MP1X0 VI Library

The MindWare MP1X0 VI Library developed by MindWare Technologies Ltd. is a LabVIEW™ VI library written for developers that want to directly control and acquire data from the **BIOPAC** MP100/150 USB instruments from **BIOPAC** Systems Inc**.** Provided in this library are both high and intermediate level functions that allow the programmer to integrate digital control, analog output and input functions into their own applications. The high level functions (with white icons) can be executed immediately to obtain data or implement control functions. The intermediate level functions (with blue icons) can be used to implement more advanced functionality.

The Library was developed using LabVIEW™ 6.02 and is compatible with Windows ME/2000 and XP operating systems. Communications with the BIOPAC hardware is established using the USB to Serial Adapter. The use of the library requires two available USB ports; one for the communications adapter and the other for the required USB key (provided with purchase of VI Libarry). The USB key can be inserted into a USB hub if the ports are not available on the computer. The minimum recommended development platform is a Pentium III 500Mhz with 128MB Ram running LabVIEW™ 6.0 or later.

The analog input VI's give the developer the ability to collect signals from any number of BIOPAC amplifiers up to maximum of 16 analog inputs. Both single-point and multi-point modes are supported. Data can be collected from any combination of amplifiers or analog inputs available on the UIM100. Data collection can also be initiated via external triggering using the provided trigger input on the UIM100.

The digital VI's give the developer the ability to read or write to any one of the 16 digital lines. The library also includes VI's to write to either of the two digital to analog converter ports (DAC) on the MP100/150. A single analog voltage may be written out the DAC's for stimulus and control applications.

Along with the discrete functions detailed above, there are also some high-level examples that are included. These examples are installed into the LabVIEW 6/examples/MP1X0 Examples directory. These examples can serve as a good starting point for developing your own application since they can be easily modified to meet your needs. These examples include a multi-point chart recorder with data streaming, d/a ramping controller, digital input/output, and an application to verify the system is operational called Test MP1X0 IO.vi.

Error checking is integrated into the VI's, if an error occurs a unique error code will be generated. These codes can be looked up in the table in Appendix B to assist troubleshooting. The VI's are documented within this manual and within the VI's themselves. You can get information about front panel controls and indicators by turning on LabVIEW™ help (Ctrl-H) and moving the cursor over each front panel object or you can get information about the entire VI by moving the cursor over the icon of the object in the front panel or in the diagram. To view online documentation right-click on icon in the front panel select VI properties/documentation.

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IMPORTANT! Do Not Connect The USB Key Until Instructed To … Please Read This Section First.

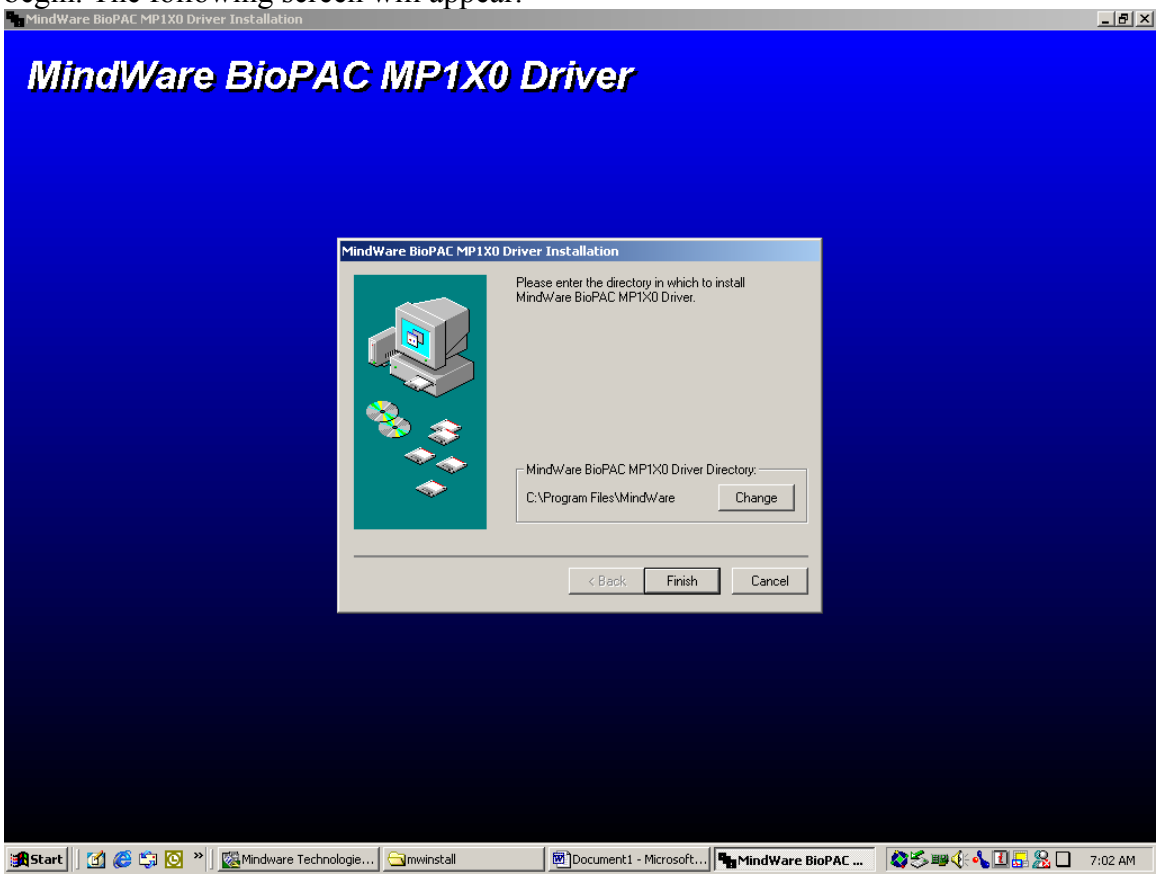
Section 1: Installation

Before installing this product please install a USB capable version of AcKnowledge™ and test that the system is functional. By doing so you will verify that your hardware is properly configured and the required drivers are installed. You must also have LabVIEW™ 6.0 or greater installed as the installation program must copy the library and support dll's into the vi.lib and user.lib folders .

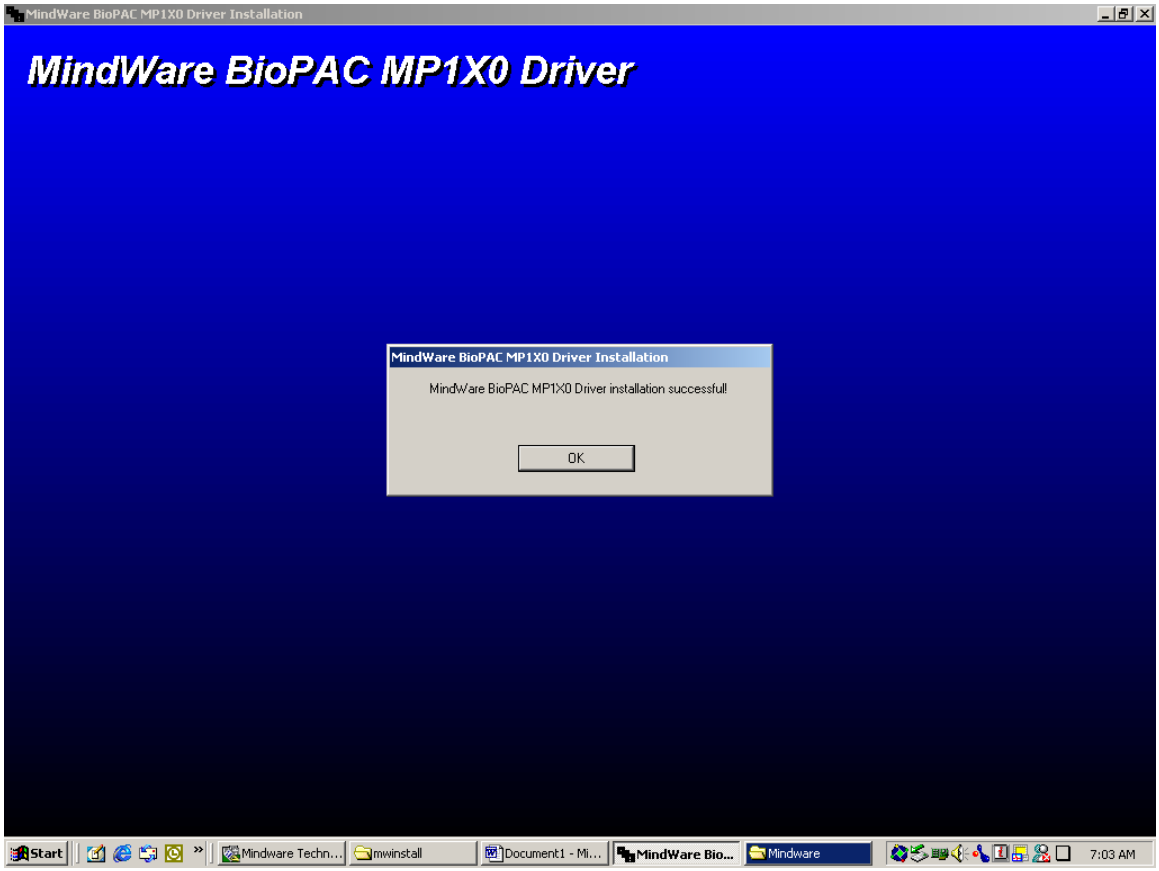
1A: Installation and Setup

It is important that you follow this detailed procedure when installing the VI Library and the USB key. Failure to follow this will require you to uninstall then reinstall the product as well as having to remove the USB key from your Device Manager. Only after the software drivers and library has been installed should you turn off the computer and install the key.

