µDAQ-Lite

User's Manual

Eagle Technology – Cape Town, South Africa

www.eagledaq.com

µDAQ-Lite Remote Devices

Data Acquisition and Process Control

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Product Warranty
Eagle Technology, South Africa, warrants its products from defect in material and workmanship from confirmed date of purchase for a period of one year if the conditions listed below are met. The product warranty will call the Eagle Technology Data Acquisition Device short as **ETDAQD**.

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- That a qualified person configure and install the **ETDAQD**, and damages caused to a device during installation shall make the warranty void and null.
- The warranty will not apply to conditions where the **ETDAQD** has been operated in a manner exceeding its specifications.

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1. Introduction

The μDAQ-Lite devices are Universal Serial Bus architecture data acquisition devices. They are part of the μDAQ series, more specifically digital I/O and Analog I/O for USB.

The μDAQ-Lite has support for eight digital input, eight digital output lines, one counter, two analog output, and eight analog inputs.

Features

The μDAQ-Lite series has some very unique features and are listed below:

- USB Revision 1.1 compliant @ full speed.
- Powered by USB port.
- TTL compatible digital I/O ports.
- 16-bit counter-timer.
- Channel list and voltage range scanning @ 49 KHz.
- 12-bit Analog I/O resolution.
- Quick and effortlessly to install.

Applications

The μDAQ-Lite series can be used in the following applications:

- Automation test equipment.
- TTL compatible status monitoring.
- Plant/Factory process control.
- Pulse counting.
- Controlling and monitoring of any TTL compatible equipment.
- Mobile computing.
- Laboratory applications

Key Specifications

- 1 x 8-bit digital output port.
- 1 x 8-bit digital input port.
- 1 x 16-bit counter.
- Fully programmable digital input/output system.
- Fully programmable counter-timer system.
- 12-bit Resolution analog input system with a max range of ±10 volt.
- Fully programmable channel/gain list @ 49 KHz.
- 12-bit Resolution analog output system with a range of ±10 volt.

Software Support

The μDAQ-Lite series is supported by EDRE SDK and has an extensive range of examples. The software will help you to get your hardware going very quickly. It also makes it easy to develop complicated control applications. All operating system drivers, utility and test software are supplied on the EDR Enhanced CD-Rom. The latest drivers can also be downloaded from the Eagle Technology website. For further support information see the Contact Details section.

Contact Details

Below are the contact details of Eagle Technology.

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2. Installation

This chapter describes how to install and configure the μDAQ-Lite device for the first time. Minimal configuration is necessary; almost all settings are done through software. The operating system will take care of all resource assignments.

Package

μDAQ package will contain the following:

- μDAQ-Lite device.
- USB cable.
- Software CD-Rom.

Operating System Support

The μDAQ-Lite series support the Windows Driver Models (WDM) driver types. The operating systems are listed in the table below.

Board Type	Revision	Operating Systems	Driver Type
μDAQ-Lite	Revision 1	Windows 2000/98/ME/XP	WDM PnP

Table 2-1 Operating System Support

Installation

This section will describe how to connect your USB device to your computer.

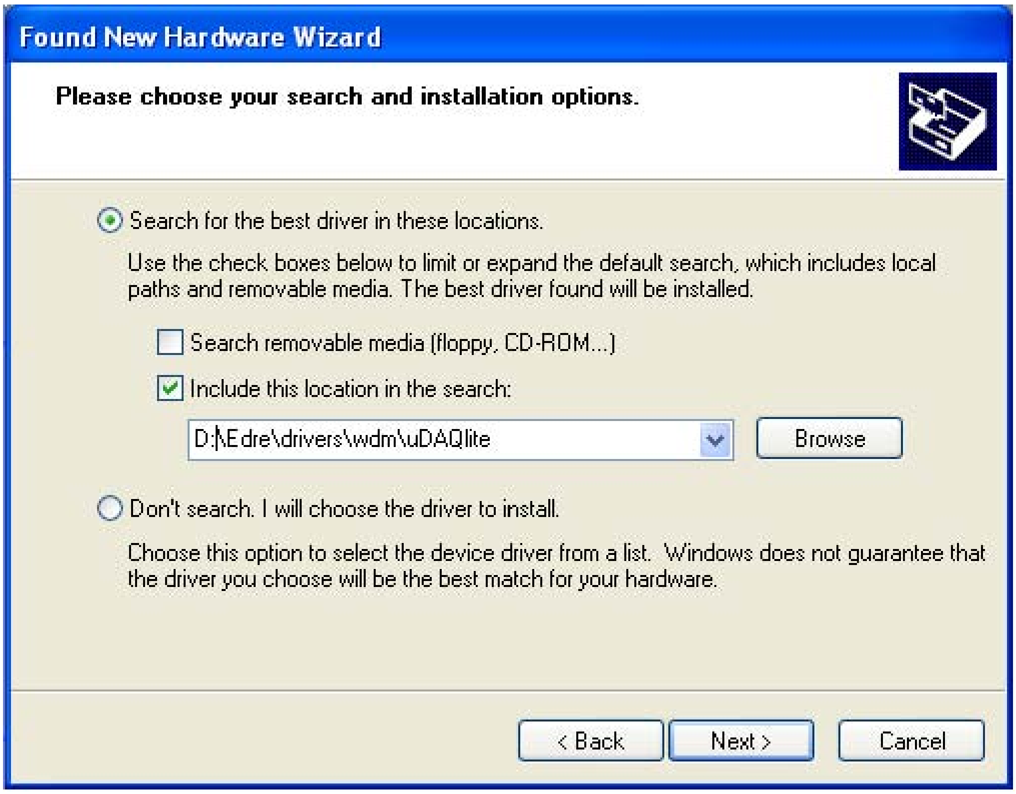
- Select any unused USB port and plug-in the A-side of the USB cable.
- Pug-in the B-side of the cable into the USB device.
- The operating system should immediately detect a new device was installed.

PnP Installation

Installing the Windows 98/2000/XP device driver is a very straightforward task. Because it is plug and play Windows will detect a new device was installed. No setup is necessary. You simply have to supply Windows with a device driver.

Wait until Windows detects the new hardware

Select the Advanced option and click "Next"



Select “Search for the best driver in these locations”

You can enter the directory path on the CDROM where the driver can be found or select to “Browse” the CDROM. If you opt to browse, search for the uDAQlite.inf file on the Eagle CD-Rom.

The driver is normally located in the <CDROM>:\EDRE\DRIVERS\WDM\uDAQlite directory.

