10 the measured output voltage should be scaled by a factor of 10.
Resolution	2.5 mV nominal

Accuracy:

x1 (Measured output not scaled by user)	± 1% setting ±10 mV
x10 (Measured output scaled by user)	± 1% (setting × 10) ±100 mV

Output Impedance: 10 kΩ nominal.

Connector: MCX female jacks for both Channel 1 and 2 trigger level outputs. Outputs are labelled VT1 for Channel 1 and VT2 for Channel 2.

Automatic Trigger

In the automatic trigger mode, the maximum and minimum values of the input waveform are measured and the trigger points are set nominally halfway between these values. The peak values are available via the DMM function.

The input signal must be continuously repetitive and be ≥ 5 ns (pulse) or ≤ 20 MHz sinewave. The FTIC will also auto-trigger to a DC level (i.e. any signal with an AC content of < 150 mV pk-pk). In this case, the processor will return zero for the peak values and will set the trigger level to the nominal DC voltage at the input. The lowest frequency of auto-trigger can be set to 50 Hz or 1 kHz in order to minimize auto-trigger acquisition times.

Selectable Auto-Trigger Minimum Frequency

The auto-trigger algorithm is optimized for the lowest AC frequency to be acquired. In general, the lower the frequency that the algorithm has to process, the longer will be the maximum and typical acquisition times. For this reason, the user is given the ability to program the lowest input frequency that must be acquired, thereby reducing to a minimum the auto-trigger acquisition time.

The algorithm will accept a programmable lower acquisition frequency of 50 Hz or 1 kHz (note that a lower limit of more than 1 kHz would provide no further reduction in maximum or typical acquisition times). The following table shows how acquisition time is affected by input frequency. The default setting is 1 kHz.

Minimum Input Frequency Set	Actual Input Frequency	Typical Acquisition Time
50 Hz	50 Hz	2.60 s
50 Hz	1 kHz	1.36 s
1 kHz	1 kHz	0.285 s
1 kHz	20 MHz	0.312 s

Auto Attenuation

The auto-trigger selects the appropriate attenuator automatically, and the following conditions apply:

x1 Attenuation: Selected if positive and negative peak amplitudes are less than ±4.6 V and the peak to peak amplitude of the signal does not exceed ~4.8 V.

x10 Attenuation: Selected if positive or negative peak amplitudes are greater than ±5.1 V or the peak to peak amplitude of the signal exceeds ~4.8 V.

Auto-Trigger Minimum Amplitude

150 mV pk-pk.

Auto-Trigger Level Accuracy

(Relative to true trigger point)

x1	±30 mV ±1% of trigger level reading
x10	±300 mV ±1% of trigger level reading

Frequency 1 or 2

Range

6×10^{-4} to 235e6

LSD

$LSD = F \times 10^{-D}$

Where: D = Number of digits selected
F = frequency rounded to nearest log decade

Resolution

The resolution is selectable between 3 and 10 digits.

For 3 to 5 Digits	$\text{Resolution} = \pm \text{LSD} \pm \dfrac{1.4 \text{ x TriggerError x Frequency}}{\text{Gate Time}}$
For 6 to 10 Digits	$\text{Resolution} = \pm (2 \text{ x LSD}) \pm \dfrac{1.4 \text{ x TriggerError x Frequency}}{\text{Gate Time}}$

Subject to Notes (i) and (ii) at end of this section.

Best Case Resolution

The following calculations are based upon the assumption that the only contribution to the input noise is that of the input amplifier. Figures shown are for 9 digits selected (i.e. nominal gate time = 1 s) with sinewave input.