Step 1: Place the installation disk in your cd drive. Double-click on the Setup icon to begin. The following screen will appear.

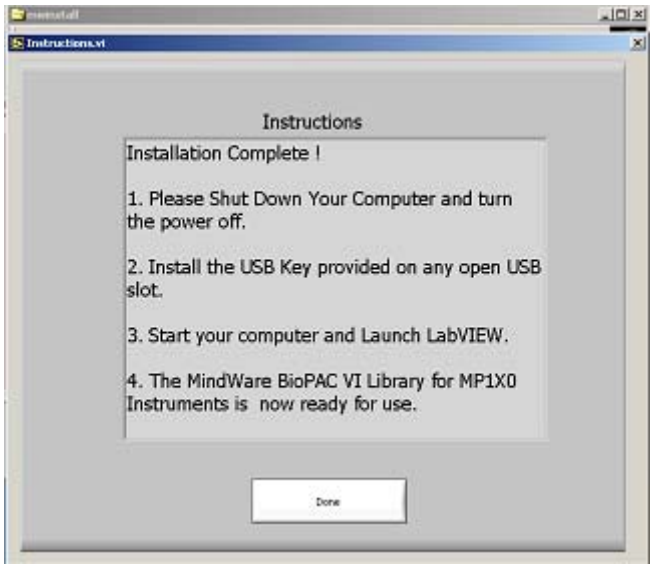


Step 2: Select Finish and allow the software installation to begin.
Step 3:The following screen will appear. Select OK.



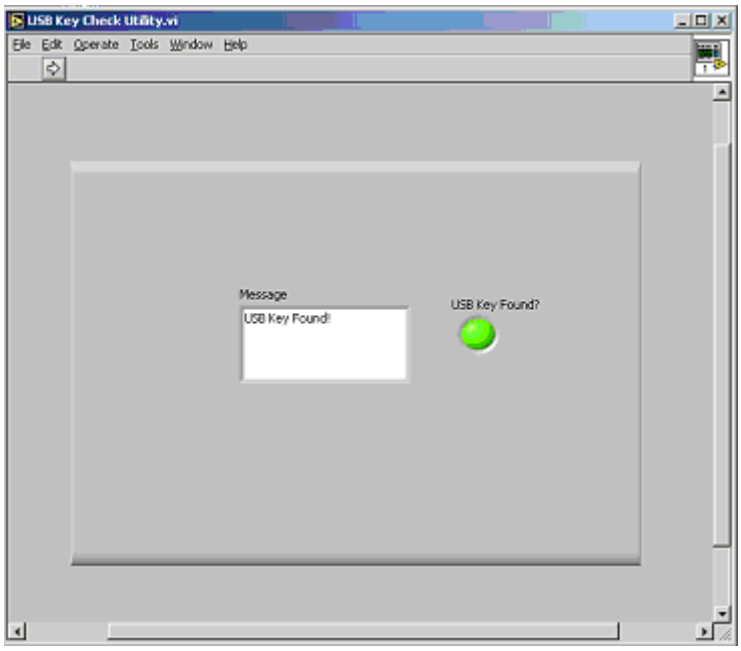
Step 4: Installation Compete Indicator

Important!!! Follow these instructions to complete the installation.



Step 5: Verifying Successful Installation

Installed in the MindWare program group will be an application titled USB Key Check Utility. Run this application to verify that the drivers and dll's have been properly installed.



1B: Verifying USB and VI Library Installation

Once the Found new Hardware Wizard has completed, all of the required drivers, dll's, and vi library have been installed. It is recommended that you run the USB Key Check application located in the MindWare program group to verify that the installation was a success. This application simply checks for the presence of the USB key. If the message "USB Key Found" is displayed in the window the installation was a success. If this is not the case, Run the "Add or Remove " function found in the control panel and remove the installation. You will also need to remove the USB device using the Device Manager under the Universal Serial Bus Controller group.

The MindWare MP1X0 Library is installed in the user.lib under your LabVIEW™ 6.0 installation directory and the dll's are located in the vi.lib folder . To gain access to the VI's, simply right-click on the User Libraries icon and the MindWare BIOPAC VI Library will appear. Simply add these vi's to your diagram as needed.

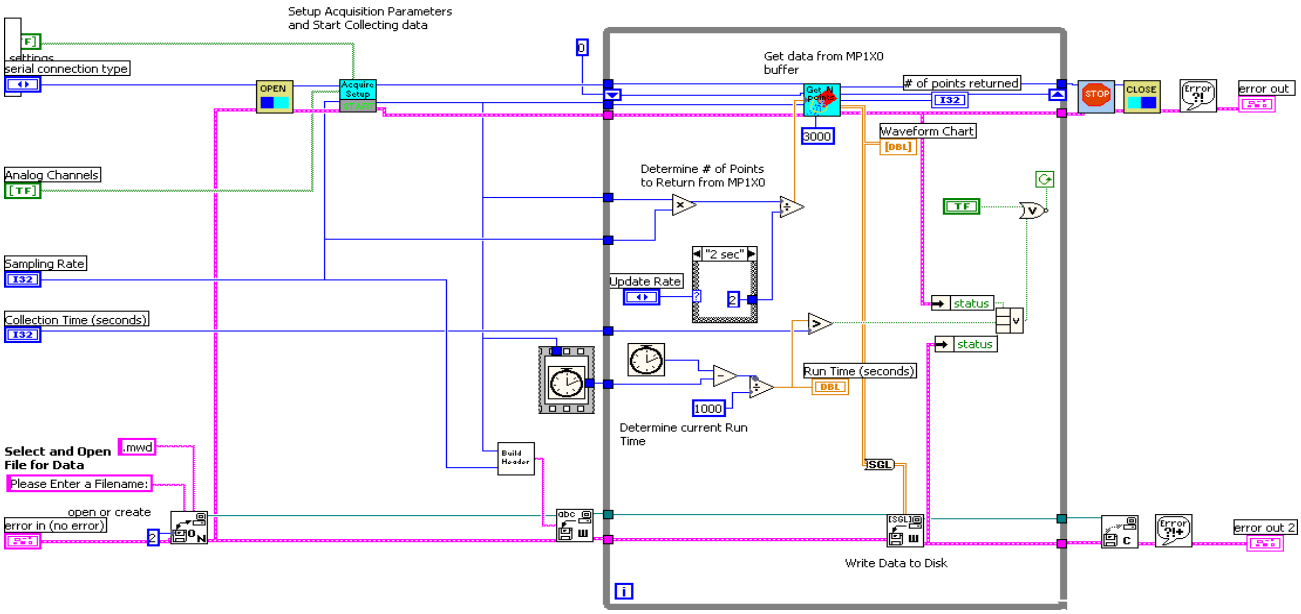
There are also several programming examples supplied to illustrate how to incorporate the various functions into your own application. The examples are located in the Examples folder under LabVIEW™. The will be installed in a folder named MindWare MP1X0 Examples. You are now ready to begin creating your own custom applications.

Section 2: Examples

There are 7 example applications that demonstrate the correct method of accessing the MP1X0 hardware. The examples are complete and functional and can serve as a good starting point for your own applications.

Example 1: Multi Point Acquisition And Stream To Disk Example

This example illustrates how to collect data from multiple channels, display it to a chart and stream it to a file. It is trigger-enabled meaning that data collection can be synchronous to an external event. By entering a time in the Collection Time control, data will be collected for the time specified The update rate is also selectable allowing the application to fetch smaller segments of data from the MP1X0. This helps to increase the efficiency of the data exchange between the PC and the BIOPAC hardware as well as allowing the display to act more like a strip chart recorder.



Controls and Indicators

serial connection type This control specifies the method you are communicating with the MP100 or MP150.