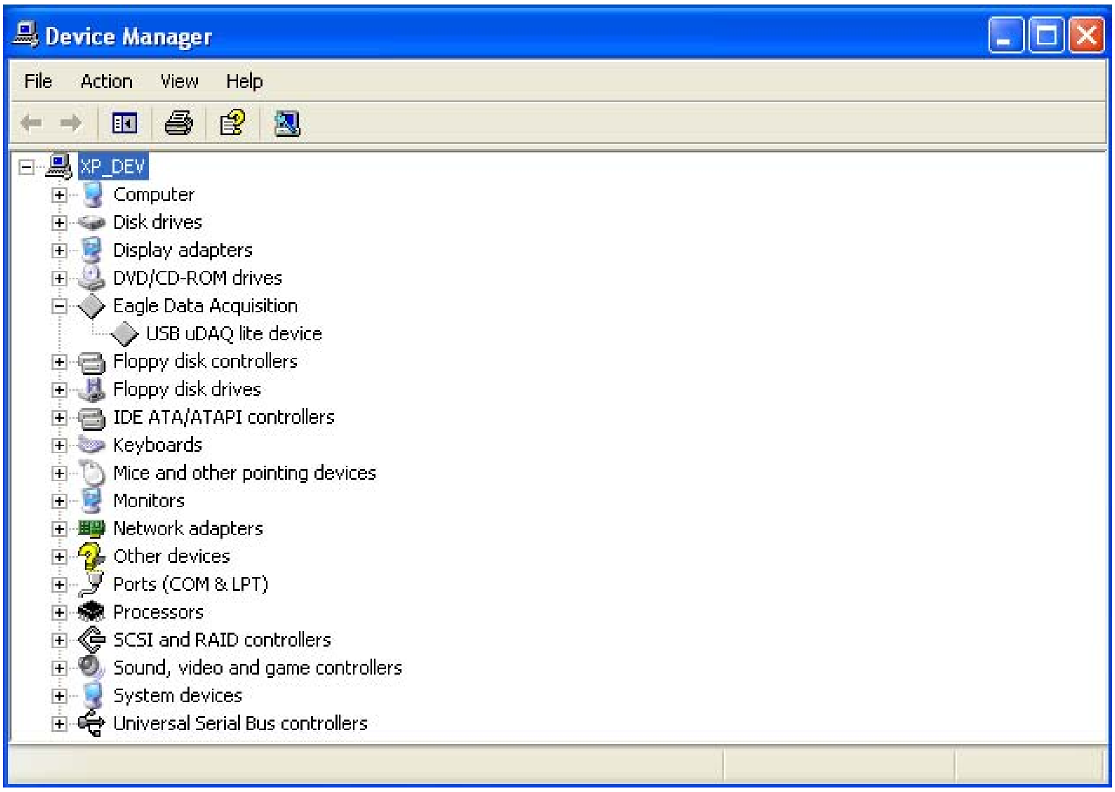
Click “Next”

When done you might have to restart your computer.

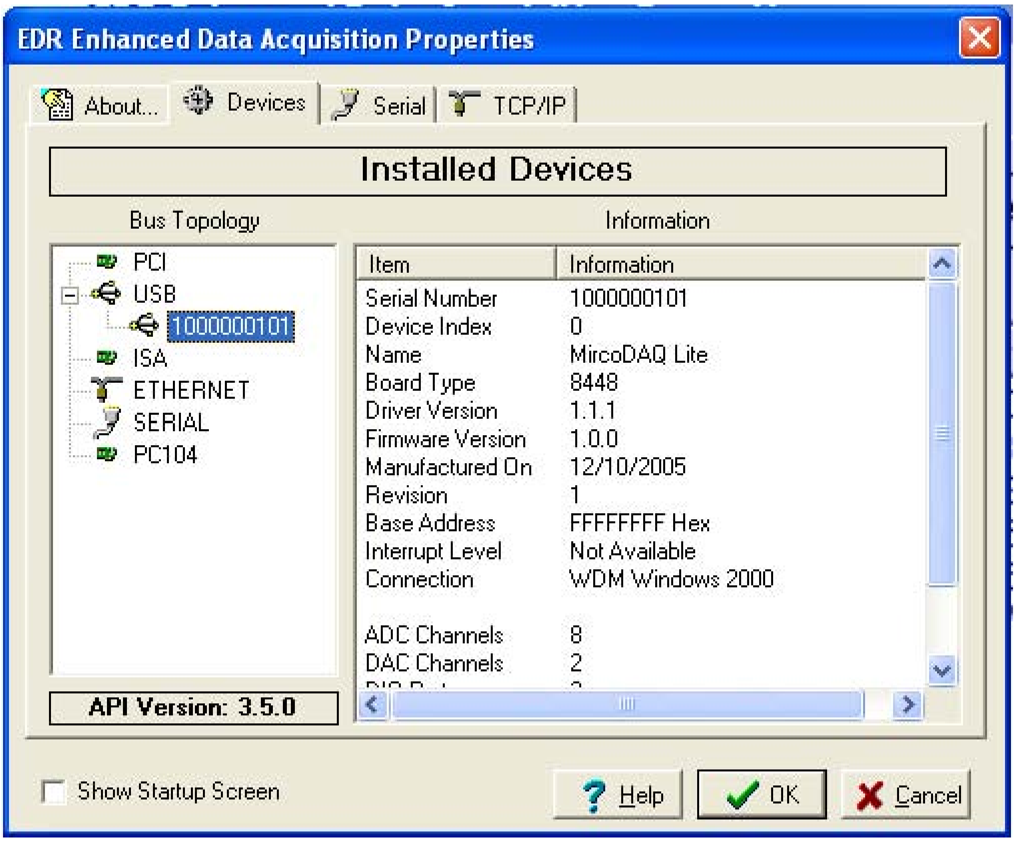
Post installation

When done with the driver installation the device manager can be open to make sure the installation was a success.

- First make sure that the driver is working properly by opening the *Device Manager*.
- Check under the Eagle Data Acquisition list if your board is listed and working properly. See picture below.



- Run ***edreapi.exe*** found on the Eagle CD-Rom and follow the on screen instructions. Edreapi.exe will install activex controls and libraries needed by applications controlling the hardware. (Normally located in <CDROM>:\EDRE\API directory)
- You can now verify that installation was successful by opening the control panel and then the "*EDR Enhanced Setup"* folder. This dialog should list all installed hardware. Verify your board's properties on this dialog. See picture below



Application Software

The EDR Enhanced Software Development Kit CD-Rom comes with WaveView for Windows™. WaveView has support for Analog Inputs, Analog Outputs, Digital I/O.