Table A-1, Frequency 1 - Best Case Resolution (Hz)

Input Frequency	Input Level			
	50 mV RMS	**100 mV RMS**	**500 mV RMS**	**1 V RMS**
10 Hz	0.0005	0.0003	0.00005	0.00003
100 Hz	0.0005	0.0003	0.00005	0.00003
1 kHz	0.0005	0.0003	0.00005	0.00003
10 kHz	0.0005	0.0003	0.00007	0.00005
100 kHz	0.0007	0.0005	0.0003	0.0002
1 MHz	0.003	0.002	0.002	0.002
10 MHz	0.02	0.02	0.02	0.02
100 MHz	0.2	0.2	0.2	0.2

Accuracy

$\pm$ Resolution $\pm$ Timebase Error $\times$ Frequency

Period 1 or Period 2 (Period Average)

Range

5 ns to 1.7 x 10^3 s

LSD Displayed

LSD = P x 10^{-D}

Where: D = Number of digits selecte.
P = Period rounded up to next log decade

Resolution

For 3 to 5 Digits	$\text{Resolution} = \pm \text{LSD} \pm \frac{14 \text{ x TriggerError x Period}}{\text{GateTime}}$
For 6 to 10 Digits	$\text{Resolution} = \pm(2 \text{ x LSD}) \pm \frac{14 \text{ x TriggerError x Period}}{\text{GateTime}}$

Subject to Notes (i) and (ii) at end of this section.

Accuracy

$\pm$ Resolution $\pm$ Timebase Error $\times$ Period

Ratio 1 over 2

Function

Displays the ratio of the frequency at INPUT 1 to the frequency at INPUT 2, i.e. Frequency1/Frequency2 (1 divided by 2).

Ratio Range

Frequency 1 and Frequency 2 can each be in the range 6 x 10^{-4} Hz to 100 MHz.

LSD

For 6-10 digits selected:

$$\frac{10}{\text{Frequency2 x GateTime}}$$ (Rounded to nearest decade)

Subject to Notes (i) and (ii) at end of this section.

For 3-5 digits selected:

As above; or Ratio X $10^{-(D+2)}$ (where D = Number of digits selected) whichever gives the lesser value.

Resolution

$$\frac{\pm \text{LSD} \pm (1.4 \text{ x Channel2 Trigger Error x Ratio})}{\text{GateTime}}$$

Subject to Notes (i) and (ii) at end of this section.

Accuracy

$\pm$Resolution (higher frequency applied to INPUT 1)

Time Interval (Separate or Common)

Time Range

Common Mode	5 ns to 8 x 105 s
Separate Mode	0 ns to 8 x 105 s

Note: In separate mode, Stop can occur before Start by up to 2 ns in order to ensure that 0 ns is met.

Input Channels Commoned

START	on Input 1
STOP	on Input 1

Input Channels Separate

START	on Input 1
STOP	on Input 2

or

START	on Input 2
STOP	on Input 1

Trigger Slopes

START	Positive or Negative
STOP	Positive or Negative

LSD

1 ns

Resolution

± LSD ± 1ns RMS ± START TRIGGER ERROR[ii] ± STOP TRIGGER ERROR[ii]

Accuracy

± RESOLUTION ± (TIMEBASE ERROR x TI) ± (TRIGGER LEVEL TIMING ERROR[iii])

± 2ns (DIFFERENTIAL CHANNEL DELAY ERROR[iv])

Pulse Width

Measurement Range

5 ns to 20 ms

Input Channel

INPUT 1

Minimum Pulse Height

150 mV $_{pk-pk}$

Trigger Slopes

Positive Pulse:

START	Positive
STOP	Negative

Negative Pulse:

START	Negative
STOP	Positive

Trigger Point

START	50% of measured pk-pk
STOP	50% of measured pk-pk

LSD

1 ns (100 ps with averaging)

Resolution

± LSD ± 1 ns RMS ± START TRIGGER ERROR[ii] ± STOP TRIGGER ERROR[ii]

Accuracy

± RESOLUTION ± (TIMEBASE ERROR x Wp) ± (TRIGGER LEVEL TIMING ERROR[iii]) ± E_{50} / SR^{ST} ± E_{50} / SR^{SP} ± 2 ns (DIFFERENTIAL CHANNEL DELAY ERROR[iv])

Where:

