PC104-30FG Series

PCI PnP Analog Input Board
User's Manual

Eagle Technology – Cape Town, South Africa

www.eagledaq.com

Analog Input Boards

Data Acquisition and Process Control

© Eagle Technology
31-35 Hout Street • Cape Town • South Africa
Phone +27 21 423 4943 • Fax +27 21 424 4637
Email eagle@eagle.co.za

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1 Introduction

The PC104-30FG series PC104 bus architecture data acquisition boards. They are available in two basic models, the G and F series. They can samples at 100kHz or 330kHz respectively. Addition to analog input, they also have analog output, digital input/output and counter-timer capabilities. For this reason the PC104-30FG is an excellent all purpose data acquisition device with extensive analog input capabilities.

Features

The PC104-30FG does have some very unique features and are short listed below:

- 8/16 differential or 16/32 single-ended A/D inputs
- 330kHz or 100kHz sampling rate
- Software controlled input ranges and gains
- 12bit Resolution
- 3 x 8-bit I/O ports
- 1 user counter-timers

Key Specifications

- A/D resolution: 12-bits
- D/A resolution: 12-bits
- DIO width: 8-bits
- CT width: 16-bits
- A/D scan rate: 100kHz or 330kHz

Software Support

The PC104-30FG is supported by EDR Enhanced and comes with 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 quickly. All operating system drivers and utility are supplied on a CD-Rom.

2

2 Installation

This chapter describes how to install and configure the PC104-30FG for the first time. Minimal configuration is necessary; almost all settings are done through software.

Package

PC104-30FG package will contain the following:

- PC104-30FG board
- EDR Enhanced Software Development Kit CD-Rom

Operating System Support

The PCI104-30FG series support the Windows NT and Windows Driver Models (WDM) driver types. The operating systems are listed in the table below.

Board Type	Revision	Operating Systems	Driver Type
PC104-30FG	Revision 1	Windows 2000/XP	WDM PnP

Table 2-1 Operating System Support

Hardware Installation

This section will describe how to install your PC104-30FG into your computer.

- Switch off the computer and disconnect from power socket.

Failure to disconnect all power cables can result in hazardous conditions, as there may be dangerous voltage levels present in externally connected cables.

- Remove the cover of the PC.
- Insert bracket screw and ensure that the board sits firmly in the PC104 socket.
- Replace the cover of the PC.
- Reconnect all power cables and switch the power on.
- The hardware installation is now completed.

Software Installation

Windows 2000/XP

Installing the Windows 2000/XP device driver is a very straightforward task. The board does support plug and play so Windows needs to be told that a new device was installed. The *Add New Hardware Wizard* will be used for this task.

Click ***Start-> Settings-> Control Panel-> Add New/Remove Hardware***.

