User manual for

UEIDAQ for LabVIEW®

High Performance Data Acquisition Software for IBM PC, PC/XT, PC/AT and compatible Computer Systems.

Third edition.

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Preface

This manual is written for users of UEIDAQ LabVIEW ® for Windows Drivers software package. It provides all information necessary to successfully use the supplied driver software in conjunction with LabVIEW®.

This manual assumes:

- That you have a basic knowledge of electronic circuitry and measurement techniques.
- That you are familiar with the host PC which you are using.
- That you are familiar with LabVIEW®.
- That you have read chapters 1 thru 4 of the user manual accompanying your WIN-30, UEI-30, UEI-126, UEI-127, UEI-14, UEI-36, UEI-192, or UEI-66

The manual contains the following sections.

Chapter 1 - Getting Started.

- Chapter 1 contains an overview of UEIDAQ LabVIEW® Driver software package, and its capabilities.

Chapter 2 - Using the LabVIEW® VIs.

- Chapter 2 provides a tutorial on the use of the UEI LabVIEW® VIs.

Chapter 3 - Configuration functions.

- Chapter 3 discusses the board configuration functions.

Chapter 4 - Easy I/O functions.

- Chapter 4 discusses the Easy I/O functions. These are simple, high level analog I/O functions, that provide a quick way to satisfy most commonly encountered data acquisition requirements.

Chapter 5 - Analog input functions.

- Chapter 5 discusses the low level analog input functions. These are somewhat more complex functions that allow more flexibility than the easy I/O functions

Chapter 6 - Analog output functions.

- Chapter 6 discusses the low level analog output functions.

Chapter 7 - Digital I/O functions.

- Chapter 7 discusses the Digital I/O functions. These functions provide digital input and output functions.

Chapter 8 - Utility functions.

- Chapter 8 discusses the utility functions. These functions provide various services, such as synchronization and format conversion, that do not access data acquisition hardware directly.

Chapter 9 - Signal processing VIs.

- Chapter 9 discusses the signal processing VIs. These functions provide the means to analyze your data once it is acquired. They include FFT, IFFT and Hilbert transforms.

Chapter 10 - Window VIs.

- Chapter 10 discusses the window VIs. Window operations are used both for filter design and spectrum analysis.

Chapter 11 - Spectrum analysis VIs.

- Chapter 11 discusses the spectrum analysis VIs. These are used to estimate the spectral content of a sampled signal.

Chapter 12 - Filter VIs.

- Chapter 12 discusses the Filter VIs. These VIs are used to filter waveforms.

Chapter 1

1. Getting started

This chapter introduces the UEIDAQ LabVIEW® Driver system.

1.1. Introduction

UEIDAQ LabVIEW® Driver software has been written to allow the easy use of all WIN-30, UEI-30, UEI-126, UEI-127, UEI-14, UEI-36, UEI-192 and UEI-66 functions from LabVIEW® for Windows V3 or later.

1.2. Boards supported

UEIDAQ LabVIEW® Driver package supports the following boards:

- All analog input boards; the WIN-30 and UEI-30 series boards and the UEI-126 and UEI-127.
- All UEI digital I/O boards, including the UEI-14, UEI-36 and UEI-192.
- All UEI analog output boards, including the UEI-66.

The complete range of UEI analog input boards consist of three series of boards, the "old" series, the 16-bit series, and the 32-bit or "WIN" series.

1.2.1. Old series boards.

The old series of boards consists of three boards:

1.2.1.1. UEI-26

The UEI-26 is the original board in the range. It is an analog input board, with 16 single ended inputs, and a programmable clock. Maximum throughput is 25 kHz.

1.2.1.2. UEI-30

The UEI-30 has the same analog input capability as the UEI-26, and is fully compatible with the UEI-26, but has several additional capabilities:

i. Digital I/O. There are 24 digital I/O lines, each of which may be programmed as an input or an output.

ii. Two 12-bit D/A converters with either bipolar or monopolar outputs.

iii. Two 8-bit D/A converters, also with either bipolar or monopolar outputs.

1.2.1.3. UEI-39

The UEI-39 shares all the characteristics of the UEI-30, but adds several enhancements:

i. Single channel DMA operation. This boosts throughput to 80 kHz on a single input channel.

ii. Improved analog input specification. The UEI-39 features high impedance inputs.

iii. Improved status read back. The UEI-39 has an extra conversion status bit, which simplifies programming, and can increase throughput considerably.

iv. Improved interrupt operation. The UEI-26 and UEI-30 could "lose" interrupts. The UEI-39 cannot.

Note
Old series boards are supported only in PC or PC/XT machines and 100% compatibles. Operation in PC/AT or compatible machines is not supported.

1.2.2. 16-bit series boards.

The 16-bit series of boards consists of eight boards. All 16-bit series boards are supported in PC/AT systems, and are fully compatible with all old series boards.

1.2.2.1. UEI-30B

The UEI-30B forms the basis of the "new" UEI-30 range. It features 30 kHz throughput, and advanced DMA circuitry which allows multi-channel analog input operations at full throughput.

1.2.2.2. UEI-30C

The UEI-30C has all the features of the UEI-30B, but features an A/D throughput of 100 kHz.

1.2.2.3. UEI-30D

The UEI-30D is a development of the UEI-30C, with A/D throughput of 200 kHz. It is designed for use in PC/AT and AT compatible PCs. In addition to improved throughput, the UEI-30D also contains FIFO buffers for A/D data, for improved operation in conjunction with multi-tasking operating systems such as OS/2.

1.2.2.4. UEI-30DS

The UEI-30DS is a development of the UEI-30D, and is identical in operation and capabilities to the UEI-30D, except for the addition of simultaneous sample and hold operation on all 16 input channels. The available analog input ranges of the UEI-30DS have also been modified to support this capability.

1.2.2.5. UEI-30DS/4

The UEI-30DS/4 is a low cost version of the UEI-30DS, with only four simultaneously sampled input channels. In all other respects it is identical to the UEI-30DS.

1.2.2.6. UEI-30PG

The UEI-30PGL and UEI-30PGH are essentially the same as the UEI-30D, but feature programmable gain. The UEI-30PGL has gains of 1, 10, 100 and 1000, while the UEI-30PGH has gains of 1, 2, 4 and 8 available.

1.2.2.7. UEI-126

The UEI-126 is a low cost very high performance board intended for use primarily in laptop PCs. It features 16 single ended analog inputs, two analog outputs, 8 digital inputs, 8 digital outputs, and a programmable clock. Maximum throughput is 50 kHz.

1.2.2.8. UEI-127

The is a low cost very high performance simultaneous sampling board intended for use primarily in laptop PCs. It features 4 single ended, simultaneously sampled analog inputs, two analog outputs, 8 digital inputs, 8 digital outputs, and a programmable clock. Maximum throughput is 100 kHz.

1.2.3. 32-bit series boards.

The 32-bit series of boards consists of eight boards. All 32-bit series boards are supported in PC, PC/XT and PC/AT systems, and are fully compatible with the 16-bit series of boards.

The first part of the "32-bit" series of boards is the WIN-30 series, which features input resolution of 12 bits:

	Analog Inputs	Analog Outputs
WIN-30D	16 single ended, 12-bit resolution	-
WIN-30DA	16 single ended, 12-bit resolution	Two 12-bit, two 16-bit
WIN-30DS	16 simultaneously sampled, 12-bit resolution	Two 12-bit, two 16-bit
WIN-30DS/4	4 simultaneously sampled, 12-bit resolution	Two 12-bit, two 16-bit
WIN-30PGL	16 single ended/8 differential, programmable gains of 1, 10, 100, 1000, 12-bit resolution	Two 12-bit, two 16-bit
WIN-30PGH	16 single ended/8 differential, programmable gains of 1, 2, 4, 8, 12-bit resolution	Two 12-bit, two 16-bit
WIN-30PGSL	16 single ended/8 differential, programmable gains of 1, 10, 100, 1000, 12-bit resolution, simultaneous sampling	Two 12-bit, two 16-bit
WIN-30PGSH	16 single ended/8 differential, programmable gains of 1, 2, 4, 8, 12-bit resolution, simultaneous sampling	Two 12-bit, two 16-bit

The WIN-30 series of boards is also available in 16 bit analog input resolution, as the WIN-3016 series, detailed below:

	Analog Inputs	Analog Outputs
WIN-3016D	16 single ended, 16-bit resolution	-
WIN-3016DA	16 single ended, 16-bit resolution	Two 12-bit, two 16-bit
WIN-3016DS	16 simultaneously sampled, 16-bit resolution	Two 12-bit, two 16-bit
WIN-3016DS/4	4 simultaneously sampled, 16-bit resolution	Two 12-bit, two 16-bit
WIN-3016PGL	16 single ended/8 differential, programmable gains of 1, 10, 100, 1000, 16-bit resolution	Two 12-bit, two 16-bit
WIN-3016PGH	16 single ended/8 differential, programmable gains of 1, 2, 4, 8, 16-bit resolution	Two 12-bit, two 16-bit

1.2.4. Digital I/O boards

The following digital I/O boards are supported:

1.2.4.1. UEI-14

The UEI-14 has six 8-bit digital I/O ports. Each port can be programmed as either an input or output. The UEI-14 also features 3 counter-timer devices, but these are not supported by UEIDAQ.

1.2.4.2. UEI-36

The UEI-36 has three 8-bit digital I/O ports. Each port can be programmed as either an input or output.

1.2.4.3. UEI-192

The UEI-192 has twenty four 8-bit digital I/O ports. Each port can be programmed as either an input or output.

1.2.5. Analog output boards

The following analog output boards are supported:

1.2.5.1. UEI-66

The UEI-66 has twelve analog outputs, each of which can be configured for monopolar or bipolar outputs..

1.2.5.2. UEI-66A

The UEI-66A has eighth analog outputs, each of which can be configured for monopolar or bipolar outputs..

1.3. Windows support

Windows support is provided as follows:

- Windows 3.1 enhanced mode only is supported. Operation under Windows 3 or earlier, or in Windows 3.1 standard mode is not possible.

- Windows 3.1 support is via a DLL (Dynamic Linked Library) and a virtual device driver (Vxd). Both of these must be accessible to Windows for the driver system to operate. Installation of the DLL and Vxd are discussed further later in this manual.