Wp = measured pulse width

E_{50} = Auto Trigger Error

SR^{ST} = Slew Rate of input signal at start

SR^{SP} = Slew Rate of input signal at stop

Rise/Fall Time

Measurement Range

20 ns to 20 ms

Input Channel

INPUT 1 commoned with INPUT 2

Minimum Pulse Height

500 mV pk-pk

Minimum Pulse Width

20 ns at signal peaks

Rise Time Trigger Points

START on +ve slope at 10% of measured pk-pk

STOP on +ve slope at 90% of measured pk-pk

Fall Time Trigger Points

START on -ve slope at 90% of measured pk-pk

STOP on -ve slope at 10% of measured pk-pk

LSD

1 ns (100 ps with averaging)

Resolution

± LSD ± 1 ns RMS ± START TRIGGER ERROR[ii] ± STOP TRIGGER ERROR[ii]

Accuracy

Risetime	± RESOLUTION ± (TIMEBASE ERROR x Tr) ± (TRIGGER LEVEL TIMING ERROR[iii]) ± E_{10} x SR_{ST}[iii] ± E_{90} x SR_{SP}[iii] ± 2ns (DIFFERENTIAL CHANNEL DELAY ERROR[iv])

Fall Time	± RESOLUTION ± (TIMEBASE ERROR x Tf) ± (TRIGGER LEVEL TIMING ERROR[iii]) ± E_{10} x SR_{ST}[iii] ± E_{90} x SR_{SP}[iii] ± 2ns (DIFFERENTIAL CHANNEL DELAY ERROR[iv])

Where:

Tr = measured Rise Time

Tf = measured Fall Time

E_{10} = Error in measuring the 10% point

E_{90} = Error in measuring the 90% point

SR^{ST} = Slew Rate of input signal at start

SR^{SP} = Slew Rate of input signal at stop

Notes and Definitions

Note (i) - Resolution/Aperture

In FREQUENCY, PERIOD, RATIO and DUTY CYCLE modes, the number of significant digits is determined by the aperture or resolution selected (see Table below to determine the number of significant digits. The actual gate time will be extended by up to two periods of the input signal.

The resolution of TIME INTERVAL, PHASE and TOTALIZE measurements is determined by the input signal(s).

Aperture		Resolution	Number of digits (D) [(a)]
From	To		
10s	100s	10	10
1s	9.999s	9	9
100ms	999ms	8	8
10ms	99ms	7	7
1ms	9ms	6	6
1ms[(b)]	9ms	5	5
1ms[(b)]	9ms	4	4
1ms[(b)]	9ms	3	3

Notes:

a) *To avoid unnecessary shifting of digits, the MSD is allowed to exceed the resolution by 1 digit for a 10% over range.*

b) *Included for backword compatibility.*

Note (ii) - Trigger Error

$$Err_{trig} = \frac{\sqrt{e_i^{\,2} + e_n^{\,2}}}{S_{trig}} \quad \text{seconds RMS}$$

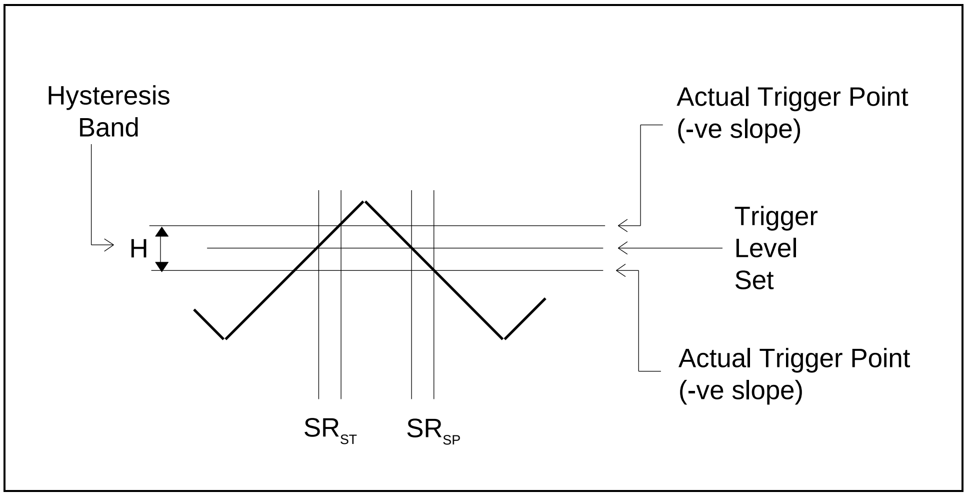
Where: Errtrig = Trigger Timing Error in seconds RMS.

e_i = input amplifier RMS noise (typically 170 □V RMS in 200MHz bandwidth).

e_n = input signal RMS noise in 200MHz bandwidth.