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

stop Hitting this button will stop the VI programmatically and end data collection.

Analog Channels

This control determines which channels to collect data from. When the Boolean switch is in the up or "true" state that channel will be collected. You must specify at least one channel or will receive an error message.

Sampling Rate This control tells the MP1X0 how fast to sample in samples/second

trigger settings

MSB4

Update Rate This control determines the size of data read from the MP1X0 and thus how fast the chart will be updated. The actual update rate will vary depending on machine performance and instrument limitations. This is an approximation

Collection Time (seconds) This control sets the length of time to record data

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

# of points returned

Waveform Chart

Run Time (seconds) This is the approximate running time(in seconds) for the VI and how long it has been collecting data. When Run Time exceeds Collection Time control the VI will stop collecting data

error out 2 The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** numeric identifies the error or warning.

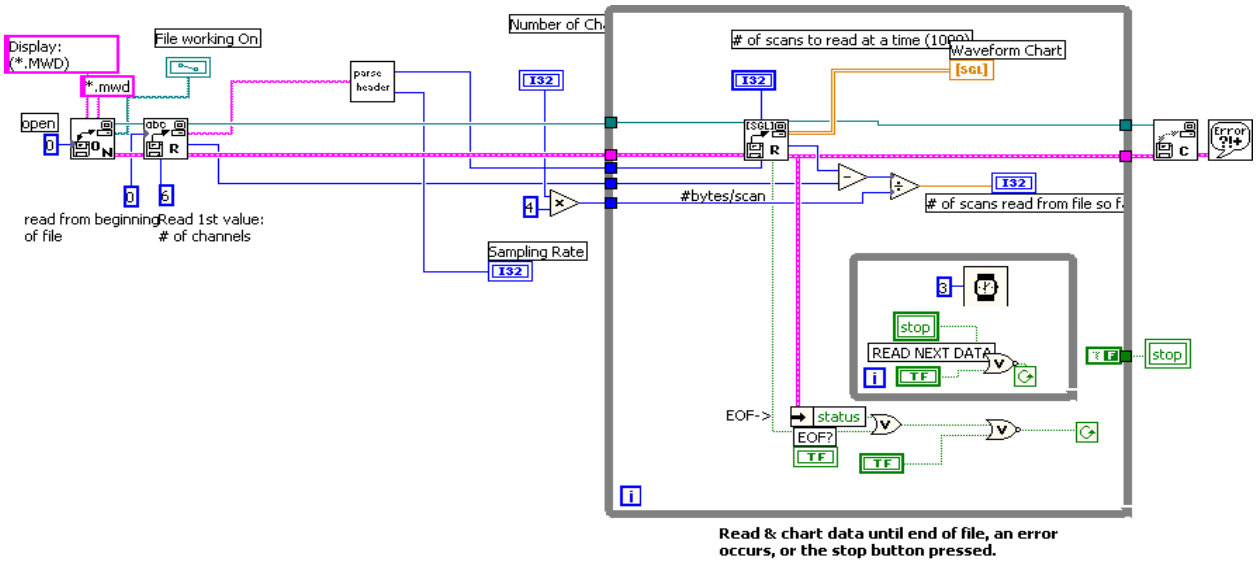
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Example 2: Read Data From Disk Example

This example illustrates how to open and read the contents of a data file collected by using the Multi Point Acquisition And Stream To Disk Example. By setting a value in the # of Scans to Read control, data will be read and returned by indexing in this data size. The Read next Data control allows you to continue through the file until an EOF is detected.



stop Hitting this button will stop the VI programmatically and end data read.

# of scans to read at a time (1000) Enter the minimum number of scans to read and display from the file at each loop iteration. Default is 1000 scans.

READ NEXT DATA This control allows VI to read the next segment of data from the selected file. The size of the "chunk" is determined by the " # of scans to read" control

Number of Channels in File This shows the number of channels of data in the file.

# of scans read from file so far This shows the total number of scans read from the file so far.

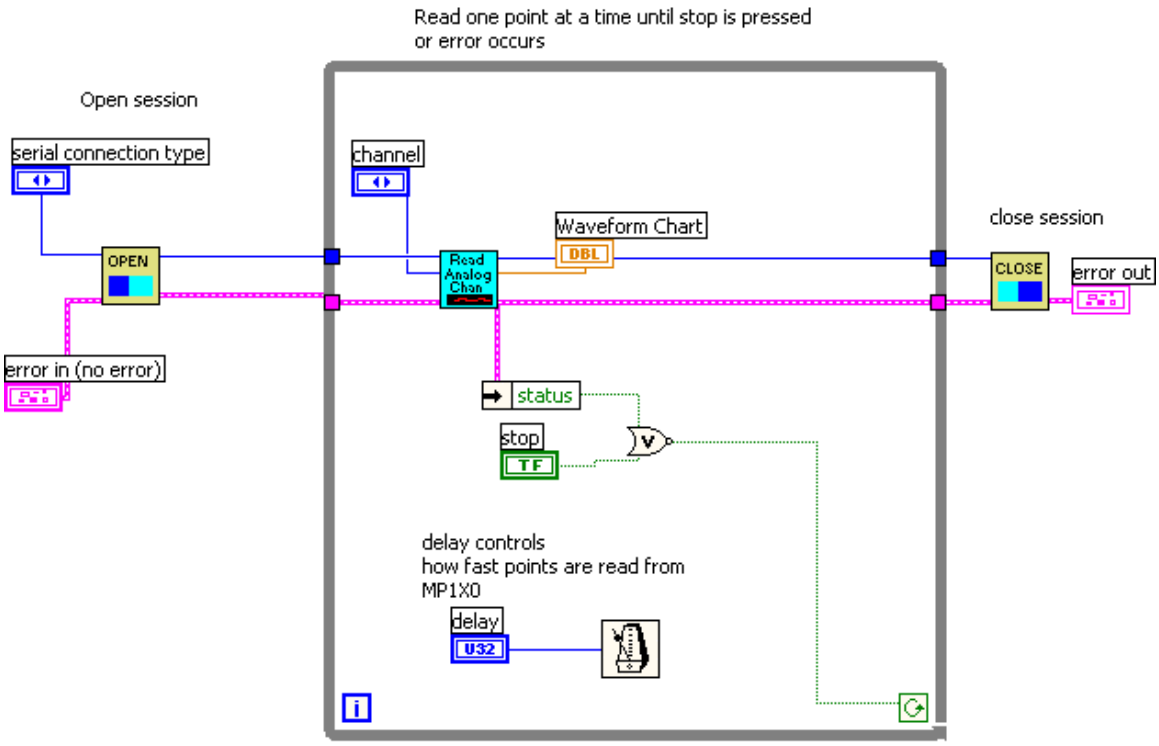
Sampling Rate Shows Sampling rate that data was acquired at in file being read

Waveform Chart Displays data read from file,
File working On This indicator displays path to current file being read

EOF? EOF? is TRUE if you attempt to read past the end of file.

Example 3: Single Point Acquisition To Chart Example

This example returns a data point from the specified channel. The channel number to read from is listed in the Channel control. Channel numbers may be dynamically changed as this VI executes..



stop Hitting this button will stop the VI programmatically and ends data collection.

serial connection type This control specifies the method you are communicating with the MP100 or MP150 with.

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

delay specifies how long to wait in ms before reading next point

channel Specifies which channel to read

Waveform Chart

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

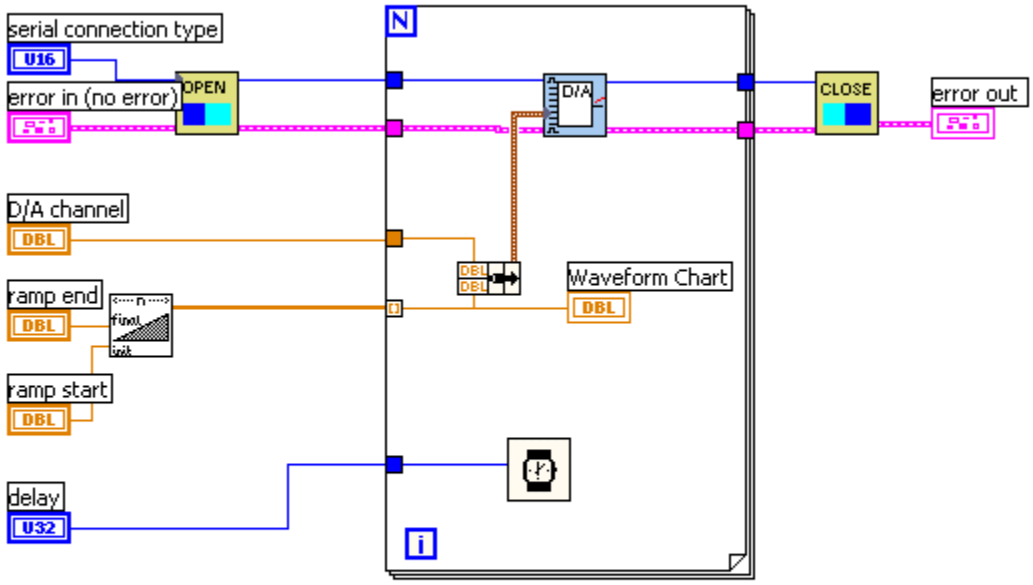
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Example 4: D/A Ramp Example

This example illustrates how to output data to one of the two analog outputs. There are programmable start and stop voltages which define the output voltage ranges. There is also a programmable delay that allows you to time out between subsequent voltage outputs.