- A minimum configuration of a 386 processor and 4 MBytes of memory is required. A 386DX or 486 processor and 8 Mbytes of memory are recommended.

1.4. Functions supported

Functions supported depend on two factors:

- The version of UEIDAQ installed on your machine. Depending on the product that you purchased, your version of UEIDAQ may support only certain boards. Versions of UEIDAQ that are supplied with a specific board always support that board, but may or may not support other UEI products. Consult the documentation supplied with the version of UEIDAQ that you are using.

- The board in question. Various boards support only certain functions. The list below provides a rough guide:

1.4.1. UEI-26 and UEI-30

Diagnostics, analog output on all four D/A outputs, obtain a single A/D sample, obtain a series of A/D samples on either a single or multiple channels, digital I/O.

1.4.2. UEI-39

Diagnostics, analog output on all four D/A outputs, obtain a single A/D sample, obtain a series of A/D samples on either a single or multiple channels, single channel DMA operation, digital I/O.

1.4.3. UEI-30B and UEI-30C

Diagnostics, analog output on all four D/A outputs, obtain a single A/D sample, obtain a series of A/D samples on either a single or multiple channels, either single channel or multiple channel DMA operation, digital I/O.

1.4.4. UEI-30D

Diagnostics, analog output on all four D/A outputs, obtain a single A/D sample, obtain a series of A/D samples on either a single or multiple channels, either single channel or multiple channel DMA operation, gap free dual DMA channel operation, digital I/O.

1.4.5. UEI-30DS

The UEI-30DS and UEI-30DS/4 share all of the abilities of the UEI-30D, and appear identical to software. The only difference in operation comes about in block mode operation, where all sampled channels are sampled simultaneously. All references in this manual to UEI-30D boards also applies to UEI-30DS and UEI-30DS/4 boards, unless specifically stated otherwise.

1.4.6. UEI-30PG

The UEI-30PG shares all the functions of the UEI-30D, but in addition allows the gain of each analog input channel to be individually set.

1.4.7. UEI-126 and UEI-127

Diagnostics, analog outputs, obtain a single A/D sample, obtain a series of A/D samples on either a single or multiple channels, digital I/O, and waveform generation.

1.4.8. WIN-30 series

Diagnostics, obtain a single A/D sample, obtain a series of A/D samples on either a single or multiple channels, either single/dual channel DMA or rep string operation, gap free dual DMA channel operation, digital I/O.

1.5. Installing the UEIDAQ LabVIEW® driver

The LabVIEW® driver installs automatically. Follow these steps:

i. Place the distribution diskette in drive A: or B:.

ii. Ascertain the name of the directory that LabVIEW® is installed to. This is usually C:\LABVIEW.

iii. Start Windows.

iv. Go to the Windows File menu and select Run.

v. Enter A:SETUP as the program to run.

vi. Press the enter key.

vii. The setup program will then run. Answer any questions that it asks.

1.6. Driver structure

The UEIDAQ driver system is structured as shown in figure 1.1 below:

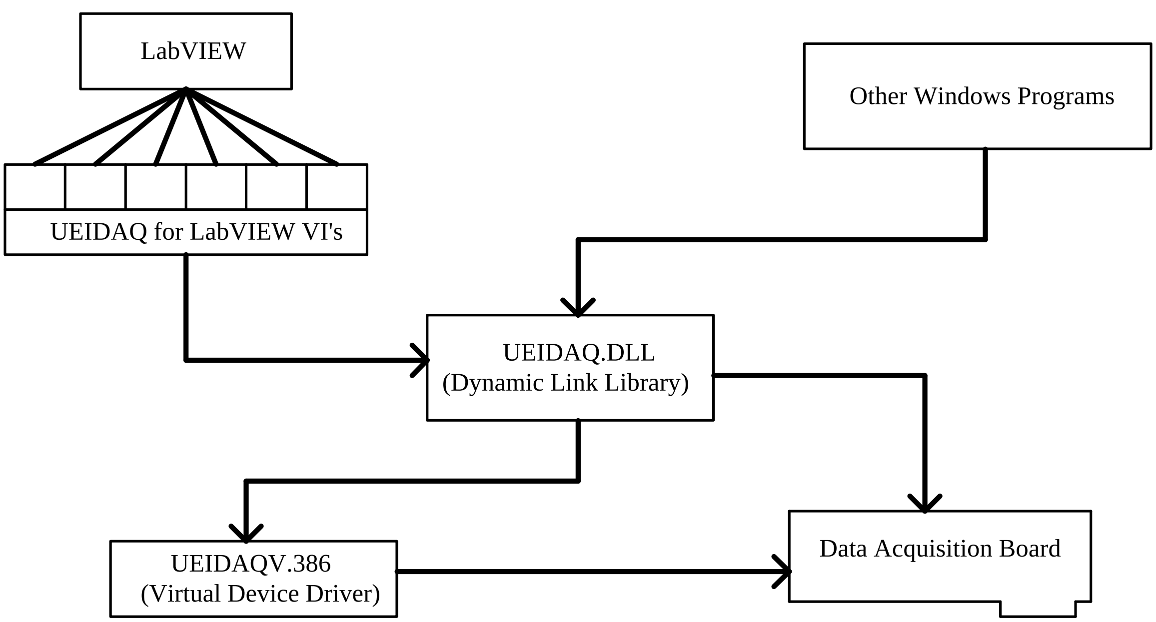


Figure 1.1. Driver structure.

There are three components to the UEIDAQ for LabVIEW® drivers:

- The UEIDAQ LabVIEW® VIs. These VIs are the part of the driver system that is visible to LabVIEW ®. You create your application by interconnecting these VIs in LabVIEW ®. In essence, the VIs are high level wrappers for calls to the UEIDAQ DLL

- The UEIDAQ DLL. All I/O requests for any UEI board under Windows 3.1 go via this DLL. It serves to synchronize all driver activity, and allows full multi-tasking.

- The UEIDAQV virtual device driver. This driver handles all high speed I/O operations, as well as providing access Ring 0 access to the DLL.

1.6.1. Driver Requirements

Windows support is provided as follows:

i. Windows 3.1 enhanced mode only is supported. Operation under Windows 3 or earlier, or in Windows 3.1 standard mode is not possible.

ii. A minimum configuration of a 386 processor and 4 MBytes of memory is required. A 386DX or 486 processor and 8 Mbytes of memory are recommended.

iii. Windows 3.1 support is via a DLL (Dynamic-Link Library) and a virtual device driver (Vxd). Both of these must be accessible to Windows for the driver system to operate. The DLL is UEIDAQ.DLL, and the Vxd is UEIDAQV.386

iv. Windows locates a dynamic-link library by searching the same directories it searches to find an application module. For Windows to the find the library, it must be in one of the following directories , which Windows searches in the order listed:

   a) The current directory.

   b) The Windows directory (the directory containing WIN.COM).

   c) The Windows system directory (the directory containing such system files as GDI.EXE).

   d) Any of the directories listed in the PATH environment variable.

   e) Any directory in the list of directories mapped in a network.

v. Microsoft recommends that DLL's be loaded into the Windows system directory. This is where the default installation program places UEIDAQ.DLL, but any other valid position is acceptable

vi. In order for Windows to load the UEIDAQV Vxd , the following line must appear in the [386ENH] section of the Windows SYSTEM.INI file : "device=c:\uei\ueidaqv.386". This assumes that the Vxd is in the default location, the c:\UEI directory. If it is not, then the line should be modified accordingly. Once again, this is automatically done by the default installation program.

1.7. Examples

A wide variety of example VI that show how to use the various functions described in this manual may be found in the "VI.LIB\UEI\EXAMPLES" VI in your Labview directory. These include waveform input and output, spectrum analysis and data analysis programs.

Chapter 2

2. Using the LabVIEW® VIs

This chapter discusses the basic operation of the driver VIs, and how to interconnect them.

2.1. Introduction to the VIs

The VIs supplied with UEIDAQ LabVIEW® driver system fall into two groups:

i. Data acquisition VIs. These VIs access the hardware of the data acquisition board, and actually perform data acquisition tasks. This chapter discusses the overall operation of these VIs

ii. Data analysis VIs. These are general purpose VIs capable of processing any LabVIEW ® data, not just that from the UEIDAQ data acquisition VIs. The operation of these VIs is identical to the VIs supplied with LabVIEW ®. Indeed, many of these VIs, for example the FFT routines, are direct replacements for routines supplied in the LabVIEW® Analysis package. The operation of these VIs are discussed in chapters 9 thru 12.

2.2. VI Naming

In order not to conflict with the naming of functions already present in LabVIEW ®, especially in the analysis library, many functions have a "UEI" prefix. For example, the FFT function is called "UEI FFT". This is necessary because LabVIEW® cannot effectively deal with functions of the same name which reside in different locations.

2.3. How the VIs view hardware

The data acquisition VIs view data acquisition boards as consisting of four interacting subsystems. These are the following:

i. Analog input subsystem; this section generally has associated with it a certain number of input channels, each of which can have an input range (0 to 5V, -5 to +5V etc.) and a gain (1,2,4,8 etc.). The analog input stage can also have a programmable clock. This allows channels to be sampled at a fixed frequency.

ii. Analog output subsystem; this section generally has associated with it a certain number of output channels, each of which can have an output range (0 to 5V, -5 to +5V etc.). The analog output stage can also have a programmable clock. This allows channels to be updated at regular intervals, for example, in order to generate waveforms.

iii. Digital I/O subsystem; this section generally has associated with it a certain number of digital port. Each port is generally 8 bits in width. Most, but not all, board have ports that can be programmed either as inputs or outputs. Some boards also allow the port to be latched or clocked by an external line. In addition, certain boards can also have a programmable clock. This allows ports to be sampled or updated at regular intervals.

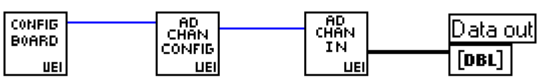
iv. Interrupt/DMA subsystem; clocked I/O oper ations on any of the above subsystems generally require that some mechanism be available to transfer data from the board to the driver software. This mechanism can be either interrupts or DMA. Normally, the operation of this subsystem is invisible to the LabVIEW ® VIs. However, the driver must ensure that only one of the I/O subsystems (analog input, analog output and digital I/O) attempt to use any interrupt or DMA channel at any one time.