S_{trig} = slew rate of input signal at trigger point (V/s).

Note (iii) - Trigger Level Timing Error (x1 attenuation)



$$\text{TriggerError} = \frac{H}{2} \times \left(\frac{1}{SR^{ST}} - \frac{1}{SR^{SP}}\right)$$

Where: TriggerError = Trigger Level Timing Error (seconds)

H = peak to peak hysteresis band (typically 15 mV for high sensitivity setting and 45 mV for low sensitivity setting All figures at +23° C)

SR^{ST} = Slew Rate of input signal at START

SR^{SP} = Slew Rate of input signal at STOP

Note (iv) - Differential Channel Delay Error

This is an internal systematic error which is typically less than 1ns and can be compensated for by numerical offset (MATH) or by adjusting cable lengths.

Totalize 1 by 2

Input Channel

INPUT 1

Maximum Rate

10^8 events per second

Range

1 to (10^{12} - 1)

Pulse Width

5 ns minimum at actual trigger points

Start/Stop

Channel 2 Pulse

INPUT2 Slope	START	STOP	
POSITIVE		↑	↓
NEGATIVE		↓	↑

Accuracy

±1 count

Totalize 2 by 1

Input Channel

INPUT 2

Maximum Rate

10^8 events per second

Range

1 to (10^{12} - 1)

Pulse Width

5 ns minimum at actual trigger points

Start/Stop

Channel 1 Cycle

INPUT1 Slope	START	STOP	
POSITIVE		↑	↑
NEGATIVE		↓	↓

Accuracy

± 1 count

Manual Totalize 1

Input Channel

INPUT 1

Maximum Rate

10^8 events per second

Range

1 to (10^{12} - 1)

Pulse Width

5 ns minimum at actual trigger points

Start/Stop

Manual using “ri2461e_openCloseGate” function.

Accuracy

±1 count

Manual Totalize 2

Input Channel

INPUT 2

Maximum Rate

10^8 events per second

Range

1 to (10^{12} - 1)

Pulse Width

5 ns minimum at actual trigger points

Start/Stop

Manual using “ri2461e_openCloseGate” function.

Accuracy

± 1 count

Phase 1 Relative to 2

To make this relative phase measurement, the FTIC first makes a series of measurements in different modes:

1. Ratio 1/2 to ensure that 1 and 2 are at the same frequency.
2. Period 1 (P_1).
3. Time Interval 1 to 2 (TI_{1-2}).

The phase difference Φ_{1-2} is then calculated as follows:

$$\Phi_{1-2} = \frac{TI_{1-2}}{P_1} \times 360°$$

Frequency Range

Frequency 1 and Frequency 2 can each be in the range 6×10^{-4} Hz to 100 MHz.

Phase Range

0.1 ° to 360 °

LSD

Fin ≤ 1 MHz	0.1°
1 MHz < Fin ≤ 10 MHz	1°
10 MHz < Fin ≤ 100 MHz	10°

Resolution

$$\pm LSD \pm \frac{\text{TI Resolution}}{\text{Period1}} \times 360°$$

Accuracy

$$\pm LSD \pm \frac{\text{TI Accuracy}}{\text{Period1}} \times 360°$$

Notes:

1. *A constant signal is required during a phase measurement.*
2. *A phase measurement will nominally take 160 ms at 100 MHz and 4 s at 1 Hz.*

Phase 2 Relative to 1

To make this relative phase measurement, the FTIC first makes a series of measurements in different modes:

1. Ratio 1/2 to ensure that 2 and 1 are at the same frequency.
2. Period 2 (P_2).
3. Time Interval 2 to 1 (TI_{2-1}).

The phase difference Φ_{2-1} is then calculated as follows:

$$\Phi_{2-1} = \frac{TI_{2-1}}{P_2} \times 360^\circ$$

Frequency Range

Frequency 1 and Frequency 2 can each be in the range 6 x 10^{-4} Hz to 100 MHz.