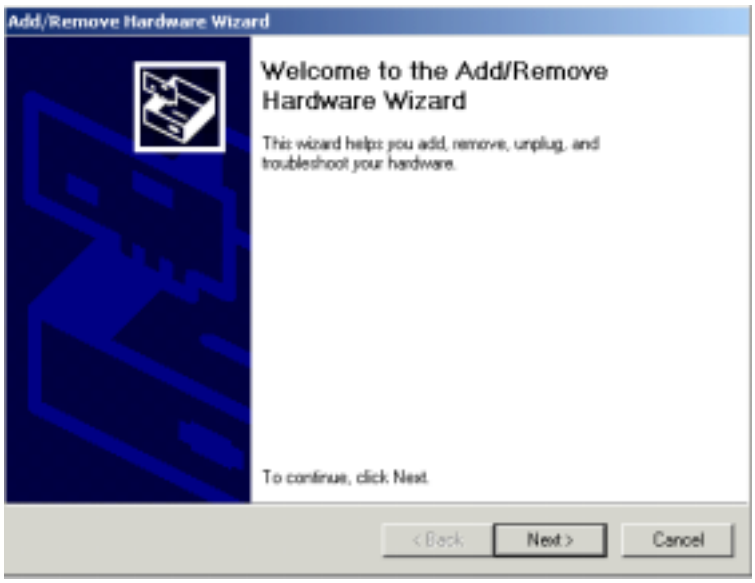


Figure 2-1 Step 1

Select *Add a device.*

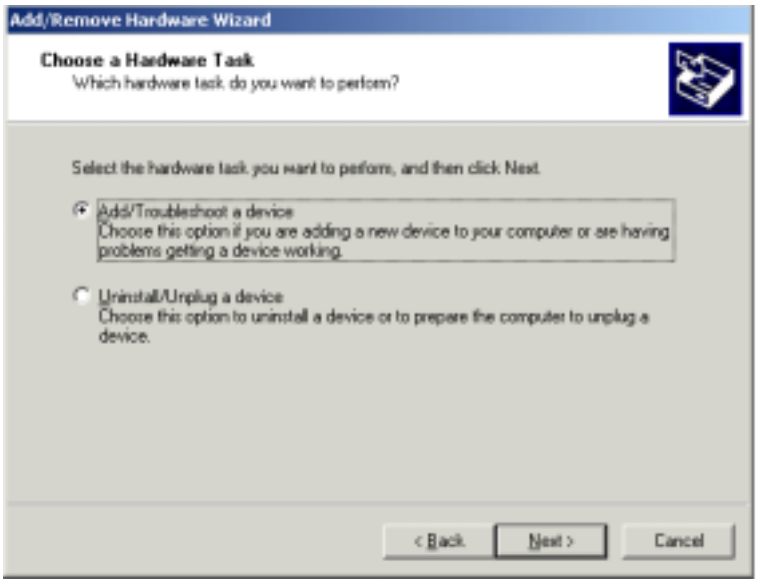


Figure 2-2 Step 2

Select *Add a new device.*

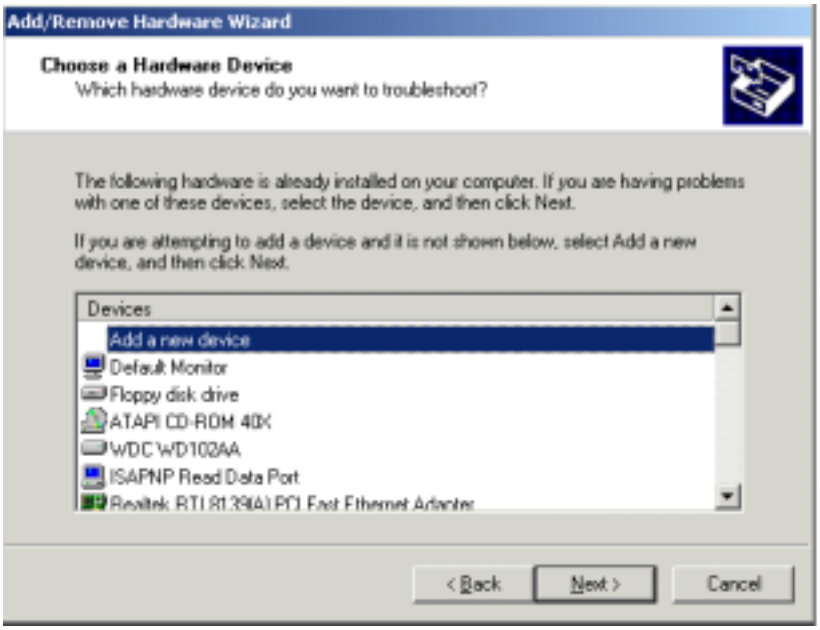


Figure 2-3 Step 3

Select *No, I want to select the hardware from a list*

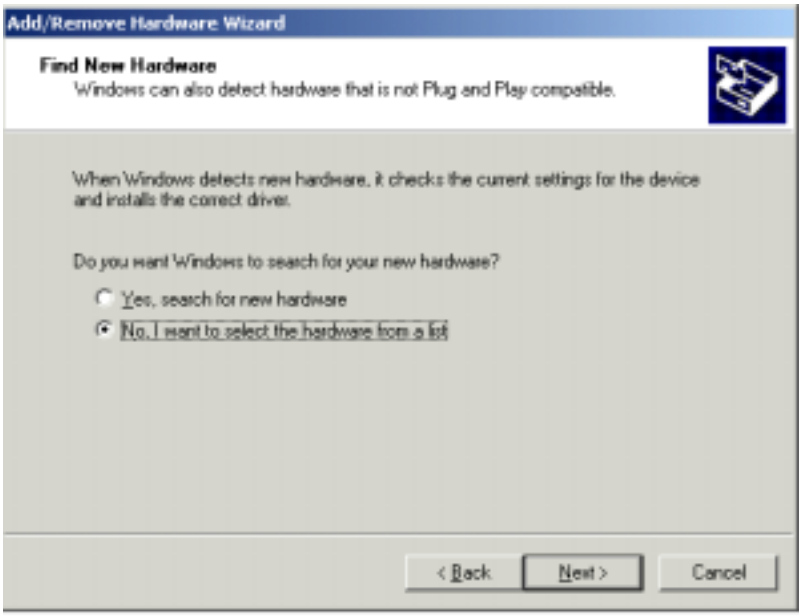


Figure 2-4 Step 4

Select *Other Device or Eagle Data Acquisition* if it exists.