One of the primary responsibility of the driver system in a multi-tasking environment such as LabVIEW ® is to ensure that only one operation at a time is performed on each of these subsystems. The mechanism that the UEIDAQ LabVIEW® drivers use to ensure this is the Task Id.

In addition to ensuring that only one operation at a time occurs on any of the subsystems, Task Ids are also used to ensure that a board has been correctly initialized prior to operation.

2.4. Data acquisition VI operation

The basic structure of a simple data acquisition is shown below:



The flow of Task Ids is as follows:

i. Task Id's can only be originated by the Configure Board VI. One this has been done, you must use this Task Id for all I/O operations on the board in question. Optional inputs to the Configure Board VI include the board type, the base address of the board, and a logical board number. Note that this board number is used purely to identify the board uniquely; you can use any number between 0 and 7, as long as you don't use the same number for two boards.

ii. The Task Id from the Configure board VI can then be used to configure the analog input, analog output and digital I/O subsections of the board. The VIs in question are:

a) AD Channel Configure : This configures a range of A/D input channels. You can use several of these VIs in series to configure different channels differently. You can also configure a channel in a particular way, perform an input function, and then reconfigure the channel for a different function.

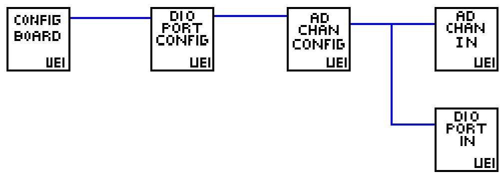
b) DA Channel Configure : This configures a range of D/A output channels. You can use several of these VIs in series to configure different channels differently. You can also configure a channel in a particular way, perform an output function, and then reconfigure the channel for a different function.

c) DIO Port Configure : This configures a range of digital I/O ports. You can use several of these VIs in series to configure different ports differently. You can also configure a port in a particular way, perform a digital I/O function, and then reconfigure the port for a different function.

iii. Once a Task Id has been originated by the Configure Board VI, and processed by one of the subsystem configuration VIs, you can perform any of the analog input, analog output or digital I/O functions.

2.5. Multiple execution paths

When data acquisition functions are connected in series as shown above, then the functions execute serially; a specific function cannot execute until the previous function has completed. Sometimes it can be useful to allow data acquisition functions to execute in parallel. This can be done as follows:



Note the following:

i. All configuration functions must be completed prior to the execution paths splitting

ii. VIs in parallel as above may execute in any order.

iii. If one path contains a clocked I/O operation to a particular subsystem, then no parallel path should contain any I/O operation involving that subsystem.

iv. Only one path in a set of parallel paths may contain a clocked I/O operation.

v. Split execution paths can be resyncronized by the Synchronize VI.

2.6. Channel addressing

Channel addressing for the UEIDAQ LabVIEW® drivers is done via arrays of channels . Two kinds of arrays are supported:

i. Integer arrays. Integer arrays are simply arrays of integer channel numbers. If you only want to select one channel, simply create an array of only one element.

ii. String channel arrays are identical to LabVIEW® channel arrays:

   a) You can separate channel entries by placing each one in a separate array element, or

   b) separate channel entries by placing them in a single array element separated by commas (e.g. 1,2,3), or

   c) specify a range of channels by separating the first and last channels by a colon (e.g. 1:3), or

   d) any combination of the above

2.7. Error codes

The error codes used by the UEIDAQ LabVIEW® drivers have exactly the same meaning as for standard LabVIEW® VI's. Thus normal LabVIEW® error handling VIs can be used.

The error codes used are:

0	No Error.
-61	Bad board; normally caused by an error in an earlier VI.
-69	Input parameters out of range.
-72	Operation requiring the requested subsystem is already in progress.
-10005	Multi-tasking error; usually caused by a bad device number.
-10007	Channel number out of range
-10019	Clock frequency was invalid.
-10080	Gain setting invalid
-10402	Device not found
-10403	Invalid parameters; the operation was not attempted.
-10444	Insufficient memory.
-10600	Subsystem or board has not been configured.
-10805	Hardware error; an error occurred during an I/O operation to a board.
-10840	Unknown error; probably as the result of a version conflict.
-20008	Array sizes are invalid.
-20021	Filter size must be greater than 1.
-20023	Cutoff frequencies were invalid.

2.8. Quick reference

The data acquisition VIs in the UEIDAQ library include:

2.8.1. Configuration functions

- Configure Board : Configures a board.
- AD Chan Config : Configures a range of analog input channels.
- DA Chan Config : Configures a range of analog output channels.
- DIO Port Config : Configures a range of digital I/O channels.
- Version : Returns the version number of the UEIDAQ DLL that is installed on your system.

2.8.2. Easy I/O functions

- AD Easy Wave: This is a high level, easy to use, way to acquire an analog waveform.
- AD Trig Wave: This is a high level, easy to use, way to acquire an analog waveform, with analog triggering.
- DA Easy Wave: This is a high level, easy to use, way to output an analog waveform.

2.8.3. Analog input functions

- AD Chan In : Acquires a single sample from each of a group of channels.
- AD Wave In : Low level analog input function. Starts a waveform acquisition process.
- AD Check : Low level analog input function. Checks to see whether a waveform acquisition started by AD Wave In has completed.
- AD Close To Integer : Low level analog input function. Completes a waveform input function started by AD Wave In. The output from the function is an array of integer data.
- AD Close To Single : Low level analog input function. Completes a waveform input function started by AD Wave In. The output from the function is an array of single precision floating point data.

2.8.4. Analog Output functions

- DA Chan Out: This outputs a specified voltage on a group of analog output channels.
- DA Wave Out : Low level analog output function. Starts a waveform output process.
- DA Check : Low level analog input function. Checks to see whether a waveform output operation started by DA Wave Out has completed.
- DA Close : Low level analog output function. Completes a waveform output function started by DA Wave Out.

2.8.5. Digital I/O functions

- DIO Port In : This inputs digital data from a group of digital input ports.
- DIO Port Out : This outputs digital data to a group of digital output ports.

2.8.6. Utility functions

- Software Trigger : This function emulates the operation of a oscilloscope style analog trigger operation on a buffer with data in it.
- String To Int Chan List : This function converts a list of channels in string format to the integer array format required by most of the data acquisition functions.
- Synchronize : This VI synchronizes the execution of multiple paths of data acquisition.

Chapter 3

3. Configuration functions

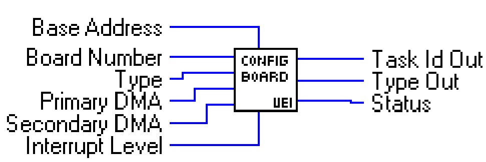
This chapter provides a description of the various configuration VIs used by the driver.

3.1. Configuration VI introduction

The configuration VIs are:

- Configure Board : Configures a board.
- AD Chan Config : Configures a range of analog input channels.
- DA Chan Config : Configures a range of analog output channels.
- DIO Port Config : Configures a range of digital I/O channels.

3.2. Configure board



Configure Board

Configure board configures the specified board.

This function is used to detect the presence of a specific board, and to configure it for operation. The output of this VI, the Task Id, is required as an input by subsequent data acquisition operations, and serves to identify on which board the operation is to be performed.

Base Address is the base address of the board. If this is set to -1, then the default base address for the board type is used. If the base address is set to 0, and the type is set to auto-identify, then an address of 700 hex is used. The value defaults to -1

Board number is the board's logical identifying number. This may be between 0 and 7, and may be arbitrary chosen, as long as no two boards have the same number. It defaults to 0.

Type is the board type. This may be one of the following values

0 : Auto-identify

1 : UEI-26/UEI-30

2 : UEI-39

3 : UEI-30B or UEI-30C

4 : UEI-30D or UEI-30DS

5 : UEI-30PGL

6 : UEI-30PGH

7 : UEI-126

8 : UEI-127

9 : WIN-30D/DS

10 : WIN-30PGL and PGSL

11 : WIN-30PGH and PGSH

12 : WIN-3016D/DS

13 : WIN-3016PGL and PGSL

14 : WIN-3016PGH and PGSH

15 : UEI-14

16 : UEI-36

17 : UEI-192

18 : UEI-66

19 : UEI-64

20 : UEI-73

Note that not all board types can be auto-identified. Also remember to consult the RELEASE.TXT file on the distribution diskette to see what boards your specific version of the UEIDAQ supports. The default setting for this control is auto-identify.

Primary DMA is the primary DMA channel. For boards that do not support software configuration of DMA levels, this should be set to correspond to the DMA level for which your board has been configured. In the case of boards that do support software configuration of DMA levels, the board will be set to this DMA level. Consult your hardware manual for a discussion of the appropriate DMA level for your application. If this control is set to -1, the default level, a setting of 3 is used for boards that use 8-bit DMA, and a setting of 5 for boards that use 16-bit DMA.

Secondary DMA is the secondary DMA channel for those boards that support dual-channel gap-free DMA. For boards that do not support software configuration of DMA levels, this should be set to correspond to the DMA level for which your board has been configured. In the case of boards that do support software configuration of DMA levels, the board will be set to this DMA level. Consult your hardware manual for a discussion of the appropriate DMA level for your application. If this control is set to -1, the default level, a setting of 0 is used for boards that use 8-bit DMA, and a setting of 6 for boards that use 16-bit DMA.

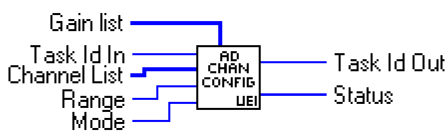
Interrupt Level is the interrupt level (IRQ setting) for the board. For boards that do not support software configuration of interrupt levels, this should be set to correspond to the interrupt level for which your board has been configured. In the case of boards that do support software configuration of interrupt levels, the board will be set to this interrupt level. Consult your hardware manual for a discussion of the appropriate interrupt level for your application. If this control is set to -1, the default level, the interrupt level will be set to the factory default for type of board identified, or to IRQ5 for boards that are software programmable.

Task Id is the Task Id corresponding to the board. This must be used in all subsequent subsystem configuration VIs.

Type Out is the type of the board as actually identified by the UEIDAQ diagnostics function. If you specified anything other than auto-identify for the input type, then this will be the same as the input type, unless an error condition occurred.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

3.3. AD Chan Configure



AD Chan Config

AD channel configure configures a range of A/D input channels for range, gain and mode.