Phase Range

0.1° to 360°

LSD

Fin ≤ 1 MHz	0.1°
1 MHz < Fin ≤ 10 MHz	1°
10 MHz < Fin ≤ 100 MHz	10°

Resolution

$$\pm LSD \pm \frac{TI\ Resolution}{Period\,2} \times 360^\circ$$

Accuracy

$$\pm LSD \pm \frac{TI\ Accuracy}{Period\,2} \times 360^\circ$$

Notes:

1. *A constant signal is required during a phase measurement.*
2. *A phase measurement will nominally take 160 ms at 100 MHz and 4 s at 1 Hz.*

DVM Function

The instrument is able to measure the positive peak, the negative peak, or the DC voltage of signals applied to IN1 or IN2. To do this it makes use of the auto-trigger capabilities.

Positive (VHIGH) or Negative (VLOW) Peak

Peak Measurement Range

-42 V to +42 V

(x1 or x10 attenuation automatically selected as necessary)

Minimum Amplitude

150 mV peak to peak

LSD

0.5 mV

Resolution

x1	± 2.5 mV nominal
x10	± 25 mV nominal

Accuracy:

x1	± 6% Vpk-pk ± 50mV
x10	± 10% Vpk-pk ± 500mV

Where Vpk-pk is the Peak to Peak measurement

DC Value (VMID)

This function returns a value equal to the mean perceived peak values. If AC content is below 150 mV pk-pk then the perceived DC voltage is returned.

Measurement Range

-42 V to +42 V

(x1 or x10 attenuation automatically selected as necessary)

LSD

0.5 mV

Resolution

x1	± 2.5 mV nominal
x10	± 25 mV nominal

Accuracy:

x1	± 6% Vpk-pk ± 50mV
x10	± 10% Vpk-pk ± 500mV

Where Vpk-pk is the Peak to Peak measurement.

Time Interval Delay

Hold off Time

192 µs to 1.04856 s

Step Size

16 µs

Accuracy

± 50 µs ± 0.1% reading

Note: *The delay is also available on Input 2 when totalizing.*

Read Rate

Frequency Measurements:

588 readings per second max. under the following conditions:

- Resolution ≤ 6 digits
- Continuous trigger
- Auto-trigger OFF (both channels),
- Input freq. ≥10 kHz.

Time Interval Measurements:

1,248 readings per second max. under the following conditions:

- Resolution ≤ 6 digits
- Continuous trigger
- Auto-trigger OFF (both channels)
- Input freq. ≥10 kHz.
- TI ≤ 1 ms

Averaging

This user selectable function can give improved resolution.

Number of Samples	100
Availability	Frequency 1 Frequency 2 Period 1 Period 2 Time Interval 1 to 2 Time Interval 2 to 1 Ratio 1/2 Phase 1 relative 2 Phase 2 relative 1 Rise Time Fall Time Positive Pulse Width Negative Pulse Width Duty Cycle 1
Resolution Improvement	The resolution obtained with these functions will be 1 digit more than without averaging selected. The maximum resolution available remains at 10 digits.
Minimum LSD on Time Interval	0.1 ns

Math Function

The following algorithm can be invoked:

$$\frac{(result - offset)}{scale}$$

Offset Range	0, -10×10^{-9} to 10×10^{9}
Scale Range	-10×10^{-9} to -10×10^{9}

Notes

1. *Any number exceeding the allowed range for Offset or Scale will result in an error being reported.*
2. *Any number exceeding the display range will result in an error being reported.*
3. *The Math Function is not available on CHECK, PHASE, PULSE WIDTH, RISE/FALL TIME, VMID, VHIGH, VLOW.*

Frequency Standard

The FTIC requires a 10MHz frequency standard in order to function. This can be derived from the PXI_CLK10 signal on the backplane, from an external 10MHz standard connected to the front panel, or from an internally installed crystal oscillator. The default setting is ‘PXI_CLK10’. A buffered version of the standard in use is available at the front panel 'STD OUT' connector.