WaveView can be found on the EDR Enhanced CD-Rom. (Normally located in <CDROM>:\EDRE\APPS\WVFW directory)

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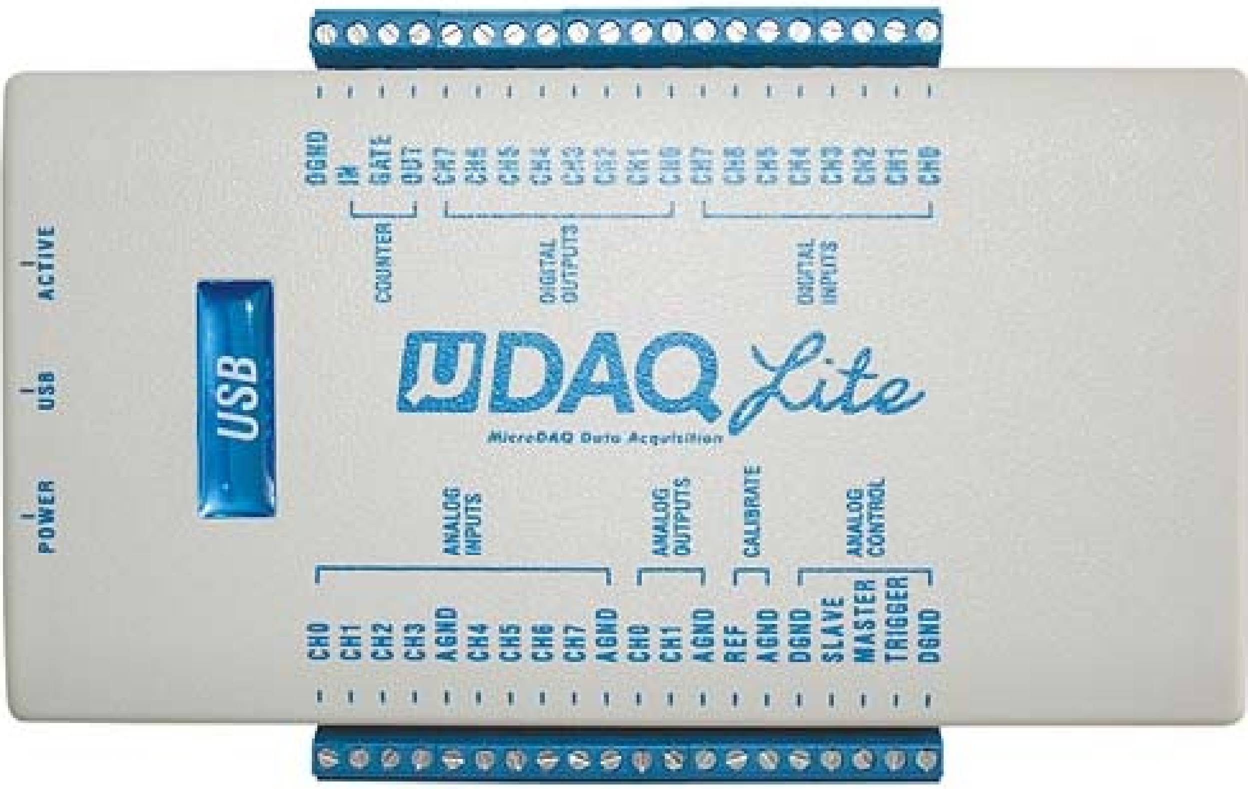
3. Interconnections

The µDAQ-Lite has connectors for digital I/O, counter-timers and analog I/O. The µDAQ-Lite make use of screw terminals for easy access. The screw terminal has a hole diameter of 1.15mm – 0.03mm.

Pin Assignments



Pin Descriptions

Channel (CH0-7)

Channel can symbolize a digital input, digital output, analog input, or analog output.

Analog Ground (AGND)

These lines are the analog reference ground the analog inputs and outputs.

Reference (REF)

The reference line is used for calibration purpose only and should never be use as a supply voltage.

Analog Trigger (TRIGGER)

This is the external gate for the analog input sampling system.

Master Clock (MASTER)

When synchronizing two or more of the μDAQ-Lite devices this pin can be used to output a clock frequency. The signal are referenced to digital ground (DGND)

Slave Clock (SLAVE)

This pin is used as the external clock source for analog sampling. It is used to control the convert timing of the analog to digital converter. The signal must be referenced to digital ground (DGND).

Digital Ground (DGND)

All digital ground signals (DIO & counter) should be connected to this pin.

Counter Input (IN)

The pin is used for the external clock source to the counter. The signal must be referenced to digital ground (DGND).

Counter Output (OUT)

This is the output of the counter. The signal are be referenced to digital ground (DGND).

Counter Gate (GATE)

The pin is used for the external gate to the counter. The signal must be referenced to digital ground (DGND).

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4. Programming Guide

The µDAQ-Lite is supplied with a complete software development kit. EDR Enhanced (EDRE SDK) comes with drivers for many operating systems and a common application program interface (API). The API also serves as a hardware abstraction layer (HAL) between the control application and the hardware. The EDRE API makes it possible to write an application that can be used on all hardware with common sub-systems.

EDR Enhanced API

The EDR Enhanced SDK comes with both ActiveX controls and a Windows DLL API. Examples are provided in many different languages and serve as tutorials. EDRE is also supplied with a software manual and user's guide.

The EDRE API hides the complexity of the hardware and makes it really easy to program the µDAQ-Lite device. It has got functions for each basic sub-system and is real easy to learn.

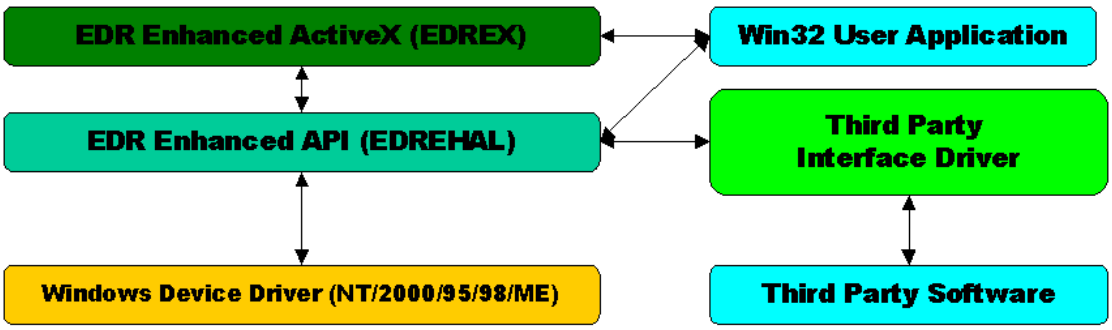

Figure 4-1 EDR Enhanced Design

Digital Inputs/Outputs

The µDAQ-Lite device can has 8 digital input and 8 digital output lines. All digital lines conform to TTL specifications.

Reading the Digital Inputs

A single call is necessary to read a digital input port. The '**Port**' parameter will always be equal to 0 because there is only one input port available.

API-CALL
Long EDRE_DioRead(ulng Sn, ulng Port, ulng *Value)
The serial number, port, and a pointer to variable to hold the result must be passed by the calling function. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDREDioX.Read(long Port)
Only the port-number needs to be passed and the returned value will either hold an error or the value read. If the value is negative an error did occur.