Task Id in is the Task Id corresponding to the board. This must be obtained from the Configure Board VI. There is no default for this control.

Channel list is a list of the channels that are to be configured. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is -1, which selects all channels on the board.

Range indicates the analog voltage range for the channels. Note that most boards are limited to a single range that applies to all channels. For such boards, if more than one range is requested, the most recent request is used. Note also that if the board that you are using does not support software range selection, then you must ensure that the range input corresponds to the range that your board is actually configured for. If these do not correspond, then voltage readings from subsequent functions will be incorrect. The default setting for this control is -5 to +5V. Range may be one of the following values:

0 : -5 to +5V

1 : 0 to +5V

2 : -10 to +10V

3 : 0 to +10V

4 : -2.5 to +2.5V

5 : 0 to +2.5V

I16 **Mode** indicates the input mode. Default setting is single ended. Possible values are:

0 : Single ended

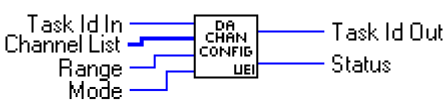
1 : Differential

[I16] **Gain list** is a list of the gains that the various channels in the channel list are to be set to, for example 10 or 1000. If this list is shorter than the channel list, it wraps round. If it is longer than the channel list, extra values are ignored. Default setting is 1. Note that these values are the actual gain values, NOT gain codes as used by UEIDAQ.

U32 **Task Id out** is the Task Id corresponding to the board. This must be used in all subsequent analog input subsystem VIs.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

3.4. DA Chan Configure



DA Chan Config

DA channel configure configures a range of D/A output channels for range and mode.

U32 **Task Id** in is the Task Id corresponding to the board. This must be obtained from the Configure Board VI. There is no default for this control.

[I16] **Channel list** is a list of the channels that are to be configured. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is -1, which selects all channels on the board.

I16 **Range** indicates the analog voltage range for the channels to be configured. If the board that you are using does not support software range selection, then you must ensure that the range input corresponds to the range that your board is actually configured for. If these do not correspond, then voltage outputs from subsequent functions will be incorrect. The default setting for this control is -5 to +5V. Range may be one of the following values:

0 : -5 to +5V

1 : 0 to +5V

2 : -10 to +10V

3 : 0 to +10V

4 : -2.5 to +2.5V

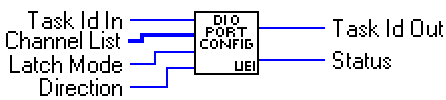
5 : 0 to +2.5V

I16 **Mode** indicates the output mode. This is currently unused, and should be left unconnected.

U32 **Task Id** out is the Task Id corresponding to the board. This must be used in all subsequent analog output subsystem VIs.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

3.5. DIO Port Configure



DIO Port Config

DIO port configure configures a range of DIO output ports for direction and mode.

U32 **Task Id in** is the Task Id corresponding to the board. This must be obtained from the Configure Board VI. There is no default for this control.

[I16] **Channel list** is a list of the ports that are to be configured. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is -1, which selects all ports on the board.

I16 **Latch Mode** indicates the input latch mode. This is currently unused, and should be left unconnected.

I16 **Direction** indicates whether the port is to be an input or an output. This is ignored for board with fixed DIO port configuration. The default value is for the ports to be inputs. Values are:

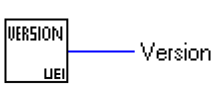
0 : Output

1 : Input

U32 **Task Id out** is the Task Id corresponding to the board. This must be used in all subsequent digital I/O subsystem VIs.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

3.6. Version



Version

Returns the version number of the UEIDAQ DLL that is installed on your system.

I32 **Version** returns the UEIDAQ version number, encoded with the minor version number in the lower 8 bits, and the major version number in the next highest 8 bits.

Chapter 4

4. Easy I/O functions

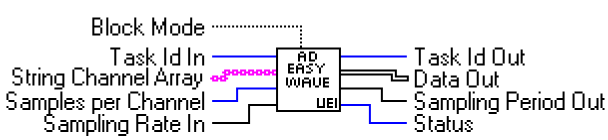
This chapter provides a description of the various Easy I/O VIs used by the driver.

4.1. Easy I/O VI introduction

Easy I/O VIs are simplified versions of the more advanced, but also more complex, low level VIs. As they are constructed out of low level VIs, you can use these VIs as to learn how to use the low level VIs, or as starting points for your own VIs. The Easy I/O VIs are:

- AD Easy Wave: This is a high level, easy to use, way to acquire an analog waveform.
- AD Trig Wave: This is a high level, easy to use, way to acquire an analog waveform, with analog triggering.
- DA Easy Wave: This is a high level, easy to use, way to output an analog waveform.

4.2. AD Easy Wave



AD Easy Wave

AD Easy Wave performs timed multi-channel input operations. You can specify which channels to sample, how often to sample them, and how many samples to obtain. The output data is scaled to the range and gain of the selected channels. This function uses internal triggering and clocks.

Task Id in is the Task Id corresponding to the board. This must be obtained from the AD Chan Configure VI. There is no default for this control.

Channel list is a list of the channels that are to be sampled. This is in string format. For a discussion of this format, see the section on channel addressing. The default setting is channel 0.

I32

Samples per channel is the number of samples to be taken for each channel in the channel list. the default is 1024.

SGL

Sampling rate in is the rate at which each channel individually will be sampled. Board throughput is the product of the sampling rate and the number of channels. Note that regardless of whether block mode is selected or not, this rate is still the rate at which each channel is sampled. The default sampling rate is 1 kHz.

TF

Block mode selects whether samples are taken in normal or block mode, for those boards that support this. Because of the way that the sampling rate is interpreted by the VI, this setting has no effect on the rate at which channels are sampled. It does have an effect on the phase of the samples: If block mode is true, then the phase shift between samples taken on the same scan through the channel list will be as small as the board can make it. For simultaneous sampling boards, this will be 0, and for other boards equal to 1/(Maximum throughput). If block mode is false, then samples taken on the same scan through the channel list will be evenly spread through the sampling interval. For more information on block mode sampling, see your hardware manual.

[SGL]

Data Out is a two dimensional array of output data. Its size is the product of the number of channels and the number of samples. It is scaled to the range and gain selected by the AD Chan Configure VI that preceded the AD Easy Wave operation.

SGL

Sampling Period Out is the actual period between successive conversions on the same input channel. Note that this may not be exactly what would be expected from the Sampling Rate In control, as data acquisition boards can generally select sampling periods in finite sized steps.

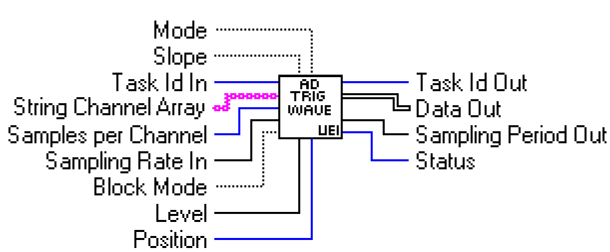
U32

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

I32

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

4.3. AD Trig Wave



AD Trig Wave performs timed multi-channel input operations with analog triggering. You can specify which channels to sample, how often to sample them, and how many samples to obtain. The output data is scaled to the range and gain of the selected channels. This function uses internal triggering and clocks. Analog triggering is simulated by acquiring three times more data that is required, looking for a trigger condition, and then discarding data prior to the trigger condition. Depending on the Mode setting, the VI can either wait for a valid trigger, or return immediately whether or not a valid trigger was found. Note that because this VI simulates analog triggering, it is possible that it will miss single shot events. Thus it should be used only on repetitive waveforms.

U32

Task Id in is the Task Id corresponding to the board. This must be obtained from the AD Chan Configure VI. There is no default for this control.

[abc]

Channel list is a list of the channels that are to be sampled. This is in string format. For a discussion of this format, see the section on channel addressing. The default setting is channel 0.

I32

Samples per channel is the number of samples to be taken for each channel in the channel list. the default is 1024.

SGL

Sampling rate in is the rate at which each channel individually will be sampled. Board throughput is the product of the sampling rate and the number of channels. Note that regardless of whether block mode is selected or not, this rate is still the rate at which each channel is sampled. The default sampling rate is 1 kHz.

TF

Block mode selects whether samples are taken in normal or block mode, for those boards that support this. Because of the way that the sampling rate is interpreted by the VI, this setting has no effect on the rate at which channels are sampled. It does have an effect on the phase of the samples: If block mode is true, then the phase shift between samples taken on the same scan through the channel list will be as small as the board can make it. For simultaneous sampling boards, this will be 0, and for other boards equal to 1/(Maximum throughput). If block mode is false, then samples taken on the same scan through the channel list will be evenly spread through the sampling interval. For more information on block mode sampling, see your hardware manual.

I32

Position sets the amount of pre-trigger data required.

TF

Slope is the slope of the trigger event to be searched for. If this is true, then a positive slope is searched for, and if it is false, a negative slope

TF

Mode is the trigger mode. If this is false, then a AD Trig wave will always output data, regardless of whether a valid trigger condition was encountered. This is equivalent of “Auto” triggering on an oscilloscope; data will always be displayed. If Mode is true, the VI will not return until a valid trigger condition has been encountered. The default setting is false.

SGL

Level sets the level at which the trigger condition will occur.

[SGL]

Data Out is a two dimensional array of output data. Its size is the product of the number of channels and the number of samples. It is scaled to the range and gain selected by the AD Chan Configure VI that preceded the AD Easy Wave operation.

SGL

Sampling Period Out is the actual period between successive conversions on the same input channel. Note that this may not be exactly what would be expected from the Sampling Rate In control, as data acquisition boards can generally select sampling periods in finite sized steps.

U32

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

I32

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Position sets the amount of pre-trigger data required. Effectively, the Software Trigger VI doesn't start searching for data in the first <Position> samples in the input buffer.

Data In is a the data to be searched. Note that this is a one dimensional array.

Slope is the slope of the trigger event to be searched for. If this is true, then a positive slope is searched for, and if it is false, a negative slope

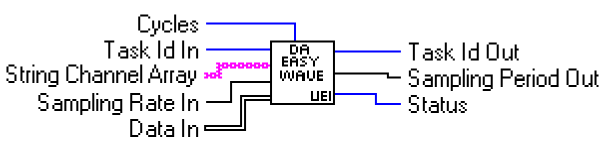
Mode is the trigger mode. If this is false, then a found will always return true, regardless of whether a valid trigger was found. This is equivalent of "Auto" triggering on an oscilloscope; data will always be displayed. If it is true, found will only return true if a valid trigger condition was found

Level sets the level at which the trigger condition will occur.