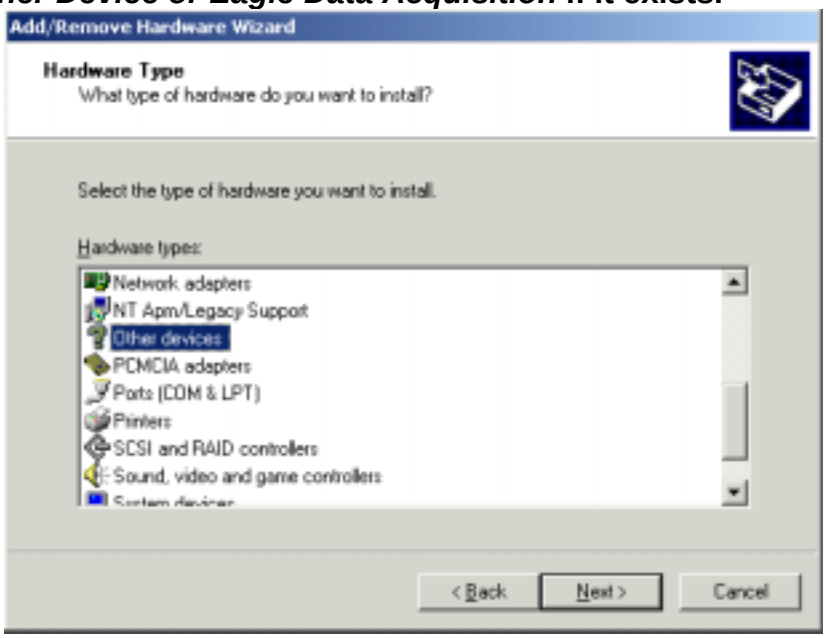


Figure 2-5 Step 5

Select *Have Disk.*

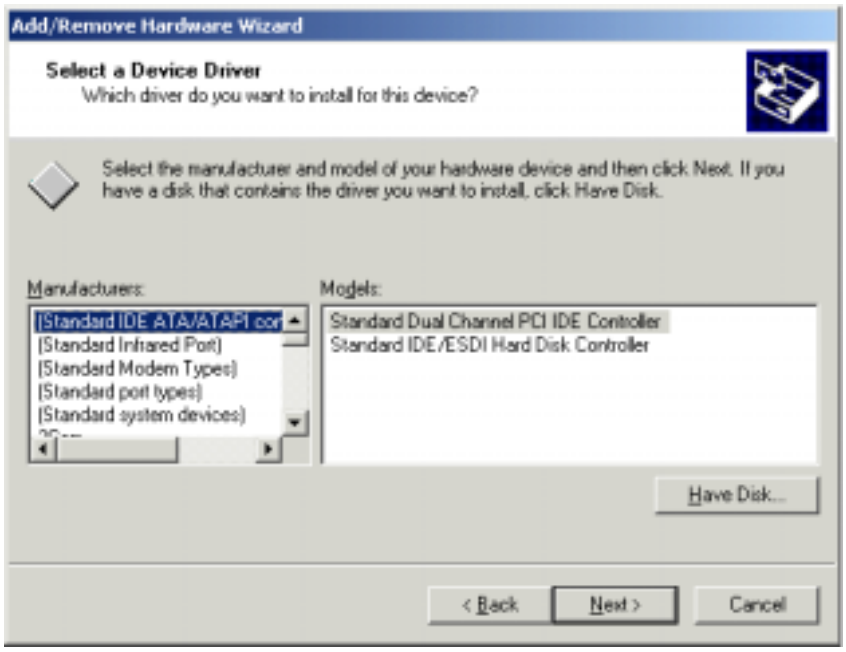


Figure 2-6 Step 6

Use the browse dialog to search for the file *pc10430h.inf.*

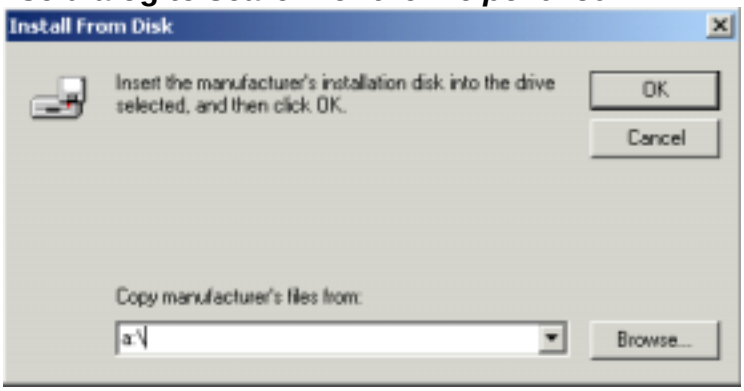


Figure 2-7 Step 7

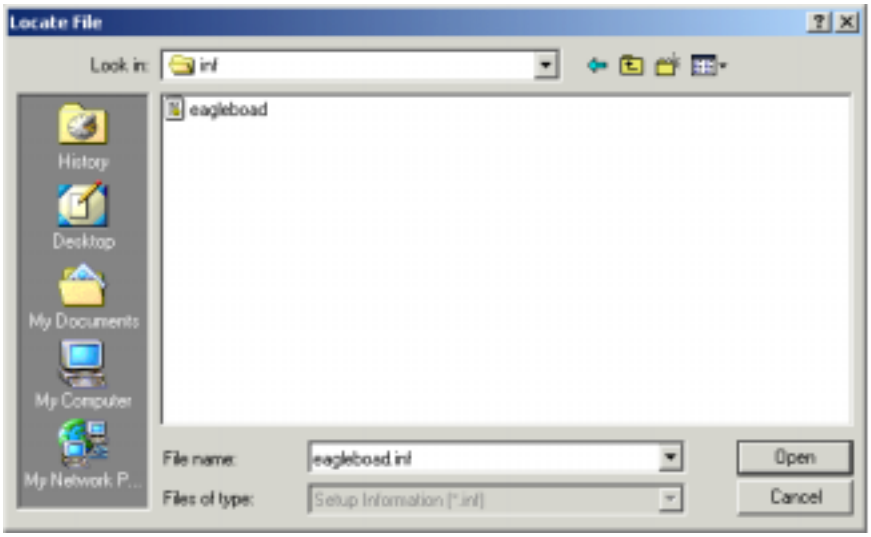


Figure 2-8 Step 8

The next dialog will display the model name of the board you are trying to install.

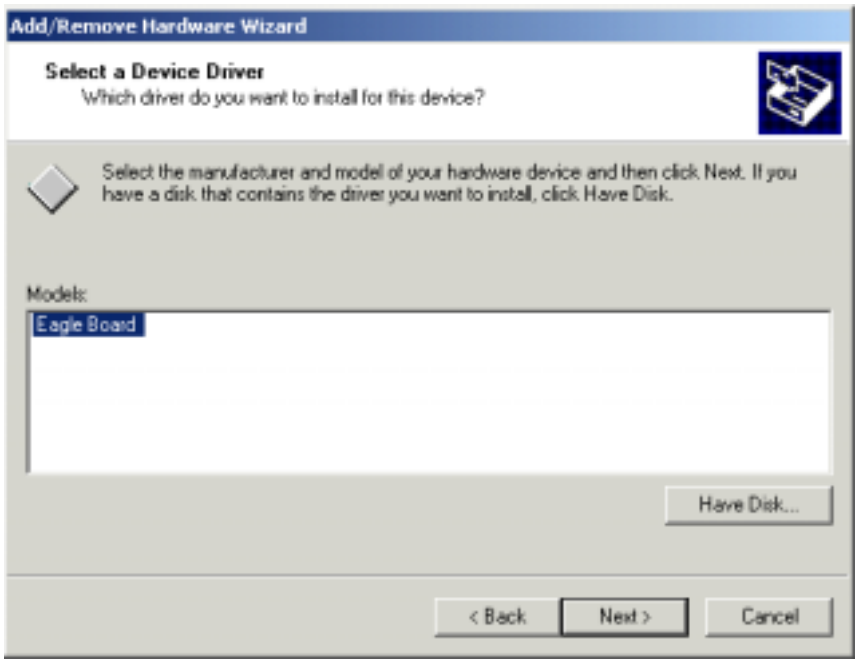


Figure 2-9 Step 9

Select the *Next* button.

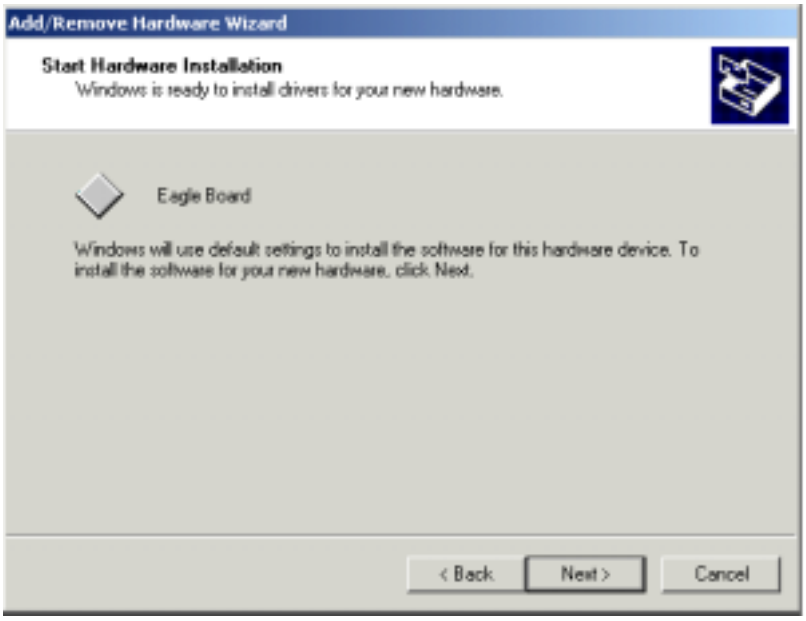


Figure 2-10 Step 10

Select the *Finish* button to complete the installation.