Writing to the Digital Outputs

A single call is necessary to write to a digital output port. The '**Port**' parameter will always be equal to 0 because there is only one output port available.

API-CALL
Long EDRE_DioWrite(ulng Sn, ulng Port, ulng Value)
The serial number, port, and a value must be passed by the calling function. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDREDioX.Write(long Port, long Value)
The port number and value to be written needs to be passed and the returned value holds an error or the value read. If the value is negative an error did occur.

Counter

The counter sub-system is supported by functions to Write, Read, Configure and controlling the gate. There is only 1 counter. The table below shows the relation of the counter and its software assigned number.

Counter	Assigned Number	Description
CT0	0	Counter 0

Table 4-1 Counter Assignment

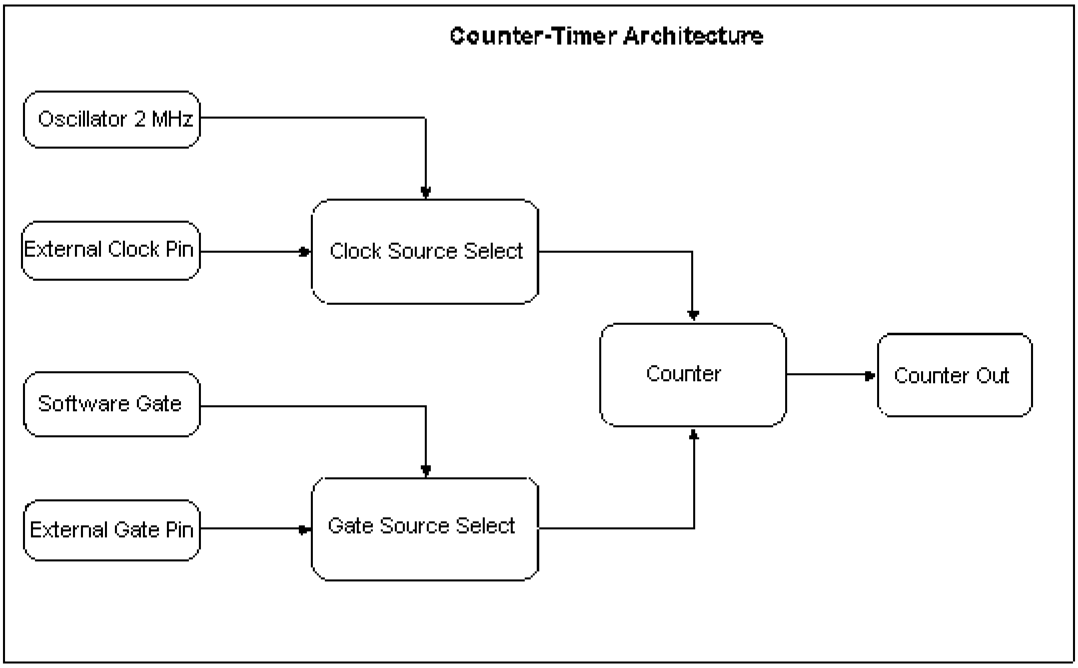

Figure 4-2 Counter-Timer Architecture

Architecture

The clock source and gate can be selected via software. The clock source can either be internal or external. The gate can also be either inter or external. The internal gate is controlled via software as well.

Writing the initial counter value

A single call is necessary to write a counter's initial load value.

API-CALL
Long EDRE_CTWrite(ulng Sn, ulng Ct, ulng Value)
The serial number, counter-number, and a value must be passed by the calling function. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDRECTX.Write(long Port, ulng Value)
The counter-number and a value must be passed by the calling function. A return code will indicate if any errors occurred.

Reading the counter value

A single call is necessary to read a counter.

API-CALL
Long EDRE_CTRead(ulng Sn, ulng Ct, pulng Value)
The serial number, counter-number, and a reference parameter must be passed by the calling function. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDRECTX.Read(long Port)
The counter number must be passed by the calling function. If the return code is negative it means an error occurred, otherwise it will be the value read from the counter.

Configuring a counter

A single call is necessary to configure a counter.

API-CALL
Long EDRE_CTConfig(ulng Sn, ulng Ct, ulng Mode, ulng Type, ulng ClkSrc, ulng GateSrc)
The serial number, counter-number, mode, type, clock source and gate source is needed to specify a counter's configuration. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDRECTX.Configure(long ct, long mode, long type, ulng source, ulng gate)
The counter-number, mode, type, clock source and gate source is needed to specify a counter's configuration. A return code will indicate if any errors occurred.

The μDAQ-Lite only uses the counter clock and gate parameters. The table below shows the options for each parameter.

Parameter	Description
Sn	Serial Number
Ct	Counter Number: 0 : Counter 0
Mode	NOT USED
Type	NOT USED
Source	0 : Internal (2 MHz) 1 : External (External connector)
Gate	0 : Internal 1 : External (External connector)

Table 4-2 Counter Configuration

Controlling the counter gate

A single call is necessary to control a counter's gate.

API-CALL
Long EDRE_CTSoftGate(ulng Sn, ulng Ct, ulng Gate)
The serial number, counter-number and gate are needed to control a counter's gate. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDRECTX.SoftGate(ulng Ct, ulng Gate)
The counter-number and mode is needed to control a counter's gate. A return code will indicate if any errors occurred.

These values are acceptable as a gate source.

Value	Description
0	Gate disabled
1	Gate enabled

Table 4-3 Gate Configuration

Analog Output

The µDAQ-Lite has 2 x 12-bit analog output channels with a range of ±10 volt. These channels are very easy to program. A single command is used to write to them.

Writing to a DAC channel

A single call is necessary to set a voltage on a DAC channel. The table below shows the relation between the software channel and the channel on the connector.

Assigned Software Channel	Assigned Connector Pin
0	DAC0
1	DAC1

Table 4-4 Assigned DAC Channels

API-CALL
Long EDRE_DAWrite (ulng Sn, ulng Channel, long uVoltage)
The serial number, DAC channel and micro-voltage is needed to set a DAC channel's voltage. A return code will indicate if any errors occurred.

ACTIVEX CALL
Long EDREDAX.Write (ulng Channel, long uVoltage)
The DAC channel and micro-voltage is needed to set a DAC channel's voltage. A return code will indicate if any errors occurred.

Analog Input

The μDAQ-Lite has a very flexible analog input sub-system. Configuration includes dynamic range, gain and differential or single ended inputs. Each of these settings can be applied to an individual channel while scanning.

The analog inputs can operate in two modes, single read or scanning. Only one mode can be used at a single moment. The table below shows the relation between the software assigned channels and the connector.