Trigger Point represents the offset into the data buffer at which the specified trigger condition occurred. If no trigger occurred, and . Mode was false, then this will return 0.

Found is set if either a valid trigger condition occurred, or mode was false.

4.4. DA Easy Wave



DA Easy Wave performs timed multi-channel output operations. You can specify which output channels to update, how often to update them, and how many times the output data is to be repeated to obtain. The output data is scaled to the range and gain of the selected channels. This function uses internal triggering and clocks.

Task Id in is the Task Id corresponding to the board. This must be obtained from the DA Chan Configure VI. There is no default for this control.

Channel list is a list of the channels that are to be used for waveform generation. This is in string format. For a discussion of this format, see the section on channel addressing. The default setting is channel 0.

Sampling rate in is the rate at which each D/A will be updated.

Data In is a two dimensional array of output data. Its size is the product of the number of channels and the number of samples. DA Easy Wave assumes that the smallest dimension corresponds to the number of D/A channels to be updated.

Cycles is the number of times that the input data will be repeated. A setting of 0 selects continuous updates; however use of this mode is not recommended as there will be no way of stopping the VI. If continuous output is required, the low level VIs should be used individually, as shown in the DA Wave example VI.

SGL **Sampling Period Out** is the actual period between successive conversions on the same input channel. Note that this may not be exactly what would be expected from the Sampling Rate In control, as data acquisition boards can generally select sampling periods in finite sized steps.

U32 **Task Id out** is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Chapter 5

5. Analog input functions

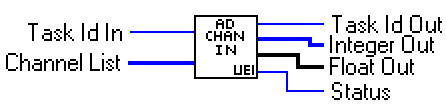
This chapter provides a description of the various analog input VIs used by the driver.

5.1. Analog input VI introduction

The analog input VIs are:

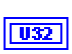
- AD Chan In : Acquires a single sample from each of a group of channels.
- AD Wave In : Low level analog input function. Starts a waveform acquisition process.
- AD Check : Low level analog input function. Checks to see whether a waveform acquisition started by AD Wave In has completed.
- AD Close To Integer : Low level analog input function. Completes a waveform input function started by AD Wave In. The output from the function is an array of integer data.
- AD Close To Single : Low level analog input function. Completes a waveform input function started by AD Wave In. The output from the function is an array of single precision floating point data.

5.2. AD Chan In

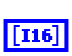


AD Chan In

AD Chan In obtains a single sample from each of the specified channels. The output data is available either as raw integer data, or as floating point data scaled to the range and gain of the selected channels.



Task Id in is the Task Id corresponding to the board. This must be obtained from the AD Chan Configure VI. There is no default for this control.



Channel list is a list of the channels that are to be measured. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is 0.

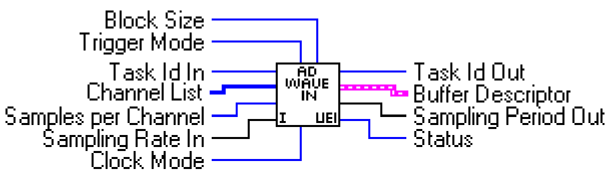
[I16] **Integer Out** is a one dimensional array of integer format output data. For information on data encoding, consult your hardware reference manual.

[SGL] **Float Out** is a one dimensional array of output data. It is scaled to the range and gain selected by the AD Chan Configure VI that preceded the AD Chan In operation. Data is in the same order as the Channel list array.

[U32] **Task Id out** is the Task Id corresponding to the board.

[I32] **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

5.3. AD Wave In



AD Wave In

AD Wave In starts a timed multi-channel input operation. You can specify which channels to sample, how often to sample them, and how many samples to obtain. You check for completion of the operation by using the AD Check VI, and complete the operation by using the AD Close VI.

Warning : The buffer descriptor output from the AD Wave In function must always find its way to a corresponding AD Close VI, regardless of any error conditions which may occur. If this is not done, any memory used by the AD Wave In function may become permanently lost.

[U32] **Task Id** in is the Task Id corresponding to the board. This must be obtained from the AD Chan Configure VI. There is no default for this control.

[I16] **Channel list** is a list of the channels that are to be measured. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is 0.

[I32] **Samples per channel** is the number of samples to be taken for each channel in the channel list. the default is 1024.

[SGL] **Sampling rate in** is the rate at which each samples will be taken. Note that this rate is NOT the same as the rate used by the AD Easy Wave function; actual sampling rate depends on the block size. The default sampling rate is 1 kHz.

[I16] **Block size** sets the size of blocks, for those boards that support block mode operations. Setting a block size of 1 is the same as setting a block size of zero. If block size is 0 or 1, then a single sample is taken on each clock pulse. In this case board throughput is equal to the sampling rate. If block size is greater than 1, then a number of samples equal to the block size are taken on each clock pulse (for boards that support simultaneous sampling, simultaneously). In this case the board throughput is equal to the product of the sampling rate and the block size. For more information on block mode sampling, see your hardware manual. Default block size is 0.

I16

Trigger mode selects the board's trigger mode, for those boards that support software programmable trigger modes. The default setting is internal. The following values are supported:

0 : Internal

1 : External

I16

Clock Mode selects whether the A/D clock is derived from the internal clock, or is supplied externally, for those boards that support software programmable clock sources. The default setting is internal. The following values are supported:

0 : Internal

1 : External

SGL

Sampling Period Out is the actual time between clock pulses. Note that may not be exactly what would be expected from the Sampling Rate In control, as data acquisition boards can generally select sampling periods only in finite sized steps.

Buffer descriptor provides information to the AD Check and AD Close VIs. You must not modify this information in any way.

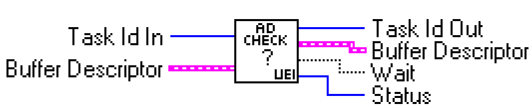
U32

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

I32

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

5.4. AD Check



AD Check

AD Check checks for the completion of an waveform input operation started by the AD Wave In VI.

U32

Task Id in is the Task Id corresponding to the board. This must be obtained from the AD Wave In VI. There is no default for this control.

Buffer descriptor provides status information from the AD Wave In VI. You must not modify this information in any way. The Buffer descriptor output should be wired to the AD Close function

U32

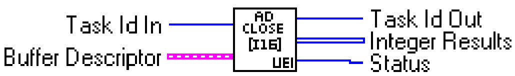
Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

TF

Wait is true if the function has not yet completed, and false if it has.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

5.5. AD Close to Integer



AD Close to Integer

AD Close to Integer closes a data acquisition operation started by AD Wave In. The output of this function is an array of 16-bit integers. For a version of this function that outputs scaled floating point values, see the AD Close To Single VI.

Task Id in is the Task Id corresponding to the board. This must be obtained from the AD Wave In VI or AD Check VI. There is no default for this control.

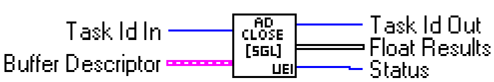
Buffer descriptor provides status information from the AD Wave In and AD Check VIs. You must not modify this information in any way.

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

Integer Results is a two dimensional array of output data. Its size is the product of the number of channels and the number of samples. For information on data encoding, consult your hardware reference manual.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

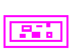
5.6. AD Close to Single



AD Close to Single

AD Close to Single closes a data acquisition operation started by AD Wave In. The output of this function is an array of floating point values. The size of this array will be twice that of an array of integer values. For a version of this function that outputs integer values, see the AD Close To Integer VI.

Task Id in is the Task Id corresponding to the board. This must be obtained from the AD Wave In VI or AD Check VI. There is no default for this control.



Buffer descriptor provides status information from the AD Wave In and AD Check VIs. You must not modify this information in any way.

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

[SGL] **Float Results** is a two dimensional array of output data. Its size is the product of the number of channels and the number of samples. It is scaled to the range and gain selected by the AD Chan Configure VI that preceded the AD Wave in operation.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Chapter 6

6. Analog Output functions

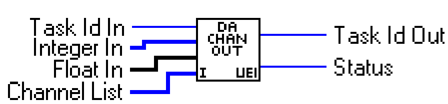
This chapter provides a description of the various analog output VIs used by the driver.

6.1. Analog output VI introduction

The analog output VIs are:

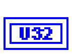
- DA Chan Out: This outputs a specified voltage on a group of analog output channels.
- DA Wave Out : Low level analog output function. Starts a waveform output process.
- DA Check : Low level analog input function. Checks to see whether a waveform output operation started by DA Wave Out has completed.
- DA Close : Low level analog output function. Completes a waveform output function started by DA Wave Out.

6.2. DA Chan Out

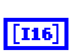


DA Chan Out

DA Chan Out writes a single value to each of the specified channels. The values can be either raw integer data, or floating point data scaled to the range of the selected channels.



Task Id in is the Task Id corresponding to the board. This must be obtained from the DA Chan Configure VI. There is no default for this control.



Channel list is a list of the channels to which data is to be written. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is 0.

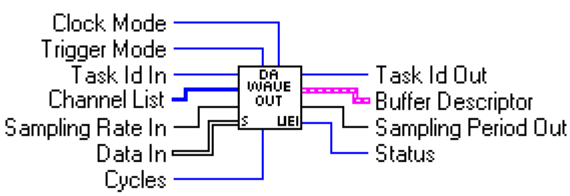
[I16] **Integer In** is a one dimensional array of integer format data to be written to the analog outputs. For information on data encoding, consult your hardware reference manual. Note that either integer OR floating point data, not both, must be supplied to this VI

[SGL] **Float In** is a one dimensional array of output data. It must be scaled to the range and gain selected by the DA Chan Configure VI that preceded the DA Chan Out operation. Data is in the same order as the Channel list array. Values that are out of range will be limited to the selected channel's output range.

[U32] **Task Id out** is the Task Id corresponding to the board.

[I32] **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

6.3. DA Wave Out



DA Wave Out DA Wave Out starts a timed multi-channel output operation. You can specify which channels to send data to, how often to update them, and how many times to repeat the data. You check for completion of the operation by using the DA Check VI, and complete the operation by using the DA Close VI.