Internal Standard Output

Frequency	10 MHz
Output Configuration	LSTTL with 47 Ω Series resistor
Drive Level	V_{OH} 2.6 V min. at -400 μA V_{OL} 0.6 V max. at 8 mA The output is also capable of driving 1 Vpk-pk min, into 50 Ω
Maximum Reverse Input (CAUTION)	Tested to ±5 V without damage
Connector	MCX female

External Standard Input

Frequency	10 MHz
Signal Level	100 mV_{RMS} sinewave minimum, 10 V_{RMS} maximum.
Maximum Input Level (CAUTION)	10 V_{RMS}, or +15 V or –15 V peak
Input Impedance	1 KΩ nominal for signals less than 1 V_{pk-pk} decreasing to 500 Ω nominal for signals 10 V_{pk-pk} and above
Coupling	AC
Connector	MCX female

External Arming

All functions (with the exception of PHASE and CHECK) can be armed by means of an EXT ARM input connector. The various modes can be selected via special functions.

External Arming Sources

'EXT ARM' input (front panel); PXI 'TRIG0-7' (user selectable).

EXT ARM Input

Input Impedance	1 KΩ nominal
Coupling	DC
Input Levels	Vil maximum 0.4 V Vih minimum 2.4 V

Maximum Input Level	10 V $_{RMS}$, or +15 V or -15 V peak
Connector	MCX female

ARM Modes

Mode	Start	Stop
1	INTERNAL	INTERNAL
2	_|‾	INTERNAL
3	‾|_	INTERNAL
4	INTERNAL	_|‾
5	INTERNAL	‾|_
6	_|‾	_|‾
7	_|‾	‾|_
8	‾|_	_|‾
9	‾|_	‾|_

Timing Requirements

Minimum START to STOP Time: 200 ns

Resolution

This is set as follows:

External Gate Time Start to Stop:

Gate Time (Tg)	Number of Meaningful Digits Returned
Tg < 100 µs	4
Tg < 1 ms	5
Tg < 10 ms	6
Tg < 100 ms	7
Tg < 1 s	8
Tg < 10 s	9
Tg > 11 s	10 (maximum available)

Gate Output

The measurement gate pulse can be made available (user selectable) on any one of the PXI trigger lines PXI_TRIG0 to 7, or on none of these.

Front Panel Components

Indicators

Table A-2, Front Panel Indicators

Channel 1 Trigger LED	This amber LED flashes to indicate that Channel 1 is triggering.
Channel 2 Trigger LED	This amber LED flashes to indicate that Channel 2 is triggering
Gate LED	This green LED lights when the measurement gate is open.
Access LED	This amber LED lights when there is a PXIe access.
Fail LED	This red LED (if permanently on) indicates a unit failure.

Connectors

Table A-3, Connectors

Label	Function	Type
IN 1	Channel 1 input	BNC Female
IN 2	Channel 2 input	BNC Female
VT1	Channel 1 trigger voltage output	MCX Female
VT2	Channel 2 trigger voltage output	MCX Female
ARM	External ARM input	MCX Female
STD OUT	Standard in-use output	MCX Female
STD IN	External Standard input	MCX Female

Power Supply

Peak and Dynamic Module Current Contributions

Supply Rail	I_{Pm} (A)	I_{Dm} (A)
+12 V	1.4	1.2
+3.3 V	0.5	0.45

*OCXO or TCXO contributes 65mA to I_{Pm} on +24V rail, negligible to I_{Dm}.

Power Absorbed

Max. power absorbed	31 W

Environmental Conditions

All environmental conditions tested to MIL-PRF-28800F, Class 3

Temperature Operating Non-operating	 0° C to +50° C -40° C to +71° C
Relative Humidity	5% to 95% RH non condensing ≤ 30° C 5% to 75% RH above 30° C 5% to 45% RH above 40° C
Altitude Operating Non-Operating	 15,000 ft maximum 15,000 ft maximum
Shock	30 g peak, half sine, 11 ms pulse
Vibration	5 to 500 Hz
Bench Handling	4-inch drop at 45°
Cooling Requirements (10°C temp. rise) Min. Flow Rate	4 l/s

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