Assigned Software Channel	Input Type	Input Pin	Reference Pin
0	Single	ACH0	AGND
...	...	...	...
7	Single	ACH7	AGND
0	Differential	ACH0	ACH1
1	Differential	ACH2	ACH3
2	Differential	ACH4	ACH5
3	Differential	ACH6	ACH7
4	Differential	ACH1	ACH0
5	Differential	ACH3	ACH2
6	Differential	ACH5	ACH4
7	Differential	ACH7	ACH6

Table 4-5 Assigned Analog Input Channels

Reading a single voltage from a channel

To read a single ADC channel you need to specify the channel, voltage range and gain.

API-CALL

Long EDRE_ADSingle (ulng Sn, ulng Channel, ulng Gain, ulng Range, plong uVoltage)

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Sn</td><td>Unsigned long</td><td>Device serial number</td></tr>
<tr><td>Channel</td><td>Unsigned long</td><td>ADC channel to read</td></tr>
<tr><td>Gain</td><td>Unsigned long</td><td>Gain Codes
<table>
<tr><th>Value</th><th>Single-ended Gain</th><th>Differential-ended Gain</th></tr>
<tr><td>0</td><td>X ¼ (±10V)</td><td>X ⅛ (±20V)</td></tr>
<tr><td>1</td><td></td><td>X ¼ (±10V)</td></tr>
<tr><td>2</td><td></td><td>X ½ (±5V)</td></tr>
<tr><td>3</td><td></td><td>X ⅝ (±4V)</td></tr>
<tr><td>4</td><td></td><td>X 1 (±2.5V)</td></tr>
<tr><td>5</td><td></td><td>X 1.25 (±2V)</td></tr>
<tr><td>6</td><td></td><td>X 2 (±1.25V)</td></tr>
<tr><td>7</td><td></td><td>X 2.5 (±1V)</td></tr>
</table></td></tr>
<tr><td>Range</td><td>Unsigned long</td><td>Range Codes
<table>
<tr><th>Value</th><th>Range</th></tr>
<tr><td>0</td><td>BIPOLAR, SINGLE-ENDED</td></tr>
<tr><td>1</td><td>BIPOLAR, DIFFERENTIAL-ENDED</td></tr>
</table></td></tr>
<tr><td>uVoltage</td><td>Pointer to long</td><td>Returned micro voltage</td></tr>
<tr><td>Return</td><td>long</td><td>Error code</td></tr>
</table>

ACTIVEX CALL

Long EDREADX.SingleRead (long Channel)

Make sure to set the *Gain* and *Range* properties of the ADC ActiveX control. This will in turn set the range and gain when reading the ADC channel.

Configuring the ADC subsystem for scanning

This is the most complicated part of configuring the μDAQ-Lite for auto scanning. Make sure that you use the correct format when applying the channel list configuration. There are many loopholes and care should be taken when implementing code to configure the μDAQ-Lite.

API-CALL

Long EDRE_ADConfig (ulng Sn, pulng Freq, ulng ClkSrc, ulng Burst, ulng Range, pulng ChanList, pulng GainList, ulng ListSize)

The following parameters must be specified when configuring the ADC sub-system.

<table>
<tr><th>Parameter</th><th>Type</th><th>Description</th></tr>
<tr><td>Sn</td><td>Unsigned long</td><td>Device serial number</td></tr>
<tr><td>Frequency</td><td>Pointer to an unsigned long</td><td>ADC Sampling frequency</td></tr>
<tr><td>ClkSrc</td><td>Unsigned long</td><td>This parameter is used to configure the clock/convert source of the ADC sub-system.
<table>
<tr><th>Offset (bits)</th><th>Description</th></tr>
<tr><td>0</td><td>Clock Source (C0-C7)
0: Internal 2 MHz clock
1: External (SLAVE)</td></tr>
<tr><td>8</td><td>Trigger Source (G0-G7)
0: Disable
1: External Trigger (TRIGGER)</td></tr>
</table>
Example Layout:
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>G7</td><td>G6</td><td>G5</td><td>G4</td><td>G3</td><td>G2</td><td>G1</td><td>G0</td><td>C7</td><td>C6</td><td>C5</td><td>C4</td><td>C3</td><td>C2</td><td>C1</td><td>C0</td></tr>
</table>
</td></tr>
<tr><td>Burst</td><td>Unsigned long</td><td>Not Used</td></tr>
<tr><td>Range</td><td>Unsigned long</td><td>Not used</td></tr>
<tr><td>ChanList</td><td>Pointer to an unsigned long</td><td>This is a pointer to an array that contains the list of channels to be scanned. The array length should be the same length as the value of ListSize</td></tr>
<tr><td>GainList</td><td>Pointer to an unsigned long</td><td>GainList is an array that contains the gain/range settings for each channel in the scan list. The array length should the same as the ListSize value.
<table>
<tr><th>Offset (bits)</th><th>Description</th></tr>
<tr><td>0</td><td>Specifies the gain of the channel.(G)
<table>
<tr><th>Value</th><th>Single-ended Gain</th><th>Differential-ended Gain</th></tr>
<tr><td>0</td><td>X ¼ (±10V)</td><td>X ⅛ (±20V)</td></tr>
<tr><td>1</td><td></td><td>X ¼ (±10V)</td></tr>
<tr><td>2</td><td></td><td>X ½ (±5V)</td></tr>
<tr><td>3</td><td></td><td>X ⅝ (±4V)</td></tr>
<tr><td>4</td><td></td><td>X 1 (±2.5V)</td></tr>
<tr><td>5</td><td></td><td>X 1.25 (±2V)</td></tr>
<tr><td>6</td><td></td><td>X 2 (±1.25V)</td></tr>
<tr><td>7</td><td></td><td>X 2.5 (±1V)</td></tr>
</table>
</td></tr>
<tr><td>8</td><td>Specifies the range of the channel. (R)
<table>
<tr><th>Value</th><th>Range</th></tr>
<tr><td>0</td><td>BIPOLAR, SINGLE-ENDED</td></tr>
<tr><td>1</td><td>BIPOLAR, DIFFERENTAIL-ENDED</td></tr>
</table>
</td></tr>
</table>
Example Layout:
<table>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>R7</td><td>R6</td><td>R5</td><td>R4</td><td>R3</td><td>R2</td><td>R1</td><td>R0</td><td>G7</td><td>G6</td><td>G5</td><td>G4</td><td>G3</td><td>G2</td><td>G1</td><td>G0</td></tr>
</table>
</td></tr>
<tr><td>ListSize</td><td>unsigned long</td><td>This is the length of the channel list.</td></tr>
<tr><td>Return</td><td>long</td><td>Error code</td></tr>
</table>

ACTIVEX CALL

Long EDREADX.Configure (plong Channels, plong Gains, long ListSize)

The *Frequency* and *ClockSource* ADC ActiveX control must be setup before calling the configure function. See the above table for the layout of the Channels and Gains lists.

EDREADX.Frequency

This is the sampling frequency of the ADC process. This parameter must be set before calling the Configure method. After calling the Configure method the Frequency property will be set to the actual sampling frequency.