Warning : The buffer descriptor output from the DA Wave Out function must always find its way to a corresponding DA Close VI, regardless of any error conditions which may occur. If this is not done, any memory used by the DA Wave Out function may become permanently lost.

[U32] **Task Id** in is the Task Id corresponding to the board. This must be obtained from the DA Chan Configure VI. There is no default for this control.

[I16] **Channel list** is a list of the channels to which data is to be written. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is 0.

[SGL] **Sampling rate in** is the rate at which the outputs will be updated. The default sampling rate is 1 kHz.

[I32] **Cycles** sets the number of times that the input data will be sent to the D/A converters. Setting a value of 0 repeats the data continuously until the DA Close Vi is called.

[I16] **Trigger mode** selects the board's trigger mode, for those boards that support software programmable trigger modes. The default setting is internal. The following values are supported:

0 : Internal

1 : External

Clock Mode selects whether the D/A clock is derived from the internal clock, or is supplied externally, for those boards that support software programmable clock sources. The default setting is internal. The following values are supported:

1 : Internal

0 : External

Data in is the waveform data to be sent to the D/A converters. This is scaled voltage data.

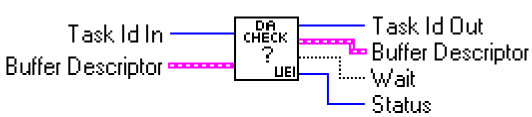
Sampling Period Out is the actual time between clock pulses. Note that may not be exactly what would be expected from the Sampling Rate In control, as data acquisition boards can generally select sampling periods only in finite sized steps.

Buffer descriptor provides information to the DA Check and DA Close VIs. You must not modify this information in any way.

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

6.4. DA Check



DA Check checks for the completion of an waveform output operation started by the DA Wave Out VI.

Task Id in is the Task Id corresponding to the board. This must be obtained from the DA Wave Out VI. There is no default for this control.

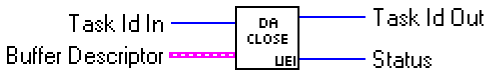
Buffer descriptor provides status information from the DA Wave Out VI. You must not modify this information in any way. The Buffer descriptor output should be wired to the DA Close function

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

Wait is true if the function has not yet completed, and false if it has.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

6.5. DA Close



DA Close closes a data acquisition operation started by DA Wave Out.

Task Id in is the Task Id corresponding to the board. This must be obtained from the DA Wave Out VI or DA Check VI. There is no default for this control.

Buffer descriptor provides status information from the DA Wave Out and DA Check VIs. You must not modify this information in any way.

Task Id out is the Task Id corresponding to the board. This must be used in all subsequent I/O operations.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Chapter 7

7. Digital I/O functions

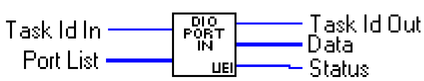
This chapter provides a description of the various digital I/O VIs used by the driver.

7.1. Digital I/O VI introduction

The digital I/O VIs are:

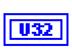
- DIO Port In : This inputs digital data from a group of digital input ports.
- DIO Port Out : This outputs digital data to a group of digital output ports.

7.2. DIO Port In



DIO Port In

DIO Port In obtains a single sample from each of the specified digital input ports.



Task Id in is the Task Id corresponding to the board. This must be obtained from the DIO Port Configure VI. There is no default for this control.

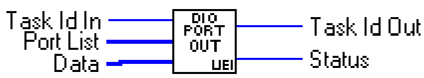
Port list is a list of the ports that are to be sampled. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is 0.

Data is a one dimensional array of integer format output data. Data is in the same order as is the port list. For information on data encoding, consult your hardware reference manual.

Task Id out is the Task Id corresponding to the board.

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

7.3. DIO Port Out



DIO Port Out

DIO Port Out writes a single value to each of the specified DIO ports.

U32

Task Id in is the Task Id corresponding to the board. This must be obtained from the DIO Port Configure VI. There is no default for this control.

[I16]

Port list is a list of the ports to which data is to be written. To convert from a string format channel list to the integer format required by this function, use the String To Int Chan List VI. The default setting is 0.

I32

Data is a one dimensional array of integer format data to be written. Each integer value represents the data for a single port. Data is in the same order as is the port list. For information on data encoding, consult your hardware reference manual.

U32

Task Id out is the Task Id corresponding to the board.

I32

Status contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Chapter 8

8. Utility functions

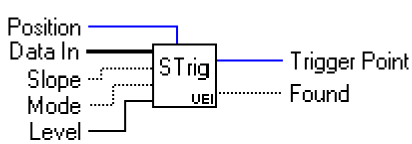
This chapter provides a description of the various utility VIs provided by the driver.

8.1. Utility VI introduction

The utility VIs are:

- Software Trigger : This function emulates the operation of a oscilloscope style analog trigger operation on a buffer with data in it.
- String To Int Chan List : This function converts a list of channels in string format to the integer array format required by most of the data acquisition functions.
- Synchronize : This function synchronizes the execution of multiple paths of data acquisition.

8.2. Software Trigger



Software Trigger Software Trigger looks for a trigger condition in an array of data, and return information on whether the condition was found, and the position at which the condition was found. This allows an analog trigger to be emulated in software. For a example of how to use this VI, study the AD Trig Wave VI.

Position sets the amount of pre-trigger data required. Effectively, the Software Trigger VI doesn't start searching for data in the first <Position> samples in the input buffer.

Data In is a the data to be searched. Note that this is a one dimensional array.

Slope is the slope of the trigger event to be searched for. If this is true, then a positive slope is searched for, and if it is false, a negative slope.

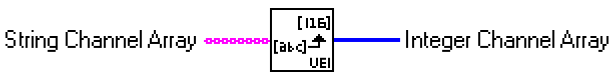
Mode is the trigger mode. If this is false, then found will always return true, regardless of whether a valid trigger was found. This is equivalent of "Auto" triggering on an oscilloscope; data will always be displayed. If it is true, found will only return true if a valid trigger condition was found.

Level sets the level at which the trigger condition will occur.

Trigger Point represents the offset into the data buffer at which the specified trigger condition occurred. If no trigger occurred, and Mode was false, then this will return 0.

Found is set if either a valid trigger condition occurred, or mode was false.

8.3. String To Int Chan List



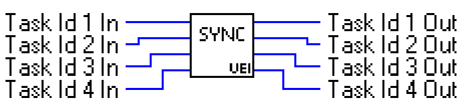
String to Int Chan List

String To Int Chan List converts a channel list in the form of a string array to a channel list formatted as an integer array.

String Channel Array is a list of the channels. This is in string format. For a discussion of this format, see the section on channel addressing. The default setting is channel 0.

Integer Channel Array is a list of the channels formatted as integers.

8.4. Synchronize



Synchronize

Synchronize synchronizes multiple paths of execution. For more information see the section on multiple execution paths.

Task Id 1 In is the Task Id corresponding to the first execution path to be synchronized. If this control is left unconnected it is ignored.

Task Id 2 In is the Task Id corresponding to the second execution path to be synchronized. If this control is left unconnected it is ignored.

Task Id 3 In is the Task Id corresponding to the third execution path to be synchronized. If this control is left unconnected it is ignored.

Task Id 4 In is the Task Id corresponding to the fourth execution path to be synchronized. If this control is left unconnected it is ignored.

Task Id 1 Out is the Task Id corresponding to the first execution path to be synchronized. Once this task ID emerges, all input paths to the VI have completed.

Task Id 2 Out is the Task Id corresponding to the second execution path to be synchronized. Once this task ID emerges, all input paths to the VI have completed.

Task Id 3 Out is the Task Id corresponding to the third execution path to be synchronized. Once this task ID emerges, all input paths to the VI have completed.

Task Id 4 Out is the Task Id corresponding to the fourth execution path to be synchronized. Once this task ID emerges, all input paths to the VI have completed.

Chapter 9

9. Signal processing VIs

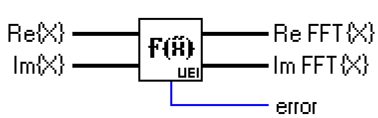
The various signal processing VIs perform various analysis functions such as frequency domain transforms on acquired data.

9.1. Signal processing introduction

The available signal processing functions are:

- FFT : performs a Fast Fourier Transform.
- Inverse FFT : performs an inverse Fast Fourier Transform.
- Hilbert transform : performs a Fast Hilbert Transform.
- Inverse Hilbert transform : performs an inverse Fast Hilbert Transform.
- Chirp-Z transform : Performs a Chirp-Z transform.
- Convolution : computes the convolution of two signals.
- Zero pad : Pads a waveform with zeros such that the waveform length is a power of two.

9.2. FFT



UEI FFT

The FFT function (UEI FFT) computes the FFT of an input sequence. If no imaginary input is connected, the VI performs an FFT on only the real-valued part. Note that this function is a "pure" FFT; if the length of the inputs are not powers of two, then they are truncated to the next lowest power of 2. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

Re{X} is the real valued part of the input sequence.

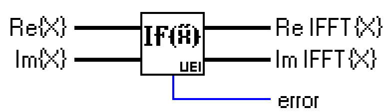
Im{X} is the imaginary valued part of the input sequence.

Re FFT{X} is the real valued part of the output sequence.

Im FFT{X} is the imaginary valued part of the output sequence.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

9.3. Inverse FFT



UEI Inverse FFT

The Inverse FFT function (UEI Inverse FFT) computes the inverse FFT of an input sequence. If no imaginary input is connected, the VI performs the function on only the real-valued part. Note that this function is a "pure" inverse FFT; if the length of the inputs are not powers of two, then they are truncated to the next lowest power of 2. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

Re{X} is the real valued part of the input sequence.

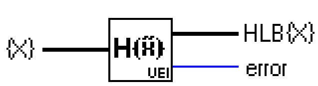
Im{X} is the imaginary valued part of the input sequence.

Re IFFT{X} is the real valued part of the output sequence.

Im IFFT{X} is the imaginary valued part of the output sequence.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

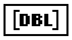
9.4. Hilbert transform



UEI Hilbert

The Hilbert transform function (UEI Hilbert) computes the fast Hilbert transform of an input sequence. Note that if the length of the input is not a power of two, then it is truncated to the next lowest power of 2. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

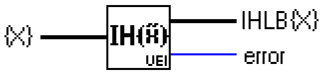
{X} is the input sequence.