DBL **D/A channel** This specifies the DAC channel to use on the MP1X0

DBL **ramp end** is the ending value, or final value of **Ramp Pattern**. The default is zero.

DBL **ramp start** is the starting value, or first value of **Ramp Pattern**. The default is zero.

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

TF **status** The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

serial connection type This control specifies the method you are communicating with the MP100 or MP150 with.

delay specifies how long to wait in ms before reading next point

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

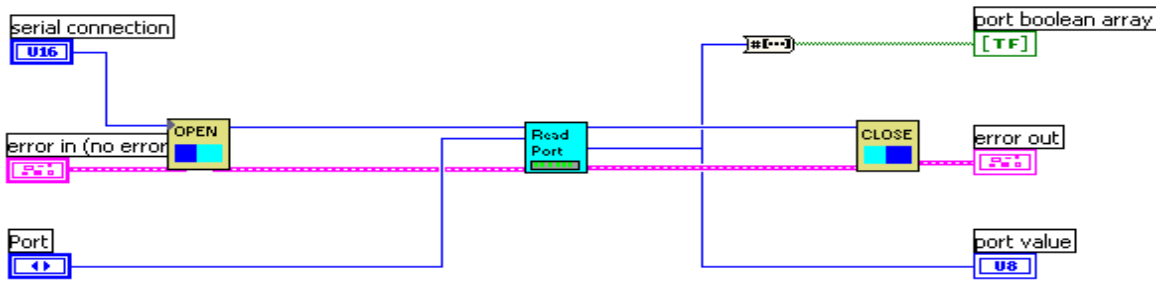
source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Waveform Chart Displays the voltage output.

Example 5: Simple Digital Read Example

This example how to do a digital read from either digital ports. The digital port is selectable. Data are returned in two formats, the binary value is shown in the port Boolean array and the numeric representation is shown in port value.



Port specifies which port to write on the MP1X0, port a is bits 0-7 and port b bits 8-15

serial connection This control specifies the port you are using to communicate with the MP1XO with

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

port Boolean array This is a Boolean array representation of the port status

port value numeric representation of port status

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

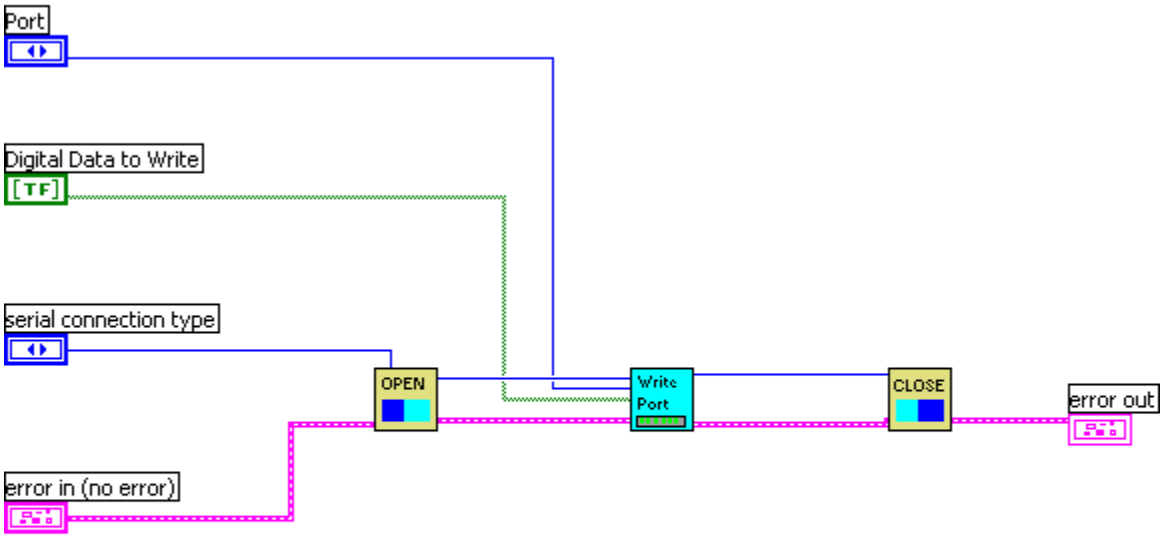
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Example 6: Simple Digital Write Example

This example illustrates how to write a single or 8-bit value out the digital ports.



serial connection type This control specifies the port you are using to communicate with the MP1XO with

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Port specifies which port to write on the MP1X0, port a is bits 0-7 and port b bits 8-15

Digital Data to Write Digital representation of value to write to port

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

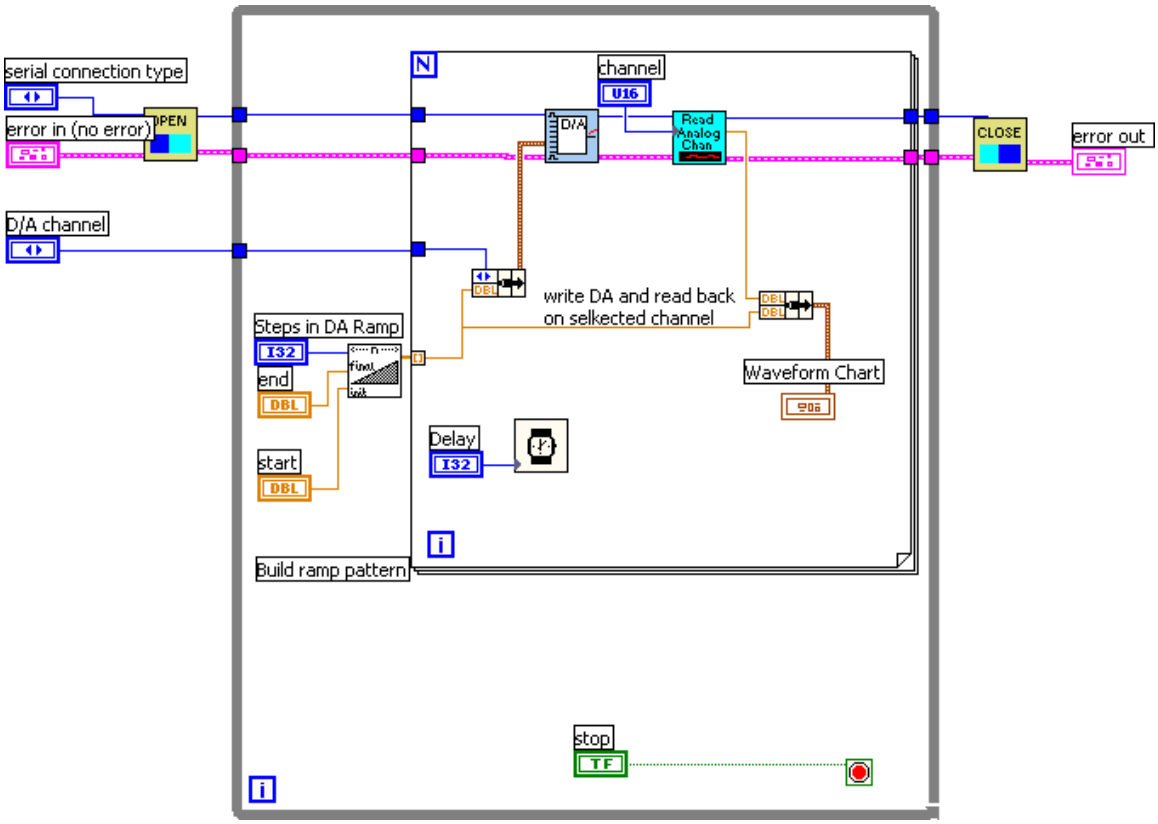
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Example 7: Test MP1X0 IO Example

This example allows you to test the analog and digital functions of the MP1X0. By using the supplied test cable (mini-phone mono to mini-phone mono) you can connect the output of one of the DAC's to any one of the analog inputs to use as a test signal. The output voltage range and update rate is selectable as well as the analog channel you want to test. This VI can be used to verify system functionality as well show how to combine intermediate level functions to perform multiple task. If you cable the output of one of the D/A outputs and feed that back into one of the analog inputs you should see two traces on your screen. One will be the predicted or calculated value of the DA output and one will be the actual measured value of this value.



