

PCI 773 Series

PCI PnP Analog Board User's Manual

PCI773T16, PCI773R16

Analog 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 PCI773 series data acquisition boards have 32-bit PCI bus architecture. They are available in two models, the RTD or Thermocouple version. The PCI773 contains 16 digital input and 16 output ports and 16 differential inputs. The PCI773 has only got one range setting witch is controlled by hardware. The range is calculated and set when manufactured. This gain was designed to give you the optimal accuracy for the application it is to be used for.

Features

The PCI773 does have some very unique features and are short listed below:

- 32-bit PCI bus Revision 2.2 compliant at 33MHz.
- PCI Bus 3.3V or +5V slot compatible.
- Fully individually programmable analog-in channels.
- Fully programmable digital input channels.
- Fully programmable digital output channels.

Applications

The PCI773 can be used in the following applications:

- Temperature measurements logging.

Key Specifications

- Analogue resolution is 14-bit.
- +/- 2.5V full-scale deviation @ 10 KHz maximum sampling rate.
- 16 digital inputs, 74HCT373 compatible.
- 16 digital outputs, 74HCT374 compatible

Software Support

The PCI773 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, utility and test software are supplied on the Eagle Technology 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.

Eagle Technology

PO Box 4376

Cape Town

8000

South Africa

Telephone +27 (021) 423 4943

Fax +27 (021) 424 4637

E-Mail eagle@eagle.co.za

Website <http://www.eagledaq.com>



2. Installation

This chapter describes how to install and configure the PCI773 for the first time. Minimal configuration is necessary; almost all settings are done through software. The PCI BIOS or operating system will take care of all resource assignments.

Before using the board calibration of the voltage offsets is necessary.

Package

PCI773 package will contain the following:

- PCI773 PCI board
- IDC40-DB37 extender cable
- Software CD-Rom

Operating System Support

PCI773 support the following operating systems

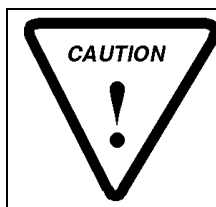
Board Type	Revision	Operating Systems	Driver Type
PCI773T16	Revision 1	Windows 2000/98/ME/XP	WDM PnP
PCI773R16	Revision 1	Windows 2000/98/ME/XP	WDM PnP

Table 2-1 Operating System Support

Hardware Installation

This section will describe how to install your PCI board 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.
- Choose any open PCI slot and insert PCI board
- Insert bracket screw and ensure that the board sits firmly in the PCI 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 98/2000/ME

Installing the Windows 98/2000 device driver is a very straightforward task. Because it is plug and play Windows will auto detect the PCI board as soon as it is installed. No setup is necessary. You simply have to supply Windows with a device driver.