HLB{X} is the output sequence.

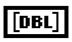
Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

9.5. Inverse Hilbert transform



UEI Inverse Hilbert

The Inverse Hilbert transform function (UEI Inverse Hilbert) computes the inverse fast Hilbert transform of an input sequence. Note that if the length of the input is not a power of two, then it is truncated to the next lowest power of 2. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

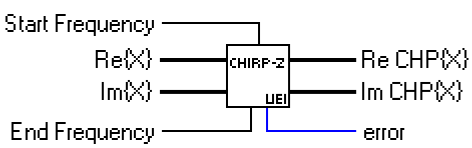


{X} is the input sequence.

IHLB{X} is the output sequence.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

9.6. Chirp-Z



UEI Chirp Z

The Chirp-Z function (UEI Chirp Z) computes the Chirp-Z transform of an input sequence. If no imaginary input is connected, the VI performs the transform on only the real-valued part. The Chirp-Z transform is similar to the FFT, but where the FFT always converts to the frequency domain over a fixed range of frequencies, the Chirp-Z allows the range of frequencies to be selected. Technically, the FFT algorithm evaluates over the unit circle in the z-plane, while the Chirp-Z evaluates over a user definable portion of the unit circle. The Chirp-Z VI provided here is not a full Chirp-Z transform; a full transform has parameters which allow the evaluation to take place not only over a portion of the unit circle as in this case, but over a arbitrary spiral in the z-plane.

Note that if the length of the inputs are not powers of two, then they are truncated to the next lowest power of 2. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

Re{X} is the real valued part of the input sequence.

Im{X} is the imaginary valued part of the input sequence. If no imaginary input is connected, the VI performs the transform on only the real-valued part.

DBL **Start Frequency** is the frequency at which the transform is to be started, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this control is 0.

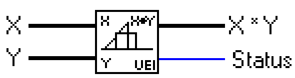
DBL **End Frequency** is the frequency at which the transform is to be ended, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this control is 1.

[DBL] **Re FFT{X}** is the real valued part of the output sequence.

[DBL] **Im FFT{X}** is the imaginary valued part of the output sequence.

I32 **Error** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

9.7. Convolution



UEI Convolution

The convolution VI (UEI Convolution) computes the convolution of X and Y. Note that this is NOT a circular convolution.

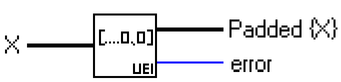
[DBL] **X** is the first sequence to be convolved.

[DBL] **Y** is the second sequence to be convolved.

[DBL] **X*Y** is the convolution of the two sequences.

I32 **Error** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

9.8. Zero pad



UEI Zero Pad

Zero pad (UEI Zero Pad) pads the input sequence with trailing zeros, such that the size of the output array is a power of 2. This is used when you want to use one of the transform VI's that require the length of their input data to be a power of two, on data that is not a power of two.

[DBL] **X** is the data to be padded.

[DBL] **Padded {X}** is the padded data.

I32 **Error** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Chapter 10

10. Window VIs

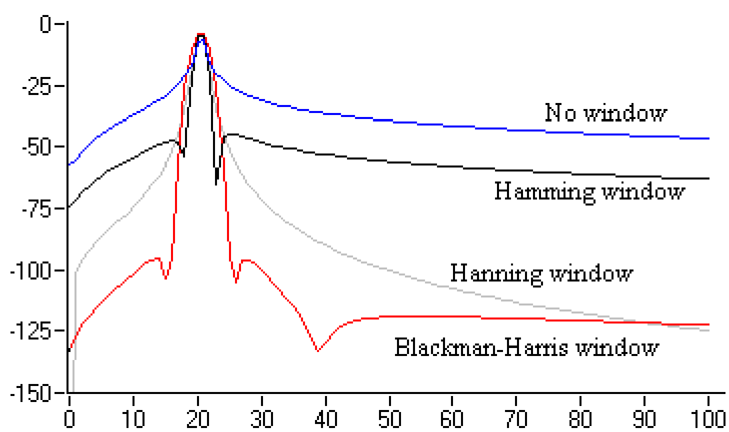
Window operations are used both for filter design and spectrum analysis.

10.1. Windows VI introduction

The following windows are available:

- Hamming window.
- Hanning window.
- Blackman-Harris window.

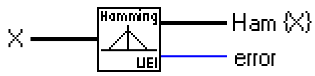
When a continuous waveform is sampled, the start and end of the sampling operation unavoidably introduce discontinuities. These discontinuities almost inevitably translate into the frequency domain as unwanted spectral leakage . This leakage can be reduced by applying a smoothing window. However, application of such a window has an undesirable side effect; the width of frequency components that actually are present is increased, making more difficult to precisely identify the presence or absence of signals. In general, there is a tradeoff between the degree to which a particular window suppresses spectral leakage, and the extent to which it broadens spectral components. The analysis library provides an assortment of windows offering different combinations of characteristics:



The other major application for smoothing windows is in the design of FIR filters . Analytic expressions are available for the tap weights for most simple FIR filters. These expressions are infinite in duration, and thus for practical applications, must be truncated. This results in a problem very similar to that discussed above, but known as Gibb's phenomenon. Once again, smoothing windows can reduce this effect.

Note that all of these window functions are normalized for operation as smoothing functions for use in spectrum analysis systems. They are scaled to compensate for power loss. When used for filter design, they must be scaled back to unity gain. See the FIR window coefficients VI for an example of how to do this.

10.2. Hamming window

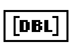


Hamming Window

This function applies a Hamming window to the input sequence.

Note : This window is normalized to preserve the average power in the input waveform. It must be scaled for use in filter design.

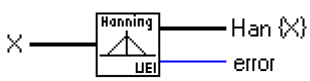
X is the data to be windowed.



Ham {X} is the windowed data.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

10.3. Hanning window

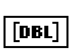


Hanning Window

This function applies a Hanning window to the input sequence.

Note : This window is normalized to preserve the average power in the input waveform. It must be scaled for use in filter design.

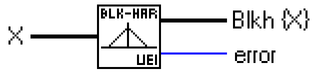
X is the data to be windowed.



Han {X} is the windowed data.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

10.4. Blackman-Harris window



Blackman Harris Window

This function applies a Blackman-Harris window to the input sequence. Note that this is the "4-term minimum" window, which provides over 92 dB of sidelobe rejection, not the more common 3-term version. This high sidelobe rejection makes this window very useful for data acquisition functions, as it reduces the level of spectral leakage to below the noise floor of even a 16-bit converter.

Note : This window is normalized to preserve the average power in the input waveform. It must be scaled for use in filter design.

X is the data to be windowed.

Blkh {X} is the windowed data.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

Chapter 11

11. Spectrum analysis VIs

Spectrum analysis VIs are used to estimate the spectral content of a sampled signal.

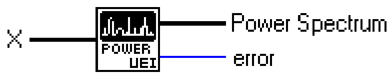
11.1. Spectrum analysis introduction

The following functions are available:

- Power spectrum : This VI computes the 2-sided power spectrum of a waveform.
- Linear spectrum : This VI computes the 2-sided voltage spectrum of a waveform.
- Power Chirp-Z spectrum : This VI computes the power spectrum of a waveform over a specified frequency interval.
- Linear Chirp-Z spectrum : This VI computes the voltage spectrum of a waveform over a specified frequency interval.
- Spectrum Analysis : This VI computes the single sided spectrum of a waveform in a format suitable for display in a graph. Output can be in voltage, power or dB's, and a smoothing window can be specified.
- Chirp-Z Spectrum Analysis : This VI computes the spectrum of a waveform over a specified frequency interval, in a format suitable for display in a graph. Output can be in voltage, power or dB's, and a smoothing window can be specified.

It should be noted that all of these functions are only capable of *estimating* the spectral content of a signal. For example, what were single spectral components in a continuous signal may be spread into multiple frequency bins by the sampling process. This is the so called "scalloping " loss or "picket fence effect ". Effects of this loss can vary from nothing to a window dependent maximum which can be from 4 dB (no window) to 0.83 dB (4-term Blackman-Harris). For more information, see for example "Digital Signal Processing", A.V.Oppenheim, R.W. Schafer, Prentice-Hall, 1975 and "On the Use of Windows for Harmonic Analysis with the Discrete Fourier Transform", F.J. Harris, Proc. IEEE, Vol 66, No. 1, January 1978.

11.2. Power Spectrum



UEI Power Spectrum

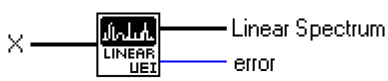
Power Spectrum (UEI Power Spectrum) computes the two sided power spectrum of an input sequence. If the input sequence is expressed in volts, then the output sequence represents power into 1 Ohm. The size of the input sequence must be a power of 2. If it is not, the sequence will be truncated. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

[DBL] **X** is the input sequence.

[DBL] **Power Spectrum** is the power spectrum.

I32 **Error** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

11.3. Linear Spectrum



UEI Linear Spectrum

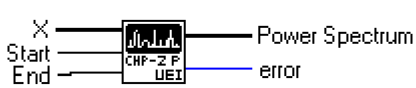
Linear Spectrum (UEI Linear Spectrum) computes the two sided linear spectrum of an input sequence. If the input sequence is expressed in volts, then the output sequence represents volts. This is calculated by taking the square root of the power sequence above. The size of the input sequence must be a power of 2. If it is not, the sequence will be truncated. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

[DBL] **X** is the input sequence.

[DBL] **Linear Spectrum** is the linear spectrum.

I32 **Error** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

11.4. Power Chirp-Z Spectrum



UEI Chp-Z Power Spectrum

Power Chirp-Z Spectrum (UEI Power Chirp-Z Spectrum) computes the power spectrum of an input sequence. The Chirp-Z transform is similar to the FFT process used by the Power Spectrum VI, but where the FFT always converts to the frequency domain over a fixed range of frequencies, the Chirp-Z allows the range of frequencies to be selected. Technically, the FFT algorithm evaluates over the unit circle in the z-plane, while the Chirp-Z evaluates over a user definable portion of the unit circle. If the input sequence is expressed in volts, then the output sequence represents power into 1 Ohm. The size of the input sequence must be a power of 2. If it is not, the sequence will be truncated. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

X is the input sequence.