EDREADX.ClockSource
The clock source property is used to specify the clock settings for the ADC process.

Offset (bits)	Description
0	Clock Source (C0-C7) 0: Internal 2 MHz clock 1: External Convert (SLAVE)
8	Trigger Source (G0-G7) 0: Disable 1: External Trigger (TRIGGER)

Example Layout

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
G7	G6	G5	G4	G3	G2	G1	G0	C7	C6	C5	C4	C3	C2	C1	C0

Starting and Stopping the ADC process

A single call is necessary to start or stop the ADC process

API-CALL
Long EDRE_ADStart (ulng Sn)
A serial number needs to be specified to start the ADC process. A returned error code will indicate if the function succeeded.

ACTIVEX CALL
Long EDREADX.Start ()
A call to the start method will start the ADC process of the device too which the ActiveX control is linked. A returned error code will indicate if the function succeeded.

API-CALL
Long EDRE_ADStop (ulng Sn)
A serial number needs to be specified to stop an ADC process. A returned error code will indicate if the function succeeded.

ACTIVEX CALL
Long EDREADX.Stop ()
A call to the start method will stop the ADC process of the device too which the ActiveX control is linked. A returned error code will indicate if the function succeeded.

Driver buffer functions

A single call is necessary copy data from the driver buffer to a user buffer. The driver-buffer is a large circular buffer that can hold data for a period of time running at full speed. This buffer needs to be emptied regularly to make sure it does not overrun. The buffer can be queried with number of samples available and other status issues as well. There are two functions available to copy data, one for copying voltages, another to copy the raw data. The raw data is significantly faster as for the data does not have to be converted to voltages before copying it to the user buffer. The raw data also occupies less space than the micro voltage buffer. There are also functions to write data to disk as the user buffer get copied. Refer to the EDR Enhanced programming manual for a reference to these functions.

API-CALL
Long EDRE_ADGetData (ulng Sn, plong Buf, pulng BufSize)
ACTIVEX CALL
Long EDREADX.GetData (plong Buffer, plong Size)
To retrieve data from the driver buffer the serial number need to be supplied, a buffer to hold the data and the size of the buffer or requested number of samples. The driver will only copy

the number of available samples in multiple of the channel list. For the ActiveX call only the buffer and size need to be supplied.

Querying the ADC subsystem

The driver can be queried to check the status of the ADC subsystem. The number of unread samples is one example. The appendix has a list of all possible query codes.

API-CALL
Long EDRE_Query (ulng Sn, ulng QueryCode, ulng Param)
A serial number, query code and parameter must be specified when doing a query.

ACTIVEX CALL
Long EDREADX.GetUnread ()
This function automatically queries the ADC driver buffer for the number of available samples.

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5. Calibration

If the device needs to be calibrated, the software can be found on the EDR Enhanced SDK CD-Rom. Normally located in <CDROM>:\EDRE\APPS\uDAQlite_cal directory.
This application provides step-by-step information of how to calibrate your device. Make sure that you have a high precision multimeter and calibration voltage source. This will help to configure your device more accurately.

Calibration Procedure – uDAQ-lite

1. Install the USB Calibration Software <CDROM>\EDRE\APPS\uDAQlite_cal
2. Run the USB Calibration Software.
3. Follow the step-by-step information on screen to tune your device.
4. Make sure to save the data to your device.

Equipment

The following calibration equipment is required to calibrate the μDAQ-lite. If the calibration equipment does conform to these specifications it will not be possible to calibrate the device accurately.

High Precision Multimeter

A high precision multimeter is required to measure output analog voltages. The HP3478A digital multimeter is an example of such a device. This device is used as standard test equipment to calibrate the μDAQ-lite. Make sure the device conform to its own calibration requirements and that it is serviced regularly. The device requirements are the following.

Item	Specification
Voltage Range	-10V to 10V
Type	Analog Input
Relative Accuracy	0.1 % of 1 bit in 16384
Accuracy	< 1.2 μV

Table 5-1 Analog Multimeter Requirements

High Precision Voltage Source

A high precision voltage source is required to generate input analog voltages. The Burster Digistant Typ 4405 is am example of such a device. The device is used as standard test equipment to calibrate the μDAQ-lite. Make sure the device conform to its own calibration requirements and that it is serviced regularly. The device requirements are the following.

Item	Specification
Voltage Range	0V to 10V
Type	Analog Output
Relative Accuracy	0.1 % of 1 bit in 16384
Accuracy	< 1.2 μV

Table 5-2 Analog Source Requirements

Coaxial Calibration Cable

A specialized cable is needed to connect the calibration equipment to the device. The connection points are the following.

Source	μDAQ and Rugged μDAQ Pin	Destination
Analog Ground	AGND	1. Voltage Generator Reference 2. Voltage Meter Reference
Analog Input Channel 0 - 7	ANALOG INPUTS CH0 - 7	Voltage Generator Positive
Analog Output Channel 0	ANALOG OUTPUTS CH0	Voltage Meter Positive
Analog Output Channel 1	ANALOG OUTPUTS CH1	Voltage Meter Positive

Table 5-3 Calibration Cable Connections

The diagram below shows a typical connection cable. To reduce external noise effects on the process only use coaxial cables. Banana type plugs can be used to connect to the calibration instruments.

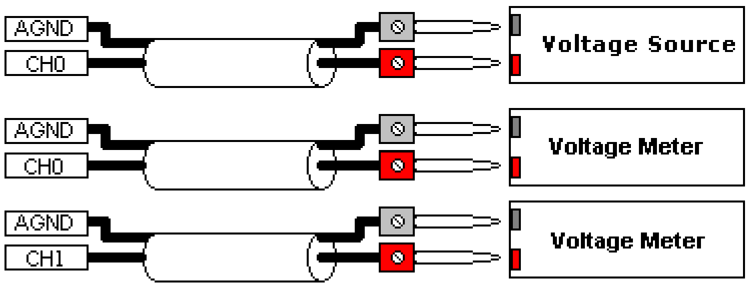

Figure 5-1 Calibration Cable

Software

The μDAQ-lite require that the device software must be installed and operational. If not see the **Installation** chapter to setup the device. The next step is to install the calibration software for the μDAQ-lite.

Software Installation

The software to calibrate the μDAQ-lite can be found on the Eagle Technology CDROM at *<EAGLECD>\EDRE\APPS\uDAQlite_cal*.
The installation application will place a short cut under Eagle Technology on the Windows Menu System.

Operation

The software application will indicate the current step and a description of what to do. Use the buttons at the bottom to navigate. The slider bar is used to adjust the setting. The mouse roller button or the keyboard arrow keys can be used for fine adjustment. The indicator box will show any readings if they are relevant to the current step. If the device does not respond to the adjustments it can be caused by the wrong wiring connection. Factory settings can be reloaded by pushing the "*Load Factory Settings"* button.