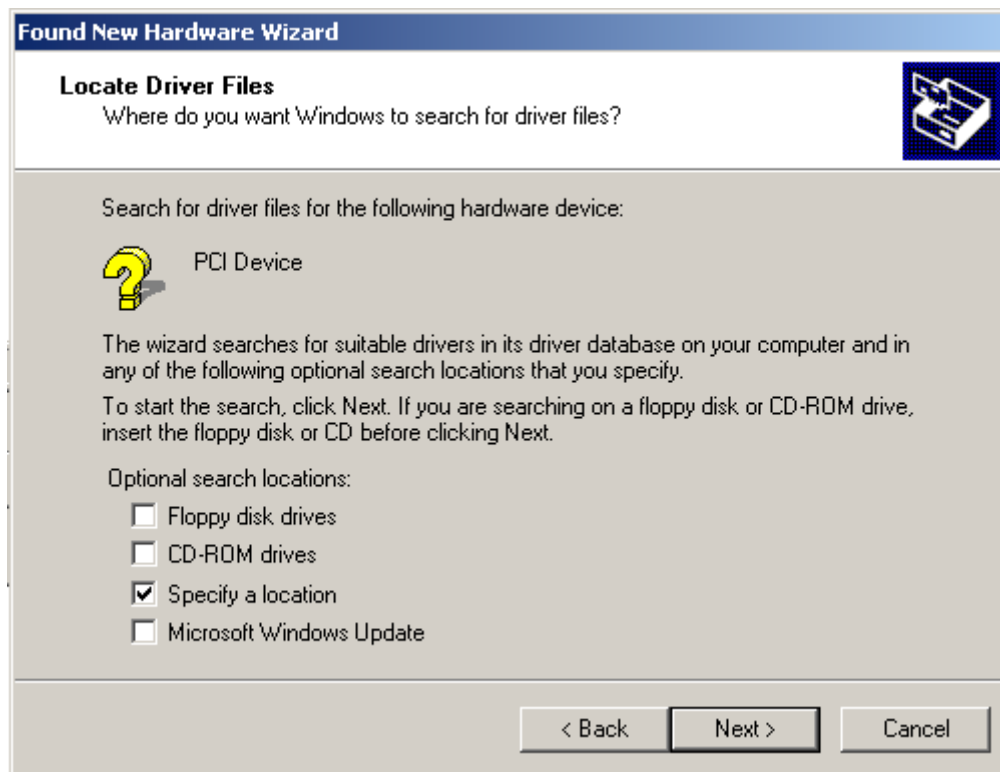
Wait until Windows detects the new hardware