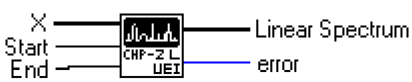
Start is the frequency at which the transform is to be started, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this control is 0.

End is the frequency at which the transform is to be ended, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this control is 1.

Power Spectrum is the power spectrum.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

11.5. Linear Chirp-Z Spectrum



UEI Chp-Z Linear Spectrum

Linear Chirp-Z Spectrum (UEI Linear Chirp-Z Spectrum) computes the linear spectrum of an input sequence. The Chirp-Z transform is similar to the FFT process used by the Power Spectrum VI, but where the FFT always converts to the frequency domain over a fixed range of frequencies, the Chirp-Z allows the range of frequencies to be selected. Technically, the FFT algorithm evaluates over the unit circle in the z-plane, while the Chirp-Z evaluates over a user definable portion of the unit circle. If the input sequence is expressed in volts, then the output sequence represents volts. This is calculated by taking the square root of the power sequence above. The size of the input sequence must be a power of 2. If it is not, the sequence will be truncated. If this is undesirable, then the Zero Pad VI can be used to pad out the sequence to the next higher power of 2.

X is the input sequence.

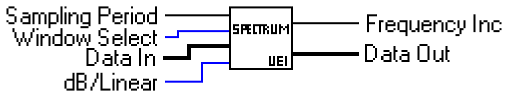
Start is the frequency at which the transform is to be started, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this is 0.

End is the frequency at which the transform is to be ended, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this is 1.

Linear Spectrum is the linear spectrum.

Error contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

11.6. Spectrum Analysis



Spectrum Analysis

The spectrum analysis VI computes the single sided spectrum of a waveform in a format suitable for display in a graph. Output can be in voltage, power or dB's, and a smoothing window can be specified. This VI processes the 2 sided output from the Power Spectrum VI into a format suitable for display. It correctly accounts for the effect of this operation on the DC component of the input sequence.

DBL **Sampling Period** is the sampling period of the input sequence, as for example provided by the AD easy Wave function.

U16 **Window Select** selects an optional smoothing window. Possible selections are:

0 : No window

1 : Hanning window

2 : Hamming window

3 : Blackman-Harris window

[DBL] **Data In** is the input sequence.

U16 **dB/Linear** selects the output format. Possible selections are:

0 : dB

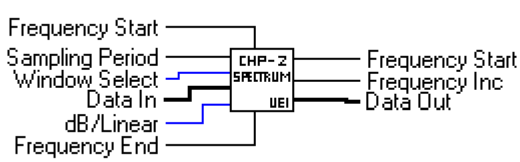
1 : Power; Watts into 1 Ohm

2 : Voltage

DBL **Frequency Inc** is the frequency increment between successive values in the output data. This can be used as an input to a waveform graph.

[DBL] **Data Out** is the spectrum output.

11.7. Chirp-Z Spectrum Analysis



Chirp-Z Spectrum Analysis

The Chirp-Z spectrum analysis VI computes the single sided spectrum of a waveform, over a specified frequency interval, in a format suitable for display in a graph. The Chirp-Z transform is similar to the FFT process used by the Spectrum Analysis VI, but where the FFT always converts to the frequency domain over a fixed range of frequencies, the Chirp-Z allows the range of frequencies to be selected. Technically, the FFT algorithm evaluates over the unit circle in the z-plane, while the Chirp-Z evaluates over a user definable portion of the unit circle. Output can be in voltage, power or dB's, and a smoothing window can be specified. This VI processes the 2 sided output from the Power Chirp-Z Spectrum VI into a format suitable for display. Note that this VI does NOT correct for the effects of this operation on the DC component of the input sequence.

DBL

Frequency Start is the frequency at which the transform is to be started, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this control is 0.

DBL

Frequency End is the frequency at which the transform is to be ended, scaled such that 1 is equivalent to half the sequence's sampling frequency. The default value for this control is 1.

DBL

Sampling Period is the sampling period of the input sequence, as for example provided by the AD easy Wave function.

U16

Window Select selects an optional smoothing window. Possible selections are:

0 : No window

1 : Hanning window

2 : Hamming window

3 : Blackman-Harris window

[DBL]

Data In is the input sequence.

U16

dB/Linear selects the output format. Possible selections are:

0 : dB

1 : Power; Watts into 1 Ohm

2 : Voltage

DBL

Frequency Start Out is the frequency at which the output data starts, scaled to the sampling frequency. This can be used as an input to a waveform graph.

DBL

Frequency Inc is the frequency increment between successive values in the output data. This can be used as an input to a waveform graph.

[DBL]

Data Out is the spectrum output.

Chapter 12

12. Filter VIs

The filter VIs are used to filter waveforms.

12.1. Filter VI introduction

The following filter VIs are available:

- FIR coefficients : Calculates the coefficients of specified FIR (Finite Impulse Response) filter.
- FIR window coefficients : Calculates the coefficients of specified FIR filter, using a specified smoothing window.
- FIR Filter : Performs a FIR filtering operation on data sequence.

FIR (Finite Impulse Response) filters have several advantages over other possible digital filter realizations such as Infinite-duration Impulse Response (IIR) filters:

i. They are always stable,

ii. always realizable, and

ii. can always be designed to have linear phase.

The easiest design technique is windowed design . Although other techniques, notably the Parks-McClellan algorithm, can lead to shorted filters, these algorithms do not always converge. In addition, the LabVIEW ® environment is not particularly memory or processing power bound.

Briefly, the windowed design technique follows these steps:

i. Choose a window which gives the desired stopband attenuation. Note that stopband attenuation is not the same as the sidelobe attenuation discussed previously with respect to spectrum analysis.

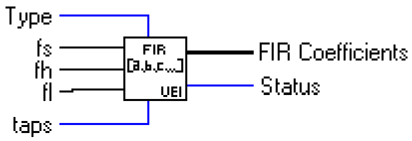
ii. Using the required transition width (the frequency width from the edge of the passband to the edge of the stopband) from the filter specification, and the transition width of the selected window, calculate the number of taps required in the filter.

iii. Use the analytic filter design formulas to obtain an expression giving the tap weights (or coefficients) for the filter.

iv. Window the resulting tap weights with the selected window.

For an algorithm and numerical values for this technique, see the Filter Estimate example VI, and for a simple tutorial on it, see "Digital Signal Processing Laboratory", V.K. Ingle, J.G. Proakis, Analog Devices/Prentice Hall, 1991.

12.2. FIR coefficients



UEI FIR Coefficients

The FIR coefficients (UEI FIR Coefficients) VI computes the tap weights for a FIR filter, based on FIR design formulas. This VI always designs linear phase filters, both for odd and even filter lengths.

U16 **Type** selects the type of filter. Possible selections are:

0 : Lowpass

1 : Highpass

2 : Bandpass

3 : Bandstop

The default value is 0.

DBL **fs** is the sampling frequency of the input sequence to the FIR filter. The default value is 1.

DBL **fl** is the low cutoff frequency. This must be between 0 and fs/2. The default value is 0.12.

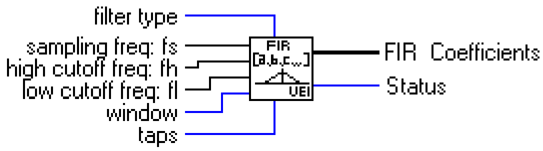
DBL **fh** is the high cutoff frequency. This must be between fl and fs/2. This is ignored for lowpass and highpass filters. The default value is 0.45

I32 **Taps** is the number of taps in the filter. This is the size of the output array.

[DBL] **FIR Coefficients** are the filter weights.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

12.3. FIR Windowed coefficients



UEI FIR Window Coefficients

The FIR Windowed coefficients (UEI FIR Window Coefficients) VI computes the tap weights for a FIR filter, based on FIR design formulas and a selected window. This VI always designs linear phase filters, both for odd and even filter lengths.

U16 **Type** selects the type of filter. Possible selections are:

0 : Lowpass

1 : Highpass

2 : Bandpass

3 : Bandstop

The default value is 0.

DBL **fs** is the sampling frequency of the input sequence to the FIR filter. The default value is 1.

DBL **fl** is the low cutoff frequency. This must be between 0 and fs/2. The default value is 0.12.

DBL **fh** is the high cutoff frequency. This must be between fl and fs/2. This is ignored for lowpass and highpass filters. The default value is 0.45

U16 **Window** selects an optional smoothing window. Possible selections are:

0 : No window

1 : Hanning window

2 : Hamming window

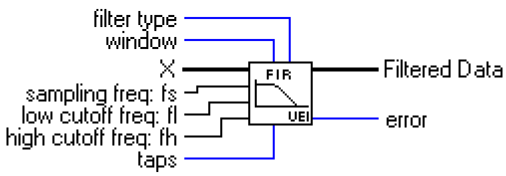
3 : Blackman-Harris window

I32 **Taps** is the number of taps in the filter. This is the size of the output array.

[DBL] **FIR Coefficients** are the filter weights.

I32 **Status** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

12.4. FIR Filter



UEI FIR Filter

The FIR Filter (UEI FIR Filter) VI implements a FIR filter. It computes the tap weights for a FIR filter, based on FIR design formulas and a selected window, then filters the input sequence with this filter. This VI always designs linear phase filters, both for odd and even filter lengths.

U16 **Filter Type** selects the type of filter. Possible selections are:

0 : Lowpass

1 : Highpass

2 : Bandpass

3 : Bandstop

The default value is 0.

DBL **Sampling Freq**: **fs** is the sampling frequency of the input sequence to the FIR filter. The default value is 1.

DBL **Low cutoff Freq: fl** is the low cutoff frequency. This must be between 0 and fs/2. The default value is 0.12.

DBL **High cutoff freq: fh** is the high cutoff frequency. This must be between fl and fs/2. This is ignored for lowpass and highpass filters. The default value is 0.45

U16 **Window** selects an optional smoothing window. Possible selections are:

0 : No window

1 : Hanning window

2 : Hamming window

3 : Blackman-Harris window

I32 **Taps** is the number of taps in the filter. This is the size of the output array.

[DBL] **X** is the input sequence.

[DBL] **Filtered Data** is the filtered sequence.

I32 **Error** contains the VI error code. Negative values indicate an error. See the section on error codes for more information on these.

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