D/A channel Specifies which DA channel to use on MP1X0

end is the ending value, or final value of **Ramp Pattern**. The default is zero.

start is the starting value, or first value of **Ramp Pattern**. The default is zero.

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

stop stops vi, *note will not stop vi until for loop completes

Steps in DA Ramp This determines how many steps are in the ramp

Delay determines the delay between steps

serial connection type This control specifies the port you are using to communicate with the MP1XO with

channel Specifies which channel to read

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

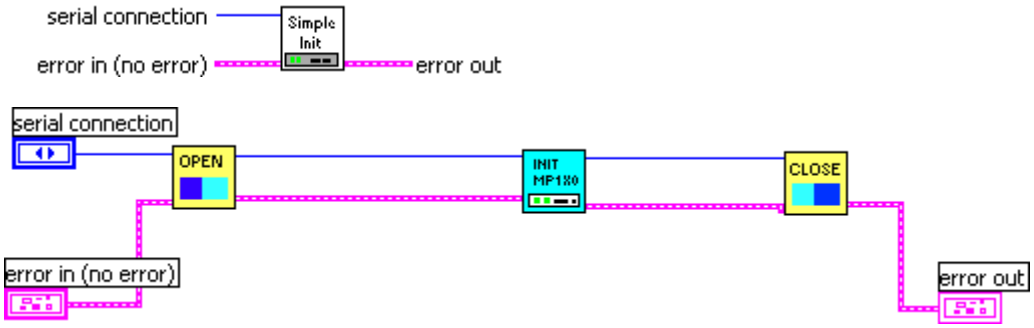
Waveform Chart

Section 3: VI Functions

Simple Initialize.VI

Simple Iniatilize.vi
This VI is a high level VI that will initialize the MP100/150

Connector Pane



Controls and Indicators

serial connection This control specifies the method you are using to communicate with the MP1X0

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

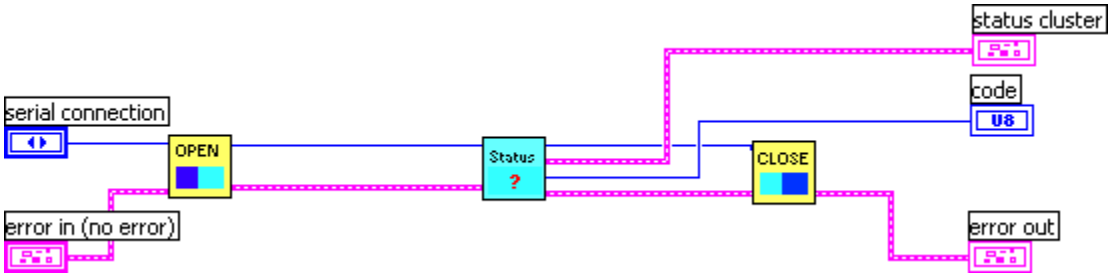
source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Simple Get Status.VI

Simple Get Status.vi
This VI returns the current status of the MP100/150

Connector Pane



Controls and Indicators

serial connection This control specifies the method you are using to communicate with the MP1X0

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status cluster This cluster contains a string and code indicating the current state of the MP100/150

status code

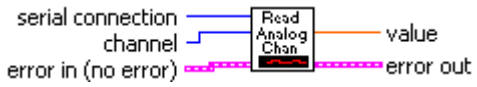
status string

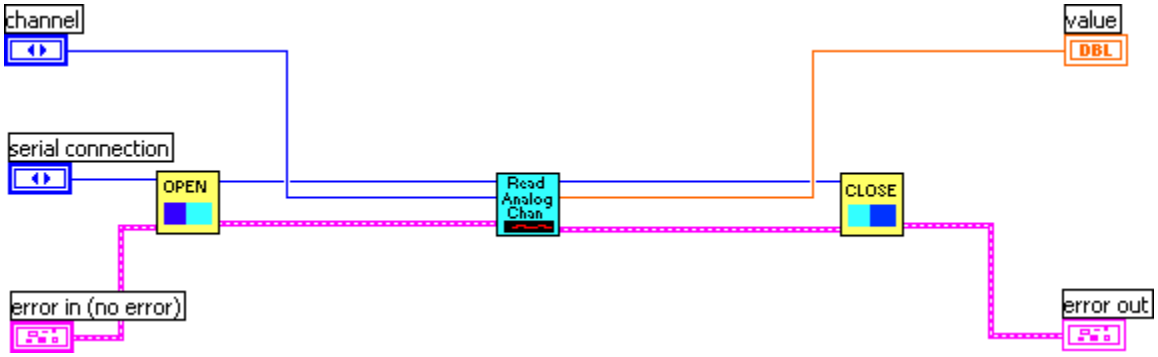
code Status code for MP100/150

Simple Read Analog Channel.VI

Simple Read Analog Channel.vi
This high level VI returns one point from the selected channel.

Connector Pane





Controls and Indicators

channel Specifies which channel to read

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

serial connection This control specifies the method you are using to communicate with the MP1X0

error out The **error out** cluster passes error or warning information out of a VI to be

used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

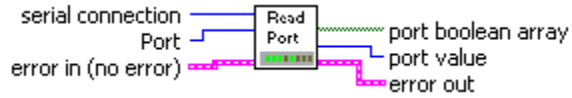
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

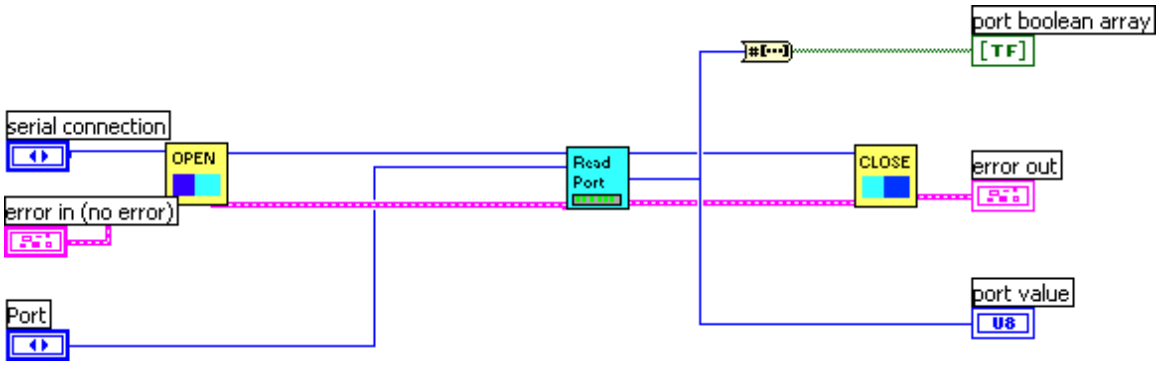
value This is the value in volts read from the indicated channel

Simple Digital Read.VI

Simple Digital Read.vi
This high level function reads the status of the indicated port and returns it as a numeric value and a Boolean array

Connector Pane

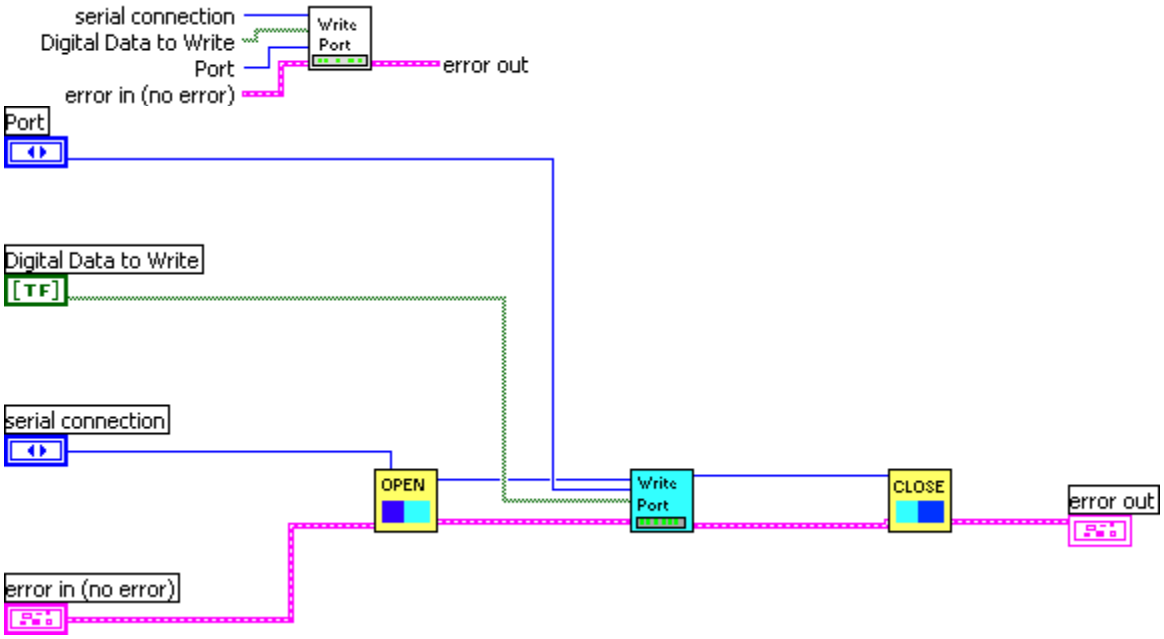




Simple Write Digital Port.VI

Simple Write Digital Port.vi
This high level function writes the Boolean value to the indicated port