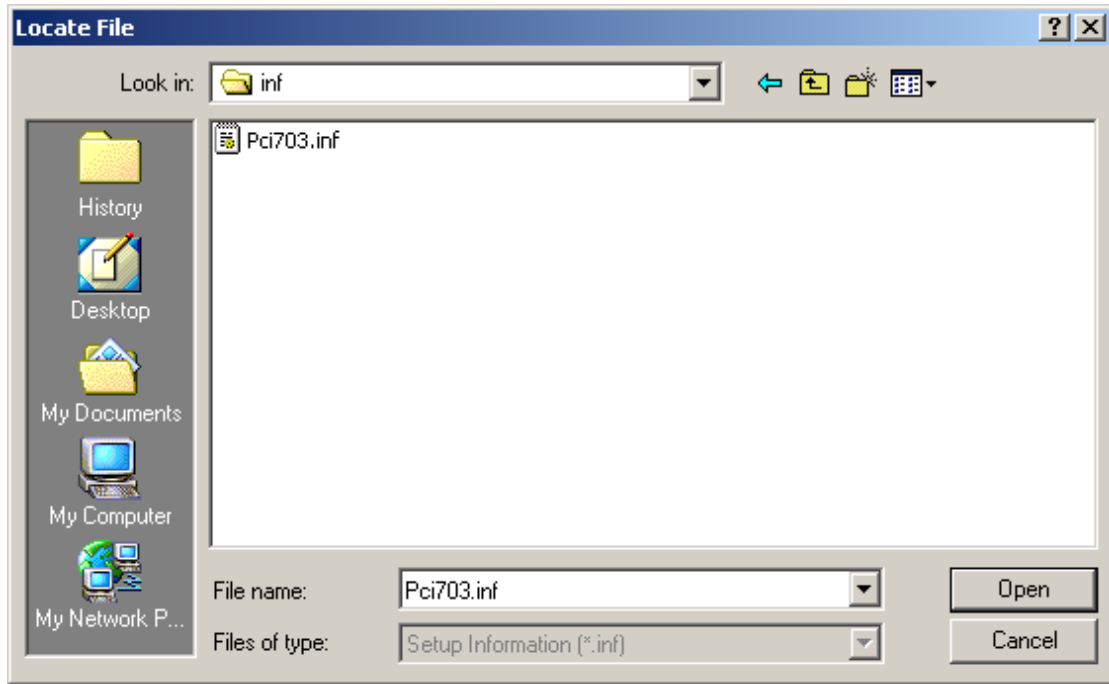
Select Next



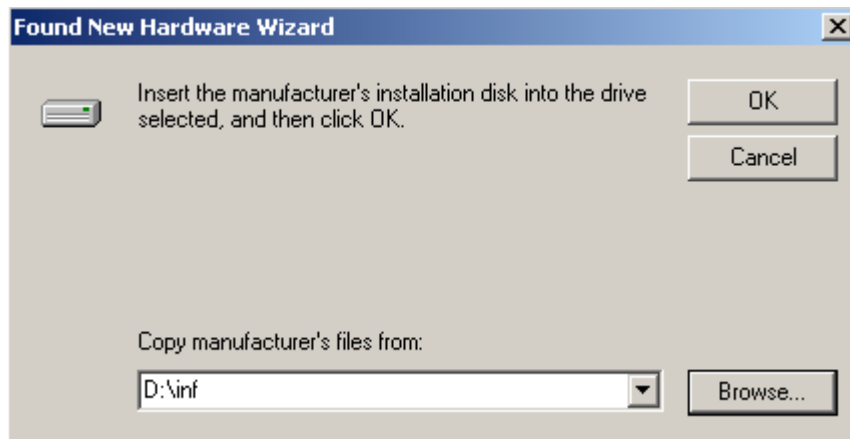
Select "Search for a suitable driver for my device..." and select next



Make sure only "Specify a location" is selected and select next

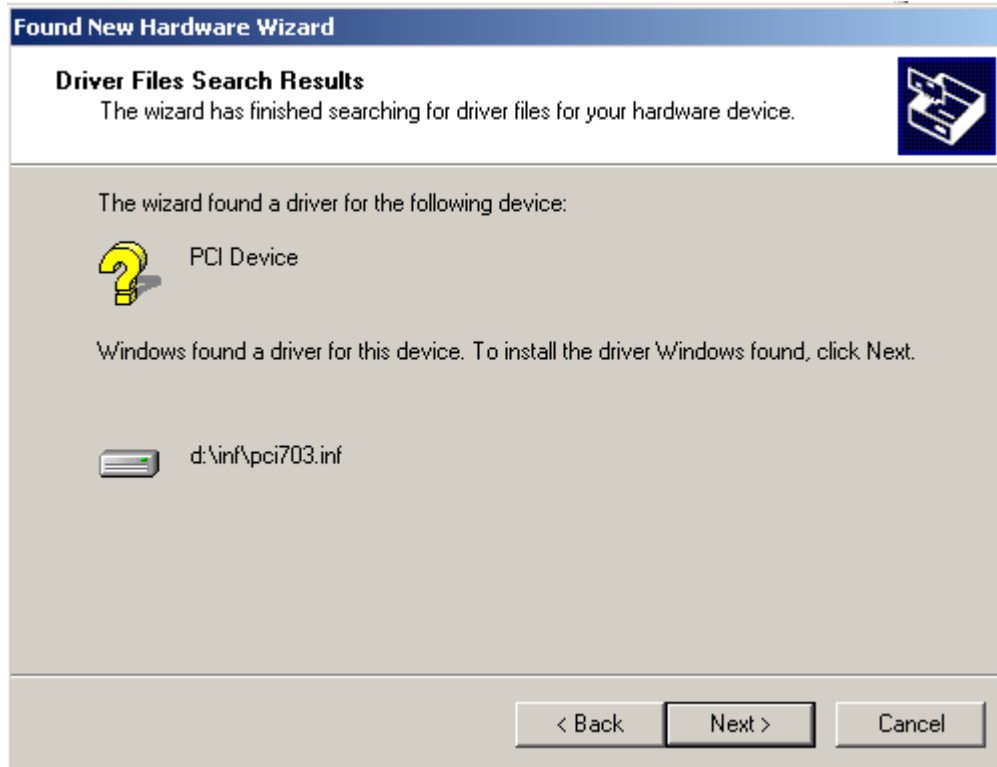


Select the browse button and search for the PCI773.inf file on the Eagle CD-Rom.



The driver is normally located in the <CDROM>:\EDRE\DRIVERS\WDM\PCI773 directory.

Select next when found.



Select next again.