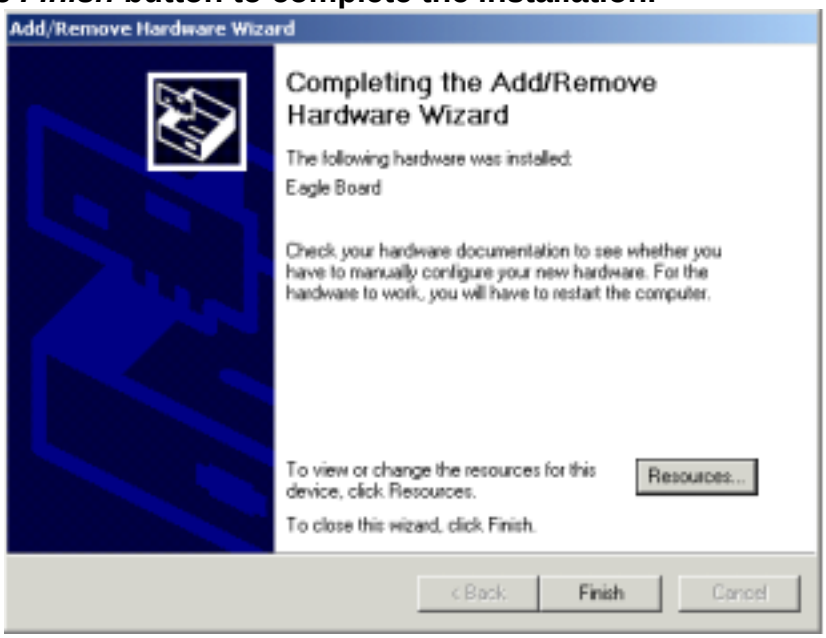
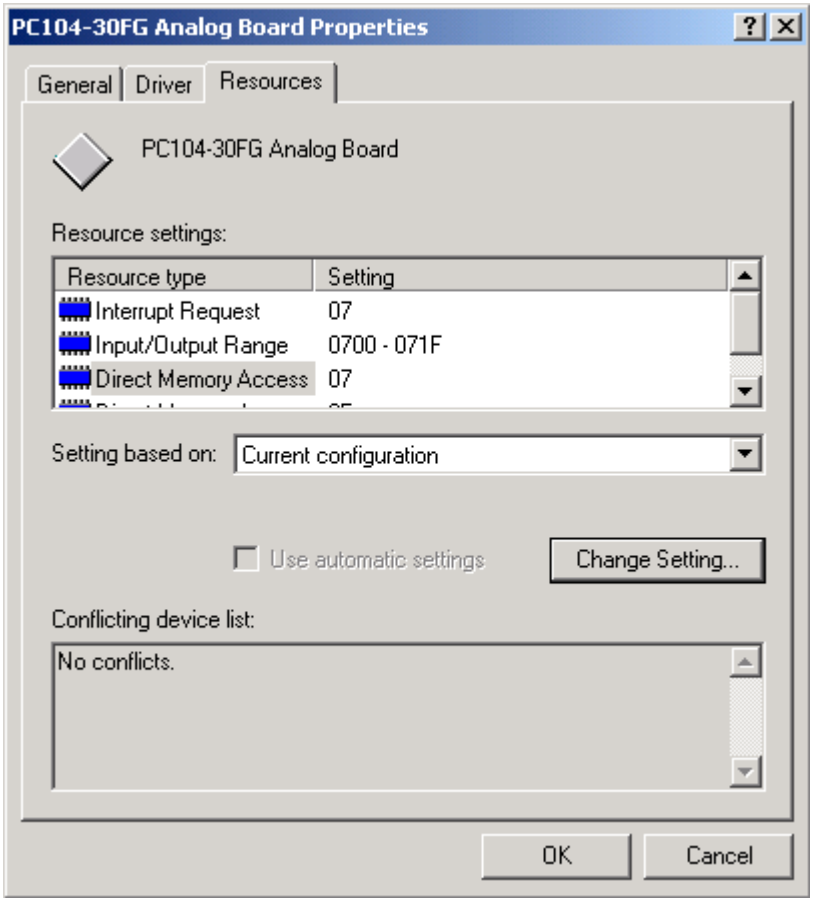


Figure 2-11 Step 11

Resource Setup

After hardware installation you will have to setup the necessary resources for the PC104-30FG.



Setup the interrupt and DMA channels. Base address setup as 700 HEX as default.

DIP Switch Settings								
Base Address	**SW1**	**SW2**	**SW3**	**SW4**	**SW5**	**SW6**	**SW7**	**SW8**
0H	On	On	On	On	On	On	On	On
20H	On	On	On	On	On	On	On	Off
40H	On	On	On	On	On	On	Off	On
60H	On	On	On	On	On	On	Off	Off
80H	On	On	On	On	On	Off	On	On
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
300H	On	On	On	Off	Off	On	On	On
320H	On	On	On	Off	Off	On	On	Off
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
700H	On	On	Off	Off	Off	On	On	On
720H	On	On	Off	Off	Off	On	On	Off
…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…
1FA0H	Off	Off	Off	Off	Off	Off	On	Off
1FC0H	Off	Off	Off	Off	Off	Off	Off	On
1FE0H	Off	Off	Off	Off	Off	Off	Off	Off

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. The picture below shows a typical board that is installed.

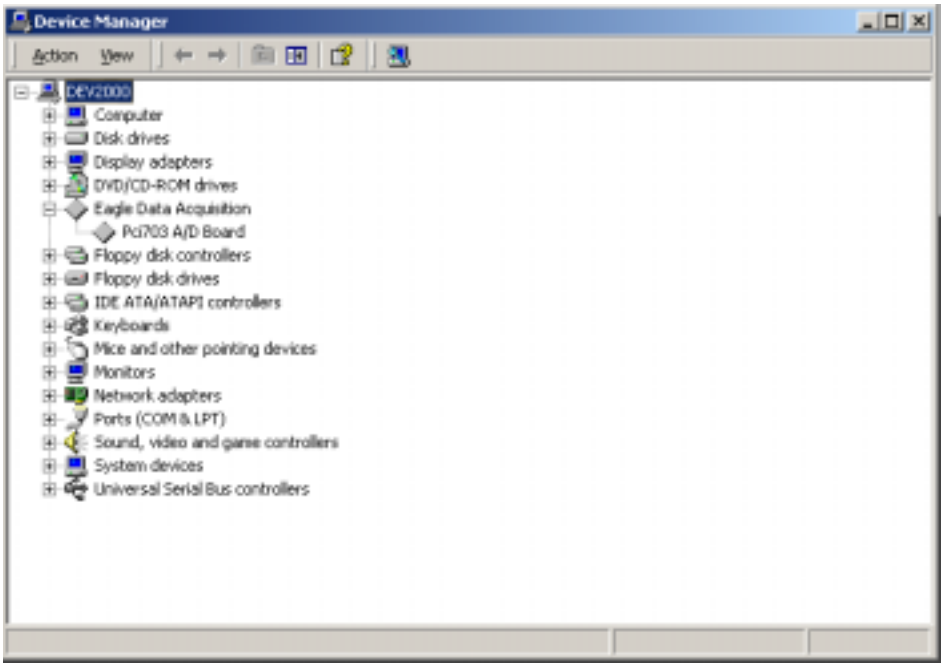


Figure 2-12 Device Manager

- Clearly you can see that the PCI device is listed and working properly.
- Now the first part of your installation has been completed and ready to install the EDR Enhanced Software Development Kit.
- Run ***edreapi.exe*** found on the Eagle CD-Rom and follow the on screen instructions
- Further open the control panel and then the *EagleDAQ* folder. This dialog should list all installed hardware. Verify your board's properties on this dialog. See picture below