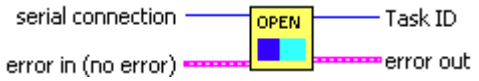
Connector Pane

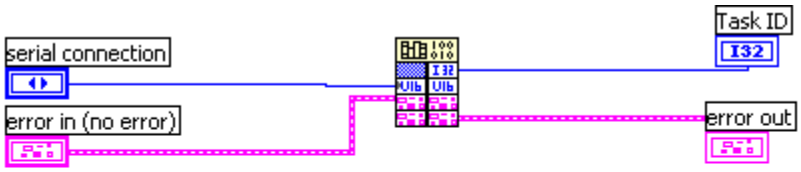


Open Session.VI

Open Session.vi
This VI opens a session for intermediate level calls. This VI returns a Task ID that is required by subsequent calls to intermediate level VI's. See MP1X0 examples or high-level functions in the library for examples of how to use this VI.

Connector Pane





int32 OpenHandle(uInt16 serialConnectionType, TD1 *errorInNoError, TD1 *errorOutNoError)

Controls and Indicators

serial connection This control specifies the method you are using to communicate with the MP1X0

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

error out The **error out** cluster passes error or warning information out of a VI to be

used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

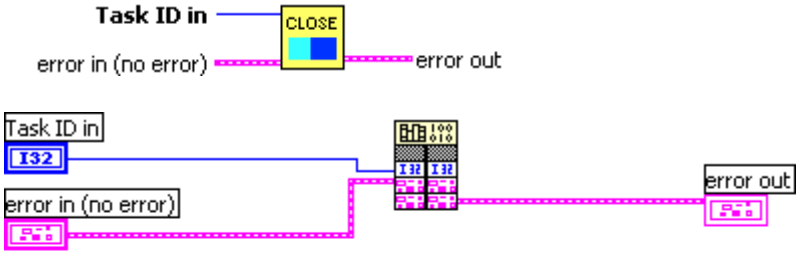
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID

Close Session.VI

Close Session.vi
This VI close the session opened by Open Session.vi. Task ID is a required input. See examples or high-level functions for examples of how to use this VI.

Connector Pane



void CloseHandle(int32 Handle, TD1 *errorIn, TD1 *errorOut)

Controls and Indicators

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID in Current Task ID, this number is returned by calling Open Session.vi

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the

error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

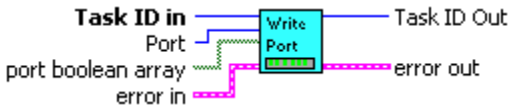
source The **source** string describes the origin of the error or warning.

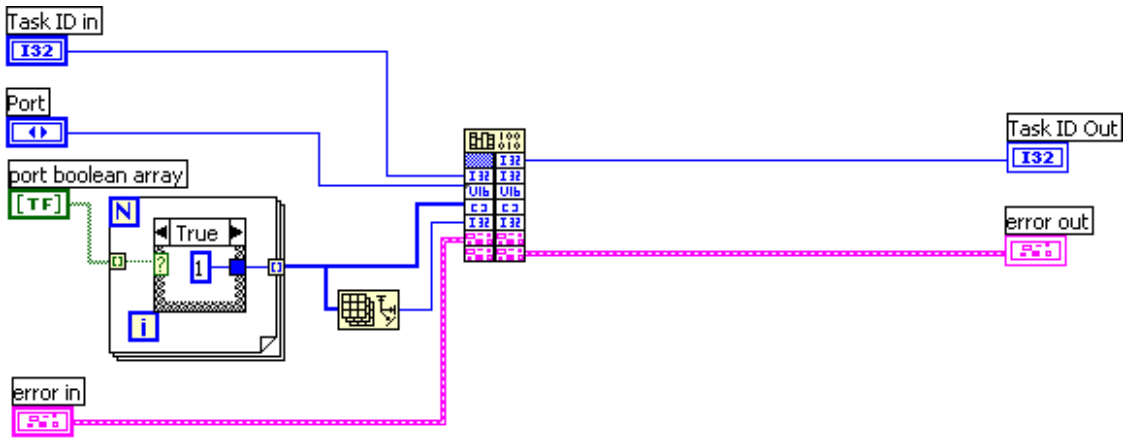
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Write Digital Port.VI

Write Digital Port.vi
This intermediate level function writes the Boolean value to the indicated port. Task ID is a required input.

Connector Pane





int32 WritePort(int32 HandleIn, uInt16 Port, LVBoolean portBooleanArray[], int32 len, TD1 *errorIn, TD1 *errorOut)

Controls and Indicators

port Boolean array Digital value to write represented as a Boolean array

Port specifies which port to write on the MP1X0, port a is bits 0-7 and port b bits 8-15

error in The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID in Current Task ID, this number is returned by calling Open Session.vi

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

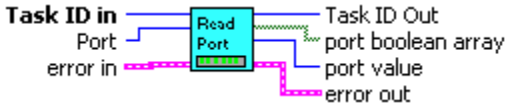
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

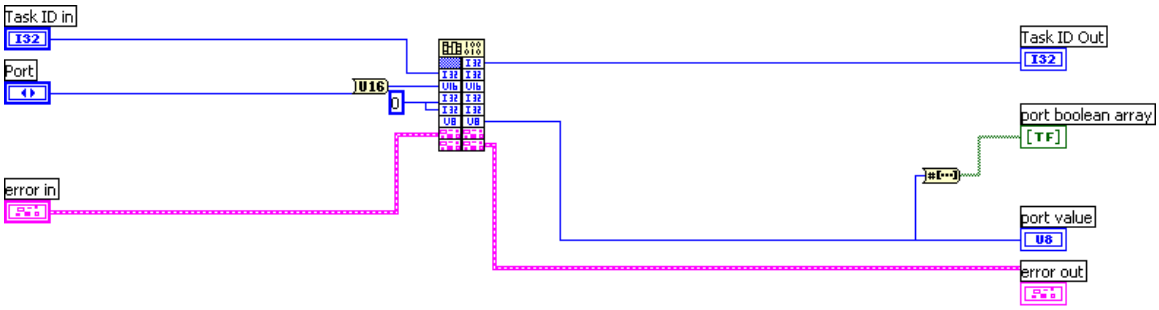
Task ID Out Current Task ID

Read Digital Port.VI

Read Digital Port.vi
This intermediate level VI is used to read the specified digital port on the BIOPAC MP1X0. Task ID is a required input.

Connector Pane





int32 ReadPort(int32 HandleIn, uInt16 Port, LVBoolean portBooleanArray[], int32 len, uInt8 *portValue, TD1 *errorIn, TD1 *errorOut)

Controls and Indicators

Port specifies which port to write on the MP1X0, port a is bits 0-7 and port b bits 8-15

error in The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID in Current Task ID, this number is returned by calling Open Session.vi

port value numeric representation of port status

port Boolean array This is a Boolean array representation of the port status

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

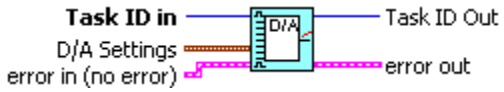
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

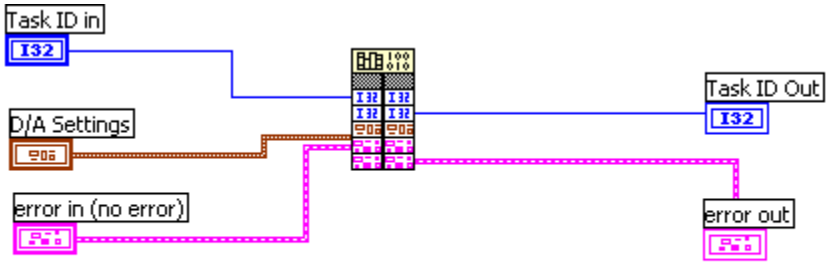
Task ID Out Current Task ID

Write DA.VI

Write DA.vi
This intermediate level VI writes the voltage input to the specified DA port. Task ID is a required input.