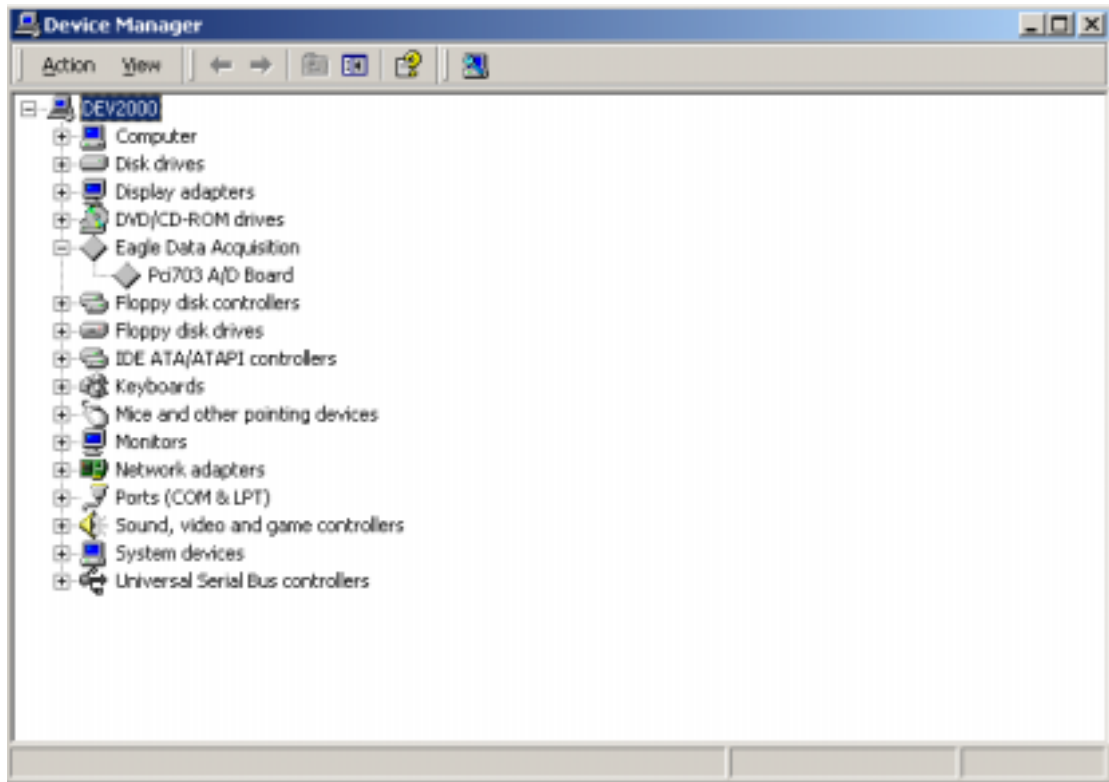


When done you might have to restart your computer.

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.



- Clearly you can see that the PCI device is listed and working properly.
- 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



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

Windows NT

Windows NT does not require any special setup procedure. The Windows NT driver does not support plug and play. If Windows 2000 detects a new device simply install a default driver, or so called placeholder. This will disable the device in the plug and play manager.

To install the Windows NT drivers simply run **edrewinnt.exe** on the Eagle CD-Rom. This will automatically install the device drivers. Restart your computer when done. Open the *EagleDAQ* folder in the control panel to check if your installation was successful.

Accessories

The PCI773 has got a wide variety of accessories that it can be connected too. See the Eagle Technology catalog for more information.



3. Interconnections

The PCI773 has two connectors, an internal IDC40 connector for digital I/O and an external connection situated on the card's bracket for differential analog-in and power.

A wide variety of genuine accessories available from Eagle Technology also make interfacing to the PCI773 very easy. Accessories are available in the form of cables, screw terminals and application modules.

External Connectors

PCI773T16 and PCI773R16

The PCI773 has an IDC40 and a DB37 male connector. A conversion cable is included that changes the IDC40 to a DB37 male connection that can be mounted on your PC case like a PCI card. Application modules include the PC73C. Adaptors would be the ADPT3740.