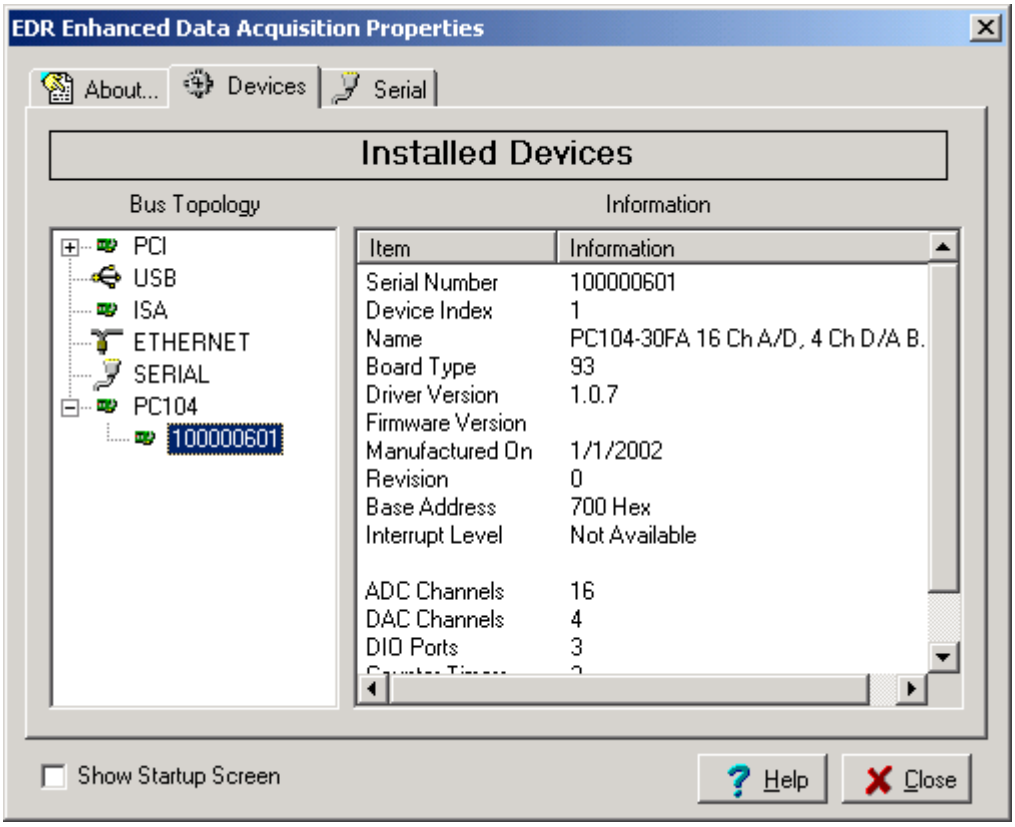


Figure 2-13 EAGLE DAQ Dialog

3

3 Interconnections

The PC104-30FG is designed so that there is a connector for analog signals and digital signals.

Pin Assignments

The table below shows the pin assignments for the PCI30FG.

Pin	Name	Pin	Name
1	CH1	2	CH0
3	CH3	4	CH2
5	CH5	6	CH4
7	CH7	8	CH6
9	CH9	10	CH8
11	CH11	12	CH10
13	CH13	14	CH12
15	CH15	16	CH14
17	AGND	18	AGND
19	SENS0	20	DAC0
21	SENS1	22	DAC1
23	SENS2	24	DAC2
25	SENS3	26	DAC3

Table 3-1 External Analog Connector – IDC-26M

Pin	Name	Pin	Name
1	PA1	2	PA0
3	PA3	4	PA2
5	PA5	6	PA4
7	PA7	8	PA6
9	PB1	10	PB0
11	PB3	12	PB2
13	PB5	14	PB4
15	PB7	16	PB6
17	PC1	18	PC0
19	PC3	20	PC2
21	PC4	22	PC4
23	PC7	24	PC6
25	DGND	26	DGND
27	GATE2	28	CLK0
29	OUT2	30	GATE1
31	OUT1	32	DGND
33	CLK2	34	DGND
35	EXT_TRIG	36	DGND
37	EXT_CLK	38	DGND
39	+5V	40	DGND

Table 3-2 Internal DIO/CT Connector – IDC-40M

Signal Definitions

This sections deal with all the signals abbreviations.

Signal	Description
CH0-15	Analog input channel
DAC0-3	Analog output channel
SENSE0-3	Sensing line for analog output channel
PA0-7	Port A on PPI
PB0-7	Port B on PPI
PC0-7	Port C on PPI
GATE1	Internal counter gate
CLK0	Internal counter clock input
OUT1	Internal clock output
GATE2	User counter 0 gate
CLK2	User counter 0 input
OUT2	User counter 0 output
EXT_TRIG	A/D external trigger
EXT_CLK	A/D external clock

Table 3-3 Signal definitions

Analog Input

The following three aspects of A/D operation can be configured:

- A/D input mode (single ended or differential)
- A/D voltage range
- A/D clock/trigger

A/D Input Mode

The PC104-30F, FA, G and GA models can provide either 16 single ended or eight differential inputs. The use of differential inputs is recommended in environments with high levels of electrical noise, when using long lines to connect the analogue inputs, or for any input operating at a gain of greater than 10. Default power-up configuration is for single ended inputs.

A/D Voltage Range Setting

On the G and GA models you can switch between ±5V and 0V to 10V. LK1 must be used to achieve the ±10V range (see board silk screen for jumper settings for the **G and GA models** only). On the F and FA models, the range can be switched between ±5V and ±10V from software.

On the PC104-30 F/G board, you can refer to the text written on the silk-screen layer with regard to jumper settings.

CHANGING JUMPER LK1 TO THE 20 V POSITION DOES NOT ENABLE YOU TO SELECT UNIPOLAR RANGE 0 TO 10 V.

Note that the default range setting is -5 to +5V.

Single Ended Inputs

With single ended inputs, connections share a common low reference that is connected to analog ground. See figure below.

The advantage of such a connection is that you have a maximum number of inputs. Its major disadvantage is the loss of common mode rejection obtainable from differential mode. Single ended inputs are very sensitive to noise lead lengths should be kept as short as possible.

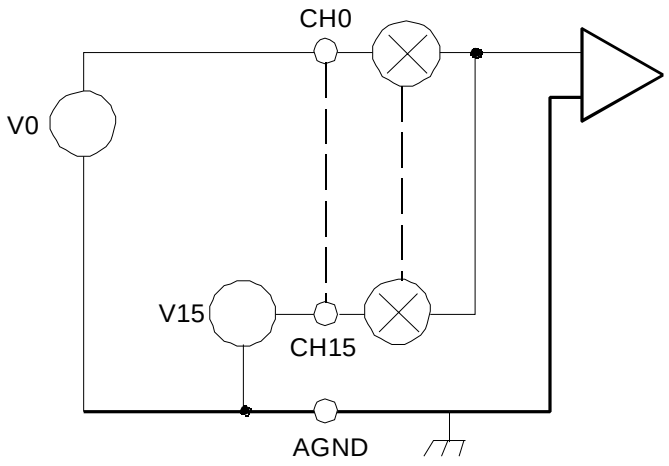


Figure 3-1 Single ended analog input

Differential Inputs

In differential input mode two multiplexer switches per channel are used. The A/D converter measures the difference in potential between the two channels.

Channels are paired to form a single differential input. Channel 0 and channel 8 is used as channel 0, channels 1 and 9 etc. To connect see diagram below. It is also very important to know that each return connection must be referenced to analog ground.

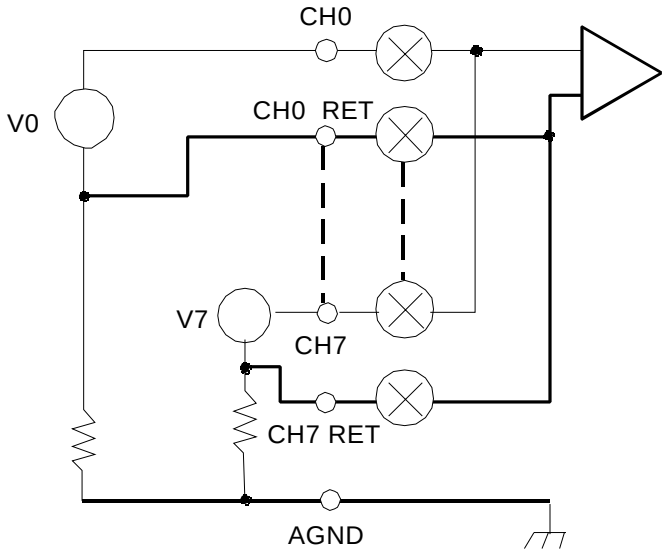


Figure 3-2 Differential Analog Inputs

In differential mode, all signal inputs to the PCI30FG must be referred to ground. This can be done by connecting a 1 to 10 kΣ resistor from the low end of each input to ground.