Connector Pane





void WriteDAC(int32 HandleIn, int32 *HandleOut, TD1 *DASettings, TD2 *errorIn, TD2 *errorOut)

Controls and Indicators

D/A Settings This control specifies which DA port to write and the voltage to write to it.

D/A channel

Voltage to Write

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID in Current Task ID, this number is returned by calling Open Session.vi

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

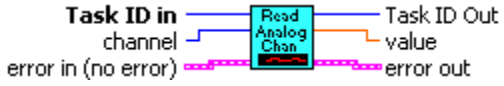
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

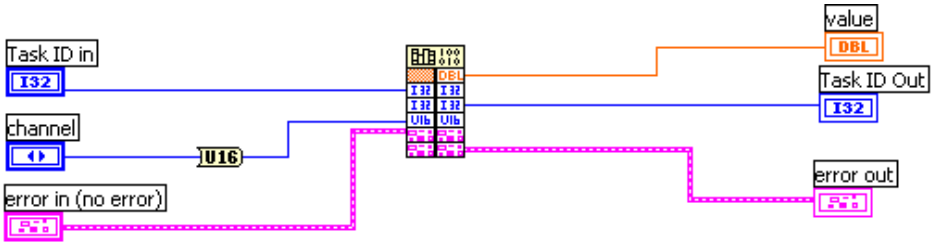
Task ID Out Current Task ID

Read Analog Channel.VI

Read Analog Channel.vi
This intermediate level VI reads one point from the specified analog channel. Task ID is a required input. See the example Single Point Acquisition to Chart Example.vi for a demonstration of how to use this VI. This VI is intended for low speed data acquisition applications.

Connector Pane





float64 Read1PointFromAnalogChannel(int32 HandleIn, int32 *HandleOut, uInt16 channel, TD1 *errorInNoError, TD1 *errorOut)

Controls and Indicators

I32 **Task ID in** Current Task ID, this number is returned by calling Open Session.vi

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

TF **status** The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

I32 **code** The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

abc **source** The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

channel Specifies which channel to read

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

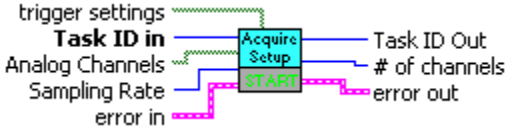
Task ID Out Current Task ID

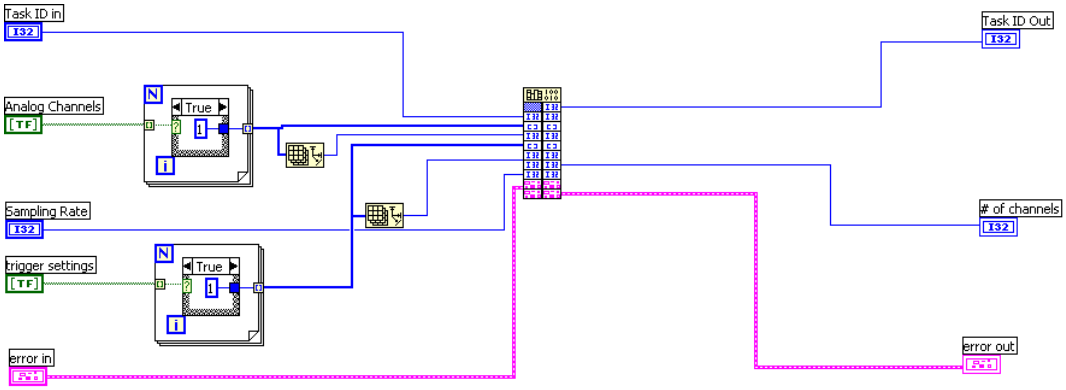
value This is the value in volts read from the indicated channel

Acquisition Setup.VI

Acquisition Setup.vi
This intermediate level VI sets up the acquisition parameters for multiple point higher speed acquisition. Inputs are channels to collect, sampling rate in samples/second per channel, trigger settings and required input is Task ID. This VI also starts the MP1X0 acquiring data. The data can then be retrieved using Get N Analog Points.vi. See Multiple Point Stream to Disk Example.vi for how to use this VI.

Connector Pane





int32 AnalogInputConfiguration(int32 handleIn, LVBoolean AnalogChannels[], int32 len, LVBoolean triggerSettings[], int32 len2, int32 *ofChannels, int32 SamplingRate, TD1 *errorIn, TD1 *errorOut)

Controls and Indicators

error in The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information

about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Sampling Rate This control tells the MP1X0 how fast to sample in samples/second

Task ID in Current Task ID, this number is returned by calling Open Session.vi

Analog Channels

This control determines which channels to collect data from. When the Boolean switch is in the up or "true" state that channel will be collected. You must specify at least one channel or will receive an error message.

trigger settings

MSB4 This control sets the trigger conditions for the MP1X0.

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

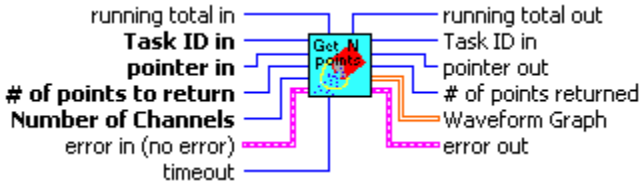
Task ID Out Current Task ID

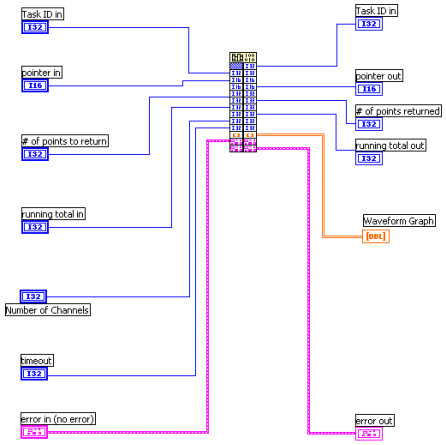
# of channels Number of channels selected

Read N Analog Points.VI

Read N Analog Points.vi
This intermediate level VI reads data from the MP1X0 buffer. It is generally used for high-speed acquisition of multiple channels. When used in a loop, pointer in and pointer out should be passed continually using shift registers. For an example of how to use this VI see Multiple Point Acquisition and Stream to Disk Example.vi

Connector Pane





int32 GetNAnalogPoints(int32 HandleIn, int16 pointerIn, int16 *pointerOut, int32 ofPointsToReturn, int32 *ofPointsReturned, int32 runningTotalIn, int32 *runningTotalOut, int32 NumberOfChannels, int32 timeout, TD1Hdl *WaveformGraph2, TD2 *errorInNoError, TD2 *errorOut)

Controls and Indicators

Number of Channels Number of channels acquiring

Task ID in Current Task ID, this number is returned by calling Open Session.vi

# of points to return Tells the VI how many points to return from the MP1X0 buffer.

pointer in Pointer value input

running total in This keeps track of total number of bytes read. Is designed to be used within a loop where the total number of bytes read is needed.

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the

error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

timeout This specifies a timeout value in ms. If this VI fails to return # of points specified in the required time plus timeout value an error will be generated

Waveform Graph

Task ID in Current Task ID, this number is returned by calling Open Session.vi

pointer out Pointer value after reading specified number of points from MP1X0 buffer.

running total out

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

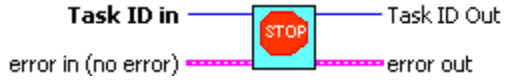
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

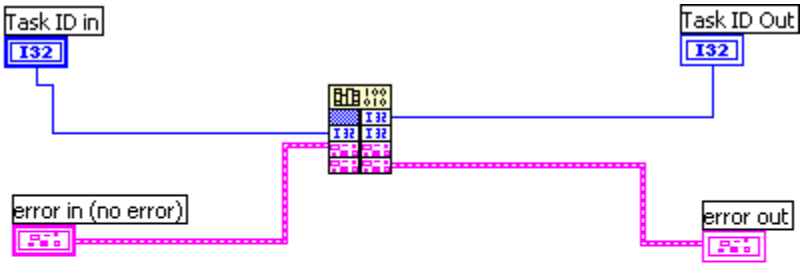
# of points returned Actual number of points returned. This value is always greater than or equal to the value specified in # of points to return control

Stop Acquisition.VI

Stop Acquisition.vi
This VI stops acquisition started by Acquisition Setup.vi. For guidance on how to use this VI see Multiple Point Acquisition and Stream to Disk Example.vi in the MP1X0 examples directory