Connector Pin Assignments

PCI773

Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	AGND	11	CH8+	21	AGND	31	CH6-
2	+12VFUSED	12	CH7+	22	CH15-	32	CH5-
3	CJCTEMP	13	CH6+	23	CH14-	33	CH4-
4	CH15+	14	CH5+	24	CH13-	34	CH3-
5	CH14+	15	CH4+	25	CH12-	35	CH2-
6	CH13+	16	CH3+	26	CH11-	36	CH1-
7	CH12+	17	CH2+	27	CH10-	37	CH0-
8	CH11+	18	CH1+	28	CH9-		
9	CH10+	19	CH0+	29	CH8-		
10	CH9+	20	-12VFUSED	30	CH7-		

Table 3-1 Pinouts for PCI773 (External Connector – DB37)

Pin	Name	Pin	Name
1	DI0	2	DI1
3	DI2	4	DI3
5	DI4	6	DI5
7	DI6	8	DI7
9	DI8	10	DI9
11	DI10	12	DI11
13	DI12	14	DI13
15	DI14	16	DI15
17	DGND	18	DGND
19	DO0	20	DO1
21	DO2	22	DO3
23	DO4	24	DO5
25	DO6	26	DO7
27	DO8	28	DO9
29	DO10	30	DO11
31	DO12	32	DO13
33	DO14	34	DO15
35	DGND	36	DGND
37	+5VFUSED	38	DGND
39	DGND	40	+5VFUSED

Table 3-2 Pinouts for PCI773 (Internal Connector – DB37)

Signal Definitions

This sections deal with all the signals abbreviations.

Signal	Description
CH0-15+	Analog inputs positive
CH0-15-	Analog input negative
AGND	Analog ground
DI/O 0-15	Digital inputs/outputs
+/-12VFUSED	Power output
+/- 5VFUSED	Power output
DGND	Digital Ground

Table 3-2 Signal definitions

Analog Input Connections

**WARNING!!**

All unused analog inputs must be connected to analog ground. The analog input system of the PCI773 can be damaged or become unstable when scanning channels that is left floating.

Digital Inputs/Outputs

The PCI773 has got 16 digital input and 16 digital output lines that can all be used for digital control purposes. 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 PCI773 each port is only 16-bit wide. The PCI773 has got two ports, the one can only be used as an input and the other as an output only.

Reading the Digital Inputs

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

API-CALL

Long EDRE_DioRead(ulong Sn, ulong Port, ulong *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(ulong Sn, ulong Port, ulong 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, ulong 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.

Analog Input

The PCI773 has got 16 differential analog inputs that can be configured for a number of gain settings. Using different gain setting will give you a higher degree of accuracy.

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_ADSSingle (ulong Sn, ulong Channel, ulong Gain, ulong Range, plong uVoltage)

Parameter	Type	Description
Sn	Unsigned long	Board's serial number
Channel	Unsigned long	ADC Channel
Gain	Unsigned long	NOT USED
Range	Unsigned long	NOT USED
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* properties of the ADC ActiveX control. This will in turn set the gain when reading the ADC channel.

Temperature Calculation

To calculate the temperature for thermocouple probes you need to read the ambient temperature for the CJCTemp channel and convert it to temperature.

Converting CJCTemp

API-CALL

Long EDRE_CalcCJCmC(long cjcuv)

ACTIVEX CALL

Long EDREADX.CalcCJCmC(long cjcuv)

Parameter	Type	Description
cjcuv	Long	CJCTemp channel uVolts
Return	Long	Mille Degrees Celsius

Calculating Temperature for Thermocouples

API-CALL

Long EDRE_CalcTCmC(long tctype, long tcuv, long ambientmc)

ACTIVEX CALL

Long EDREADX.CalcTCmC(long tctype, long tcuv, long ambientmc)

Parameter	Type	Description
tctype	Long	Type Thermocouple used. (See appendix for details)
tcuv	Long	Voltage read from channel uVolts
ambientmc	Long	Ambient temperature mille Degrees
Return	Long	Mille Degrees Celsius