Procedure and Methodology

The table below indicates the purpose in calibrating the analog device. Follow the steps as below. The software will also show a short description of the process and what to do. End the end make sure to save the new settings to the device.

Step	Type	Sub-System	Calibration Device	Description
1	Getting Ready	None	None	Press 'Next' to start the calibration process. Before starting allow for the device to settle to ambient temperature.
2	CH0 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 0 (CH0) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
3	CH1 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 1 (CH1) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
4	CH2 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 2 (CH2) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
5	CH3 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 3 (CH3) to analog ground (AGND). Move the der until you get the analog reading to hover around 0 V.
6	CH4 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 4 (CH4) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
7	CH5 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 5 (CH5) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
8	CH6 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 6 (CH6) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
9	CH7 Bipolar, Single-ended offset	Analog Input	Short circuit	Connect channel 7 (CH7) to analog ground (AGND). Move the slider until you get the analog reading to hover around 0 V.
10	CH0 Bipolar, Differential-ended offset	Analog Input	Short circuit	To calibrating differential channel 0 connect channel 0 (CH0) to channel 1 (CH1). Move the slider until you get the analog reading hovers around 0 V.
11	CH1 Bipolar, Differential-ended offset	Analog Input	Short circuit	To calibrating differential channel 1 connect channel 2 (CH2) to channel 3 (CH3). Move the slider until you get the analog reading hovers around 0 V.
12	CH2 Bipolar, Differential-ended offset	Analog Input	Short circuit	To calibrating differential channel 2 connect channel 4 (CH4) to channel 5 (CH5). Move the slider until you get the analog reading hovers around 0 V.
13	CH3 Bipolar, Differential-ended offset	Analog Input	Short circuit	To calibrating differential channel 3 connect channel 6 (CH6) to channel 7 (CH7). Move the slider until you get the analog reading hovers around 0 V.
14	Gain	Analog Inputs	Voltage Source	Connect a very accurate 10 V source across channel 0 (CH0) to analog ground (AGND). Move the slider until you get the analog reading to hover around 10 V.
15	CH0 offset	Analog Output	Multimeter	Connect a voltmeter that can measure accurately down to 1 mV over analog output 0 (CHO) and analog ground (AGND). Move the slider until the voltmeter reading hovers around 0V.
16	CH1 offset	Analog Output	Multimeter	Connect a voltmeter that can measure accurately down to 1 mV over analog output 1 (CH1) and analog ground (AGND). Move the slider until the voltmeter reading hovers around 0V.
17	CH0 gain	Analog Output	Multimeter	Connect a voltmeter that can measure accurately down to 1 mV over analog output 0 (CH0) and analog ground (AGND). Move the slider until the voltmeter reading hovers around 8V.
	CH1 gain	Analog Output	Multimeter	Connect a voltmeter that can measure accurately down to 1 mV over analog output 1 (CH1) and analog ground (AGND). Move the slider until the voltmeter reading hovers around 8V.
18	Save Calibration Values	All	None	To save these settings click on 'Save' or click on 'Exit' to discard changes.

Table 5-4 Calibration Procedure

Calibration Validity and Operating Conditions

The μDAQ-lite will perform as specified when operating under normal conditions as set in the specification appendix. However there are conditions where the device can behave outside these preset specifications. The following has an effect on the accuracy of the device. It would be good practice to recalibrate the device specifically for this environment.

No	Condition	Remedy
1	One year since last calibration.	It is advisable that the device be recalibrated every year if highest accuracy is required.
2	Harsh operating conditions.	If the unit operates in a harsh area, like factories, it is advisable that the unit recalibrated each year (1) and service every five (5) years
3	High/Low temperatures	Extreme temperature can effect to operation of the device. The identities of the analog circuit will certainly changes under extreme temperatures. The solution would be to recalibrate the unit within these conditions
4	Above average humidity	If the device operates in high humidity it can cause the unit to degrade in performance over time. The device needs to be calibrated and serviced more frequently.
5	Exceeding analog input/output specifications	If the device was driven outside its operating region it can affect the accuracy of the device. It would be best practice to recalibrate or in severe case to service the device.
6	Lightning strike	In the case of such an event the device need to be checked and tested by the manufacturer to prevent costly secondary damage.
7	Exceeding power input	If the power input was to high or of the wrong type the unit can be severely damaged
8	Extensive long storage	Make sure the device is stored in a static free environment inside the original packaging. If the device was stored for an extensive period it will need to be recalibrated.

Table 5-5 Operating Conditions Voiding Calibration

Reset Factory Settings

If you wish to reload the factory calibration settings you can simply click on *“Load Factory Settings”*. This will load the calibration setting that was stored in the device at manufacturing. To save these settings simply click on *“Save”*. These setting will be saved and the program will exit. The new calibration values will be loaded once the device has been restarted.

A

A.Specifications

Absolute maximum ratings

Parameter	Symbol	Condition	Rating	Unit
Digital Input Voltage	Vdi	Ta = 25°C with respect to ground	-0.5 to 5.0	V
Digital Output Voltage	Vdo		-0.5 to 5.0	V
Digital Output Current	Vdoc		±20.0	mA
Analog Input Voltage	Vai		±35	V
Analog Output Voltage	Vao		±10	V
Analog Output Current	Vao		±2.0	mA
Storage Temperature	Tstg	-	-50 to 150	°C
Operating Temperature	Tstg	-	0 to 70	°C
Power Dissipation	Pd	Ta = 25°C	10.0	W

Digital Input/Output Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input High	Vih	Ta = 25°C with respect to ground	2.0			V
Input Low	Vil				0.8	V
Output High	Voh		4.9	5.0		V
Output Low	Vol			0.0	0.1	V
Output Source/Sink Current	Io				20.0	mA
Input Source/Sink Current	Ii				2.0	mA

Counter-Timer Characteristics

Parameter	Condition	Min.	Max.	Spec	Unit
Input High	Ta = 25°C with respect to ground	2.0	5.25		V
Input Low		-0.5	0.8		V
Output High		2.4			V
Output Low			0.8		V
Clock Source			2	50% duty cycle	MHz
Resolution				16 (up counter)	Bit
Counter Reload		1.5	2		µSeconds

External Clock	Ta = 25°C with respect to ground		500	Falling Edge	KHz
Output Pulse (High)		0.9	1.0		μSeconds
Output Frequency			100		KHz

Analog Output Characteristics

Parameter	Condition	Spec	Unit
Number of channels	Ta = 25°C with respect to analog ground	2	-
Resolution		12	Bits
Maximum Output		+10	V
Minimum Output		-10	V
Output current		±5	mA
Zero offset error		2	mV
Full scale error		30	mV