Connector Pane





int32 AbortAcquisition(int32 TaskIDIn, TD1 *errorInNoError, TD1 *errorOut)

Controls and Indicators

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID in Current Task ID, this number is returned by calling Open Session.vi

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

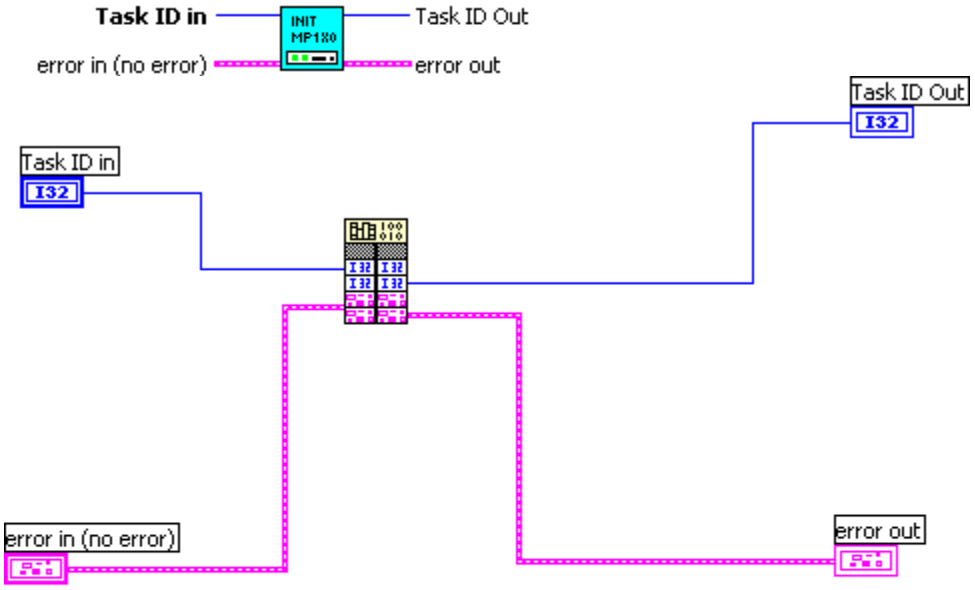
The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID Out Current Task ID

Init MP.VI

INIT MP.vi
This intermediate level VI tells the MP1X0 to initialize itself and run a self-test. See high level VI simple iniatilize.vi for example of how to use this VI.

Connector Pane



oid InitializeMP1X0(int32 HandleIn, int32 *handleOut, TD1 *errorInNoError, TD1 *errorOut)

Controls and Indicators

Task ID in Current Task ID, this number is returned by calling Open Session.vi

error in (no error) The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Task ID Out Current Task ID

error out The **error out** cluster passes error or warning information out of a VI to be used by other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

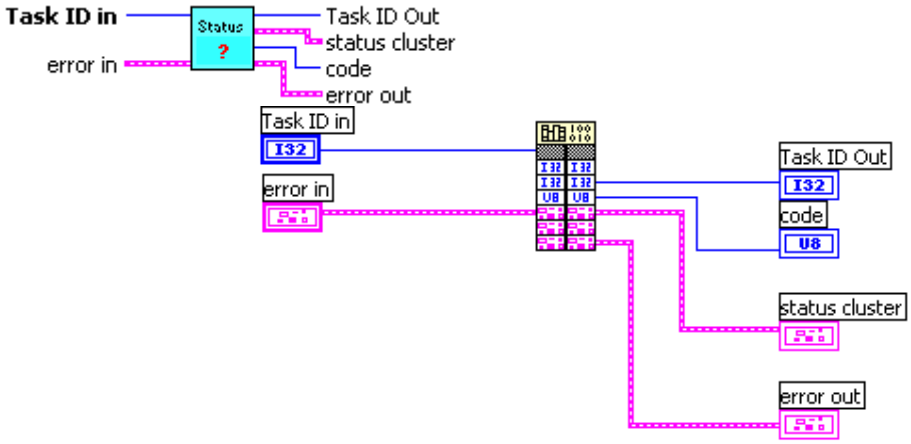
source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

Status.VI

Status.vi
This intermediate level.vi returns the current status of the MP1X0. See Simple Get Status high level.vi for an example of how to use this VI

Connector Pane



void MP1X0Status(int32 HandleIn, int32 *handleOut, uInt8 *status, TD1 *statusCluster, TD2 *errorInNoError, TD2 *errorOut)

Controls and Indicators

error in The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information

about the error displayed.

Task ID in Current Task ID, this number is returned by calling Open Session.vi

error out The **error in** cluster can accept error information wired from VIs previously called. Use this information to decide if any functionality should be bypassed in the event of errors from other VIs.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status The **status** Boolean is either TRUE (X) for an error, or FALSE (checkmark) for no error or a warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

code The **code** input identifies the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

source The **source** string describes the origin of the error or warning.

The pop-up option **Explain Error** (or Explain Warning) gives more information about the error displayed.

status cluster

status code

status string

code

Task ID Out Current Task ID

Appendix A: About MindWare Technologies Ltd.

Our Mission

Our mission is to develop advanced software tools and systems for researchers by leveraging powerful PC based technologies and innovative engineering.

Company Profile

With over 40 years of real-world engineering experience in both industry and academia. MindWare is committed to continually improving our products and systems by integrating the best of new technologies and methods into our products as they become available.

MindWare has an active presence in the academic and medical research community and we have specialized in developing systems for physiological signal acquisition and data analysis. Our solutions are used in many major institutions around by some of the top researchers in their respective fields. We have developed high performance turn key applications to score signals such as: Skin Conductance, Blood Pressure, Heart Rate/Heart Rate Variability, Impedance Cardiography, Impedance Pneumography, EMG, and EEG. Our analysis products work intimately with **BIOPAC** hardware and are capable of reading directly data acquired in AcKnowledge™ format. For more information visit our website at www.mindwaretech.com . We would be happy to send a demonstration CD for you to review. Contact us today for details!

Custom Programming and Development Solutions

MindWare Technologies Ltd. can also provide customized research systems and software solutions for your most demanding data acquisition and analysis applications. We have over 40 years experience developing systems and software to solve problems in an array of disciplines such as: biomedical, engineering, psychology, bio-mechanics, nursing, image processing and digital A/V integration. We are a value added reseller of **BIOPAC** Systems Inc. products. MindWare has also developed significant expertise with **BIOPAC's** AcKnowledge™ file format and with the direct programmatic control of the **BIOPAC** MP100/150 platform. In addition we also have significant expertise with National Instruments software and hardware and are a National Instruments Alliance Member.

In short, MindWare Technologies Ltd. can design, program and integrate your entire laboratory or just provide a turnkey application for your project needs. We have designed many laboratories that are used for both human and animal studies at major institutions nationwide. Contact us today to see how we can put our experience and expertise to work for you today!

Licensing Issues

The MP1X0 VI Library is confidential and proprietary to MindWare Technologies Ltd. and may not be reproduced, published or disclosed to others without the prior written consent of MindWare Technologies Ltd. except that one backup copy of the disks may be made solely for back up purposes.

The product is to be installed for your development purposes and requires the use of a USB security key in order to execute the VI's in the library. If you wish to build an application using the MindWare MP1X0 VI Library VI's and distribute it on more than one computer a multiple user licenses or run-time license is required from MindWare Technologies, Ltd. Please contact us for details and pricing

USB Key or Media Replacement

In the event of a lost USB key or CD the end-user must contact MindWare Technologies Ltd. for a one-time replacement. There will be a fee of $100.00 to replace a lost key and $50.00 for a lost CD. It is important to complete the registration of this product by completing the registration form and returning it to MindWare Technologies Ltd. The form can be printed from Appendix C or completed online at our website www.mindwaretech.com.

Appendix B: Error Codes

Error Code	Error Message
101	Initialize command failed
103	Acquire Data command failed
106	Set number of samples command failed
110	Set Sample Period command failed
112	Output to DA command failed
114	Set Port Direction command failed
119	Abort Acquisition command failed
149	You must select at least one channel
150	Open Handle Failed
151	Close Handle Failed
153	Decode Failed
198	Timed Out
199	No USB Key Found

Appendix C: Product Registration

By completing this registration form you will license your product with MindWare Technologies Ltd.. This will provide the required information we need if the replacement of a USB key or CD becomes necessary.

First Name M.I Last Name

Company Name

Street Address 1

Street Address 2

Street Address 3

City

State Zip

Phone Fax

Email Address

WWW

Date Purchased

Describe You Application

Mail To: MindWare Technologies Ltd.
P.O. Box 2307
Westerville, OH 43086