Analog Output

The analog outputs come with sense lines and it is important to make sure that they are connected to the correct channel. If left unconnected the output will simple float at +10V or –10V. The analog output range is ±10V and is fully software configurable. The EDR Enhanced driver support auto ranging and will always select the range with the best possible resolution. For normal operation simply connect SENSE0 to DAC0.

OVERLOADING ANY DIGITAL I/O LINE WILL CAUSE SERIOUS DAMAGE TO THE DIGITAL I/O CHIP. OPERATING OUTSIDE THE TTL VOLTAGE RANGE WILL CAUSE PERMANENT DAMAGE TO THE DIGITAL I/O CONTROL CIRCUIT.

Digital Input/Output

The PCI30FG has got 3x8-bit digital I/O ports that are fully configurable as inputs or outputs. The digital I/O uses a chip that is fully compatible with the Intel 8255 programmable peripheral interface. Make sure not to overload the PPI because it will cause serious damage and will need to be repaired.

Counter-Timer

There are three counter-timers on the PC104-30FG of which one are available for the user. Two are used for A/D timing. The timers are compatible with the Intel 8254 counter-timer device. The 8254 counter-timer datasheets can be used as reference for configuring the counter-timer sub-system.

4 Programming Guide

The PC104-30FG is supplied with a complete software development kit. EDR Enhanced (EDRE SDK) comes with 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 make it possible to write one 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 PC104-30FG. It has got functions for each basic sub-system and is really easy to learn.

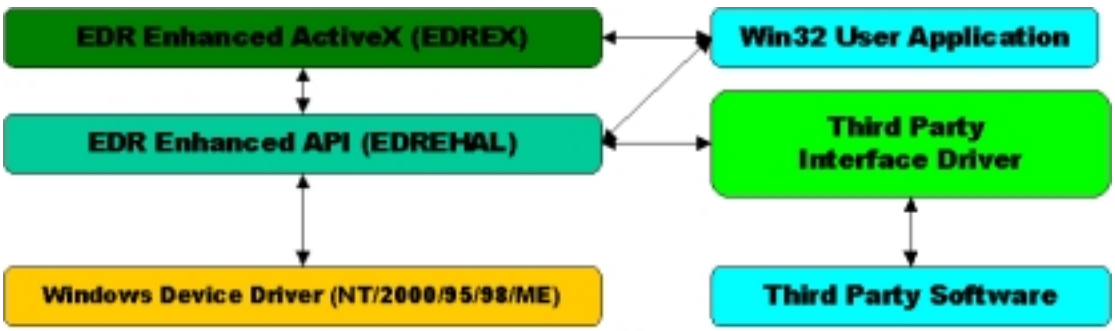


Figure 4-A EDR Enhanced Design

Digital Inputs/Outputs

The PC104-30FG has 24 digital I/O lines, configured as 3 x 8-bit ports. The EDRE API supports auto direction configuration. By writing to or reading from a port, it is automatically configured as an output or input. A port is defined as a collection of simultaneous configurable entities. Thus in the case of the PC104-30FG each port is only 8-bits wide.

Reading the Digital Inputs

A single call is necessary to read a digital I/O port.

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 I/O port.

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 Por, ulng 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.

Counters

The counter sub-system is supported by functions to Write, Read and Configure. There are 1 counters that are available to the user and are compatible with the industry standard 8254 counter-timer. The table below shows all counters and their assigned function on the board. Please note that only some are available for the user. The 8254 datasheet has more information on the counter-timer modes.

Counter	Software Assigned Number	Description
0	0	User Counter 0

Table 4-1 Counter Assignment

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 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.

Reading a counter

A single call is necessary to read a counter's current value.

API-CALL

Long EDRE_CTRead(ulng Sn, ulng Ct, pulng Value)

The serial number, counter-number, and a pointer must be passed by the calling function. A return code will indicate if any errors occurred. The value buffer will hold the value read from the counter.

ACTIVEX CALL

Long EDRECTX.Read(long Port)

The port number needs to be passed. The returned value will either hold the error code or the value read from the counter. If negative it means an error occurred, otherwise it is 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.

Only the counter mode parameter is used by the PC104-30FG. The table below shows the options for each parameter.

Parameter	Description
Sn	Serial Number
Ct	Counter Number: 0 : User Counter 0
Mode	8254 Counter Mode. See 8254 datasheet for details
Type	0 : Binary Counting (16-bits) 1 : Binary Coded Decimal (BCD)
Source	0 : Internal (8MHz) 1 : External (External connector)
Gate	0: Internal (Softgate) 1: External

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 PC104-30FG-A version has 4 x 12-bit DAC channels that support single write.

Writing to a DAC channel

A single call is necessary to set a voltage on a DAC channel.

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 (long 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

Analog input is when a voltage is read from a specific A/D channel or when A/D channels are scanned in a specific sequence at a fixed rate.

Reading a single voltage from a channel

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

API-CALL

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

Parameter	Type	Description
Sn	Unsigned long	Board's serial number
Channel	Unsigned long	ADC Channel
Gain	Unsigned long	0: Gain x 1 1: Gain x 10 2: Gain x 100 3: Gain x 1000
Range	Unsigned long	0: -5V to +5V, Single Ended 1: 0 to +10V, Single Ended 2: -10V to +10V, Single Ended 3: -5V to +5V, Differential 4: 0 to +10V, Differential 5: -10V to +10V, Differential
uVoltage	Pointer to a long	Voltage read from channel
Return	Long	Error Code

ACTIVEX CALL

Long EDREADX.SingleRead (long Channel)

Parameter	Type	Description
Channel	Long	ADC Channel
Return	Long	Voltage returned from 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.

Streaming Data

You must first setup the A/D sub-system A/D channels can be scanned. The most important part is the channel and gain list. This tells the hardware in which order to scan the channels and what gain to use. Other settings include scanning frequency, voltage range, trigger source and mode.
Dual channel DMA is used when streaming data. Please note that each DMA channel is 32K bytes, thus data will be updated in blocks of 16384 samples. If you are scanning at a very slow speed it might take a while before any data get be read from the driver buffer.

It is also important to understand the scanning mode. Normal mode means the channels will be scanned one by one according to the channel list at the specified frequency.

Configuring the ADC subsystem for scanning

This is the most complicated part of configuring the PC104-30FG 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 PC104-30FG.
The channels list size should always consist of 2 or more channel, but not more then 16. If you only want to read one channel, the same channel should be placed in the channels list twice.

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.