Analog Input Characteristics

Parameter	Condition	Spec	Unit
Number of channels	Ta = 25°C with respect to analog ground	8 single-ended, 4 differential-ended	-
Acquisition speed		49	KHz
Resolution		12-bit	Bits
Input range, single-ended		±10	V
Input range, differential-ended		±20, ±10, ±5, ±4, ±2.5, ±2, ±1.25, ±1	V
Input impedance		2	MΩ
Trigger source		Software or external (TRIGGER)	
Clock source		Internal or external (master or slave configuration)	-

Conversion Characteristics

External Clock – SLAVE pin

Parameter	Condition	Min.	Max.	Spec	Unit
Input High	Ta = 25°C with respect to ground	2.0	5.25		V
Input Low		-0.5	0.8		V
Maximum Rate			35		KHz
Conversion				Rising Edge	
Clock Source				50% duty cycle	

External Trigger – TRIGGER pin

Parameter	Condition	Min.	Max.	Spec	Unit
Input High	Ta = 25°C with respect to ground	2.0	5.25		V
Input Low		-0.5	0.8		V
External Trigger		1.0		Rising Edge	μSecond

Master Output – MASTER pin

Parameter	Condition	Min.	Max.	Spec	Unit
Pulse	Ta = 25°C with respect to ground	0.9	1.0		μSeconds
Output High		4.5	5.0		V
Output Low		0	0.8		V

Bus Interface

Bus Type	Universal Serial Bus Revision 1.1
Bus Speed	USB Full Speed – 12 Mega bit per second.
Controller	USB Serial Interface Endpoint Compliant
Voltage	5V

Power Requirements

Device	Typical	Power Source
UDAQ-lite	350 mA	USB Power

Environmental / Physical

Relative Humidity	0% to 90% (non-condensing)
Operating Temperature	0°C to 70°C
Housing	Plastic Casing
Dimension	Height: 35mm Width: 80mm Length: 148mm

Connectors

The screw terminal has a hole diameter of 1.15mm – 0.03mm.

B

B.Configuration Constants

Query Codes

Name	Value	Description
APIMAJOR	1	Query EDRE API major version number.
APIMINOR	2	Query EDRE API minor version number.
APIBUILD	3	Query EDRE API build version number.
APIOS	4	Query EDRE API OS type.
APINUMDEV	5	Query number of devices installed.
BRDTYPE	10	Query a board's type.
BRDREV	11	Query a board's revision.
BRDYEAR	12	Query a board's manufactured year.
BRDMONTH	13	Query a board's manufactured month.
BRDDAY	14	Query a board's manufactured day.
BRDSERIALNO	15	Query a board's serial number.
DRVMAJOR	20	Query a driver's major version number.
DRVMINOR	21	Query a driver's minor version number.
DRVBUILD	22	Query a driver's build version number.
ADNUMCHAN	100	Query number of ADC channel.
ADNUMSH	101	Query number of samples-and-hold channels.
ADMAXFREQ	102	Query maximum sampling frequency.
ADBUSY	103	Check if ADC system is busy.
ADFIFOSIZE	104	Get ADC hardware FIFO size.
ADFIFOOVER	105	Check for FIFO overrun condition.
ADBUFFSIZE	106	Check software buffer size.
ADBUFFOVER	107	Check for circular buffer overrun.
ADBUFFALLOC	108	Check if software buffer is allocated.
ADUNREAD	109	Get number of samples available.
ADEXTCLK	110	Get status of external clock line – PCI30FG.
ADEXTTRIG	111	Get status of external trigger line – PCI30FG.
ADBURST	112	Check if burst mode is enabled.
ADRANGE	113	Get ADC range.
DANUMCHAN	200	Query number of DAC channels.
DAMAXFREQ	201	Query maximum DAC output frequency.
DABUSY	202	Check if DAC system is busy.
DAFIFOSZ	203	Get DAC FIFO size.
CTNUM	300	Query number of counter-timer channels.
CTBUSY	301	Check if counter-timer system is busy.
DIONUMPORT	400	Query number of digital I/O ports.
DIOQRYPORT	401	Query a specific port for capabilities.
DIOPORTWIDTH	402	Get a specific port's width.
INTNUMSRC	500	Query number of interrupts sources.
INTSTATUS	501	Queries interrupt system's status.
INTBUSCONNECT	502	Connect interrupt system to bus.
INTISAVAILABLE	503	Check if an interrupt is available.
INTNUMTRIG	504	Check number times interrupted

Error Codes

Name	Value	Description
EDRE_OK	0	Function successfully.
EDRE_FAIL	-1	Function call failed.
EDRE_BAD_FN	-2	Invalid function call.
EDRE_BAD_SN	-3	Invalid serial number.
EDRE_BAD_DEVICE	-4	Invalid device.
EDRE_BAD_OS	-5	Function not supported by operating system.
EDRE_EVENT_FAILED	-6	Wait on event failed.
EDRE_EVENT_TIMEOUT	-7	Event timed out.
EDRE_INT_SET	-8	Interrupt in use.
EDRE_DA_BAD_RANGE	-9	DAC value out of range.
EDRE_AD_BAD_CHANLIST	-10	Channel list size out of range.
EDRE_BAD_FREQUECY	-11	Frequency out of range.
EDRE_BAD_BUFFER_SIZE	-12	Data passed by buffer incorrectly sized
EDRE_BAD_PORT	-13	Port value out of range.
EDRE_BAD_PARAMETER	-14	Invalid parameter value specified.
EDRE_BUSY	-15	System busy.
EDRE_IO_FAIL	-16	IO call failed.
EDRE_BAD_ADGAIN	-17	ADC-gain out of range.
EDRE_BAD_QUERY	-18	Query value not supported.
EDRE_BAD_CHAN	-19	Channel number out of range.
EDRE_BAD_VALUE	-20	Configuration value specified out of range.
EDRE_BAD_CT	-21	Counter-timer channel out of range.
EDRE_BAD_CHANLIST	-22	Channel list invalid.
EDRE_BAD_CONFIG	-23	Configuration invalid.
EDRE_BAD_MODE	-24	Mode not valid.
EDRE_HW_ERROR	-25	Hardware error occurred.
EDRE_HW_BUSY	-26	Hardware busy.
EDRE_BAD_BUFFER	-27	Buffer invalid.
EDRE_REG_ERROR	-28	Registry error occurred.
EDRE_OUT_RES	-29	Out of resources.
EDRE_IO_PENDING	-30	Waiting on I/O completion

Digital I/O Return Query Codes Codes

Name	Value	Description
DIOOUT	0	Port is an output.
DIOIN	1	Port is an input.
DIOINOROUT	2	Port can be configured as in or out.
DIOINANDOUT	3	Port is an input and an output.

C

C.Ordering Information

For ordering information please contact Eagle Technology directly or visit our website www.eagledaq.com. They can also be emailed at eagle@eagle.co.za.