Parameter	Type	Description
Sn	Unsigned long	Board's serial number.
Freq	Pointer to an unsigned long	Sampling frequency. The actual sampling frequency will be returned with this parameter.
ClkSrc	Unsigned long	0: Internal clock to A/D clock trigger and to external trigger. 1: External trigger disconnected, internal clock to A/D clock/trigger. 2: External trigger to A/D clock/trigger, internal clock disconnected. 3: External trigger to gate 1, internal clock to A/D clock/trigger.
Burst	Unsigned long	0: Normal Mode 1: Burst Mode
Range	Unsigned long	0: -5V to +5V, Single Ended 1: 0 to +10V, Single Ended 2: -10V to +10V, Single Ended 3: -5V to +5V, Differential 4: 0 to +10V, Differential 5: -10V to +10V, Differential
ChanList	Pointer to an unsigned long	This is an array of unsigned longs that contains the channels to be sampled when scanning the ADC sub-system. The max size of the channel list is 16
GainList	Pointer to an unsigned long	This is an array of unsigned longs that contains the gains of channels to be sampled when scanning the ADC sub-system.
ListSize	Unsigned long	This parameter determines the length the two previous arrays. This is also the depth of the channel list that is programmed to the board.

ACTIVEX CALL

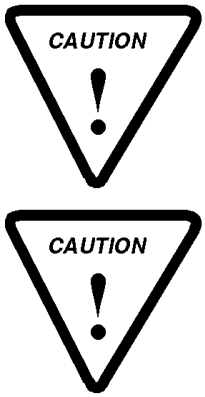
Long EDREADX.Configure (plong Channels, plong Gains, long ListSize)

Parameter	Type	Description
Channels	Pointer to an unsigned long	This is an array of unsigned longs that contains the channels to be sampled when scanning the ADC sub-system. The max size of the channel list is 16
Gains	Pointer to an unsigned long	This is an array of unsigned longs that contains the gains of channels to be sampled when scanning the ADC sub-system.
ListSize	Unsigned long	This parameter determines the length the two previous arrays. This is also the depth of the channel list that is programmed to the board.

The Frequency and ClockSource ADC ActiveX control must be setup before calling the configure function.

EDREADX.Frequency

Frequency	The ADC sampling frequency



WARNING!!

- In normal sampling mode channels are sampled sequentially according to the given channels list. The time spacing between each channel is the same as the frequency in normal mode. The maximum frequency is the same as the maximum speed of the board.
- In burst mode the all channels in the channel list is converted as fast as possible (depends on the A/D converter speed) every period. The period is the same as the sampling frequency. The maximum sampling frequency is the maximum frequency of the board divided by the number of channels in the channel list.

Frequency Example:

Normal Mode	Burst Mode
Frequency = 100 000 Hz Channel List Length = 10 Time = 10 uS Time between channels = 10 uS	Max of Board = 100 000 Hz Frequency = 20 000 Hz Channel List Length = 10 Max Frequency = 2 000 Hz Time = 500 uS Time between channels = 10 uS (ADC Rating) Time between sets = 50 uS

EDREADX.ClockSource

ClockSource	0: Internal clock to A/D clock trigger and to external trigger. 1: External trigger disconnected, internal clock to A/D clock/trigger. 2: External trigger to A/D clock/trigger, internal clock disconnected. 3: External trigger to gate 1, internal clock to A/D clock/trigger.

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)

Parameter	Type	Description
Sn	Unsigned long	Board's serial number
Return	Long	Error Code

ACTIVEX CALL

Long EDREADX.Start ()

Parameter	Type	Description
Return	Long	Error Code

API-CALL

Long EDRE_ADStop (ulng Sn)

Parameter	Type	Description
Sn	Unsigned long	Board's serial number
Return	Long	Error Code

ACTIVEX CALL

Long EDREADX.Stop ()

Parameter	Type	Description
Return	Long	Error Code

Getting data from the driver buffer

A single call is necessary copy data from the driver buffer to the user buffer.

API-CALL

Long EDRE_ADGetData (ulng Sn, plong Buf, pulng BufSize)

Parameter	Type	Description
Sn	Unsigned long	Board's serial number
Buf	Pointer to a long buffer.	Buffer to copy micro voltages too.
BufSize	Pointer to an unsigned long	Size of buffer must be passed or number of samples requested. The returned value will indicate the number of actual samples copied to the buffer.
Return	Long	Error Code

ACTIVEX CALL

Long EDREADX.GetData (plong Buffer, plong Size)

Parameter	Type	Description
Buf	Pointer to a long buffer.	Buffer to copy micro voltages too.
BufSize	Pointer to a long	Size of buffer must be passed or number of samples requested. The returned value will indicate the number of actual samples copied to the buffer.
Return	Long	Error Code

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.

API-CALL

Long EDRE_Query (ulng Sn, ulng QueryCode, ulng Param)

Parameter	Type	Description
Sn	Unsigned long	Board's serial number
QueryCode	Unsigned long	Query code. See appendix Example: ADUNREAD: This will tell you the number of available samples. ADBUSY: Is the ADC subsystem busy?
Param	Unsigned long	Extra parameter.
Return	Long	Returned query code

ACTIVEX CALL

Long EDREADX.GetUnread ()

Parameter	Type	Description
Return	Long	Number of samples available in the driver.

This function automatically queries the ADC driver buffer for the number of available samples.

5 Calibration

This chapter contains information to calibrate the A/D and D/A sub-systems of the PC104-30FG. The PC104-30FG is calibrated during the manufacturing test and therefore does not require recalibration under normal conditions. However under extreme conditions or to optimize accuracy, the board needs to be recalibrated.

Allow the host PC and the board to warm up for at least one hour before calibration.

A/D Calibration

Requirements

- Calibration is done on channel 1. The recommended connector wiring is shown in Figure 5-1.
- Calibration is performed with the board configured into its intended operating mode.
- All cables should be as short as possible. Note that screened cable is preferable in order to minimize noise interference.

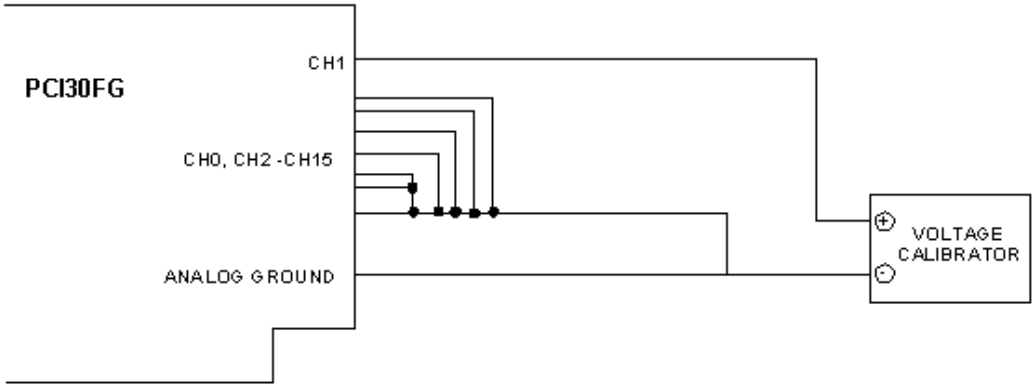


Figure 5-1 A/D Calibration Connections

Equipment Required

- Precision voltage source. Range +10V to -10V, with an absolute accuracy better than 0.005%, resolution 100 nV or better.
- Precision digital multimeter with ±10V range, absolute accuracy better than 0.0005%, resolution 100 nV or better.

Setting the Reference Voltage

Before calibrating the A/D, the reference voltages must be set properly. This is normally done during manufacturing, but if the voltage does not match, re-calibrate as follows:

+10V

Connect the multimeter to analogue ground and U16 Pin 1 or C24 +ve Side (Indicated on the component by a line). The voltage reading should be +10.0000V. If the voltage is out of specification, adjust VR4.

Another method is to set DACs to ±10V output. Set DAC output to +10V using Waveview. Connect SENSE0 [Pin 19 of AD-CON Connector] to DAC0 [Pin 20 of AD-CON Connector]. Measure the output voltage on the output of DAC0 (ie: Pin 19 of IDC26 Male Header [AD-CON]). Adjust VR4 until a voltage of 9.995V is reached.

Calibration Procedure

Run the CAL30FG.exe program installed in the PC104-30 directory.

A/D Calibration for the PC104-30G/PC104-30GA Boards

Bipolar Mode

a) Adjust A/D for maximum gain (ie. 1000) and apply 0.00mV to Channel 1 (all other channels must be grounded to AGND). Adjust VR1 (PC104-30FG Rev1B), the instrumentation amplifier offset pot, for output 800H.
b) . Set A/D for a gain of 1 and apply (-FS+2LSB) to channel 1 (ie. -4.9988V for ±5V or -9.9976V for ±10V). Adjust VR2 (PC104-30FG Rev1c), bipolar A/D offset, for an output code which flickers between 000H and 001H.
c) Set A/D for a gain of 1 and apply (+FS-3/2LSB) to channel 1 (ie. +4.9963V for ±5V range or +9.9927V for ±10V). Adjust VR5 (PC104-30FG Rev1c),gain pot, for an output code which flickers between FFEH and FFFH.
d) . Repeat the above steps until no further adjustment is required.

Monopolar Mode

a) Adjust A/D for maximum gain (ie. 1000) and apply 0.00mV to Channel 1 (all other channels must be grounded to AGND). Adjust VR1 (PC104-30FG Rev1B), the instrumentation amplifier offset pot, for output code 000H.
b) Set A/D for a gain of 1 and apply (FS+½LSB) to channel 1 (ie. for 0 to 10V range it should be +1.22mV). Adjust VR3 (PC104-30FG Rev1B), A/D offset, for an output code which flickers between 000H and 001H.
c) Set A/D for a gain of 1 and apply (+FS-3/2LSB) to channel 1 (ie. +9.9963V). Adjust VR6 (PC104-30FG Rev1B),gain pot, for an output code which flickers between FFEH and FFFH.
d) Repeat the above steps until no further adjustment is required.

A/D Calibration for the PC104-30F/PC104-30FA Boards

Bipolar Mode (±5V)

a) Adjust A/D for maximum gain (ie. 1000) and apply 0.00mV to Channel 1 (all other channels must be grounded to AGND). Adjust VR1 (PC104-30FG Rev1B), the instrumentation amplifier offset pot, for output code 800H.
b) Set A/D for a gain of 1 and apply (+FS-3/2LSB) to channel 1 (ie. +4.9963V). Adjust VR7 (PC104-30FG Rev1B), gain pot, for an output code which flickers between FFEH and FFFH.
c) Set A/D for a gain of 1 and apply (-FS+½LSB) to channel 1 (ie. -4.9988V). Adjust VR3 (PC104-30FG Rev1B), bipolar A/D offset, for an output code which flickers between 000H and 001H.
d) Repeat the above steps until no further adjustment is required. Note that steps 2 and 3 above are inter-related, and it therefore requires some expertise to enable ± Full Scale Convergence.

Bipolar Mode (±10V)

a) Adjust A/D for maximum gain (ie. 1000) and apply 0.00mV to Channel 1 (all other channels must be grounded to AGND). Adjust VR1 (PC104-30FG Rev1B), the instrumentation amplifier offset pot, for output code 800H.
b) Set A/D for a gain of 1 and apply (+FS-3/2 LSB) to channel 1 (ie. +9.9927V). Adjust VR8 (PC104-30FG Rev1B), gain pot, for an output code which flickers between FFEH and FFFH.
c) Set A/D for a gain of 1 and apply (-FS+½LSB) to channel 1 (ie. -9.9976V). Adjust VR9 (PC104-30FG Rev1B), bipolar A/D offset, for an output code which flickers between 000H and 001H.
d) Repeat the above steps until no further adjustment is required. Note that steps 2 and 3 above are inter-related, and it therefore requires some expertise to enable ± Full Scale Convergence.

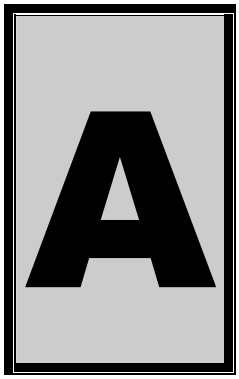
A/D Calibration Software

The program CAL30FG.EXE, supplied on the distribution disk, automates the above procedure. Note that for correct operation, the set-up information supplied in the first menu must be correct.

DAC0 to DAC3 Calibration

In general, you do not need to calibrate the DACs at all, because it has already been done when adjusting the reference voltages (ie. usually during manufacturing). However, if you require a different full scale (+10 down to +8V) output on these DACs, proceed as follows:

- Run the CAL30FG.exe program from the EDR sub-directory.
- Select DAC calibration. Alternatively, you can run Waveview and set DAC0 (with SENSE0 shorted to DAC0) to maximum full scale (ie. 10V in WaveView).
- Connect the multimeter to the output of DAC0 (with SENSE0 shorted to DAC0) and analogue ground.
- Adjust the reference pot VR4 (PC104-30FG Rev 1B) until you obtain the required voltage output.



A. 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.
D3AMAXFREQ	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.

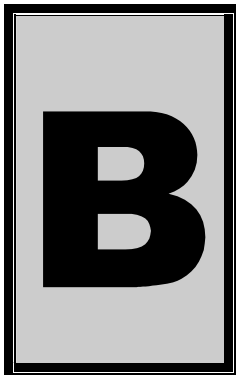
INTSTATUS	501	Queries interrupt system's status.
INTBUSCONNECT	502	Connect interrupt system to bus.
INTISAVAILABLE	503	Check if an interrupt is available.
INTNUMTRIG	504	Check number times interrupted

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 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.



B. Ordering Information

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

Board	Description
PC104-30FA	330kHz 16 Channel A/D and (4x) 12bit DACs
PC104-30F	330kHz 16 Channel A/D
PC104-30GA	100kHz 16 Channel A/D and (4x) 12bit DACs
PC104-30G	100kHz 16 Channel A/D

Table D-B-1 Ordering Information

Please visit our website to have a look at our wide variety of data acquisition products and accessories.