Calculating Temperature for RTD

API-CALL

Long EDRE_CalcRTDmC(long rtduv)

ACTIVEX CALL

Long EDREADX.CalcRTDmC(long rtduv)

Parameter	Type	Description
rtduv	Long	Voltage read from channel uVolts
Return	Long	Mille Degrees Celsius

5

5. Calibration

Calibrating the PCI773 is simple task. EDR Enhanced must be installed and the calibration software. Both can be found on the Eagle Technology Software CD-Rom (<EAGLECD>EDREVAPPS\PCI700CAL\PCI700CAL.EXE). The latest version will also be available on <http://www.eagledaq.com>.

Before using the PCI773 data acquisition board in a new computer it is very important that the voltage offset levels is recalibrated. Calibration of the gain levels is not necessary.

Requirements

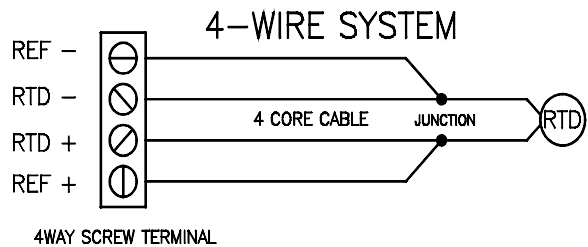
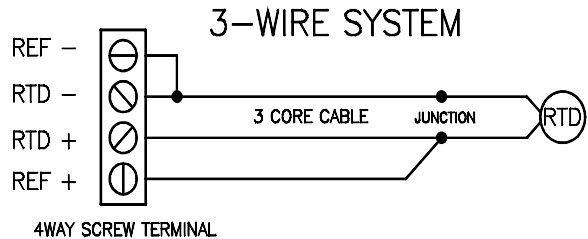
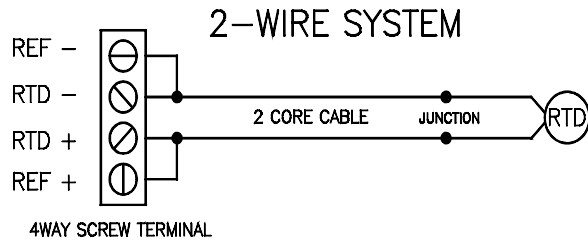
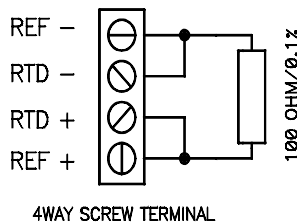
1. 1 x PCI773 with cable and adaptor.
2. Installed software
3. High accuracy calibration source,
4. Digital Thermometer.

Calibrating the PCI-773 with the RTD adaptor

- i) Calibration is done on all the channels. The recommended connector wiring is to connect all the channels RTD + inputs together and all the RTD - inputs together.
- ii) All cables should be as short as possible.
- iii) The H2 header should be set to the CAL position.
- iv) You can now start the calibration software (*PCI700CCAL.EXE*).
- v) When setting Step 1, you need to supply 0Volts to the +-CAL inputs on CON2.
- vi) Step 2 – Step 17 is setting the offset values of the 16 channels. You should supply in 0Volt signal the all of these inputs.
- vii) Then hardware gain step is not done with the RTD adaptor.
- viii) With Step 19 you need to set the H2 header to CJC position. Now set the CJC (*VR1*) pot so that the reading on the screen is the same as the ambient temperature.
- ix) **SAVE SETTINGS!**
- x) **Calibrating the ADAPTOR.**
- xi) If you are using PT100, set H3 to 10mA position and for PT1000 to the 1mA position.
- xii) Connect a 100 ohm 0.1% resistor to the RTD adaptor as shown below, to channel 0.
- xiii) Set the REF (*RV2*) pot so that you measure 1000mVolts at across the +- of channel 0.
- xiv) Great you're done.

Configuring the RTD Card

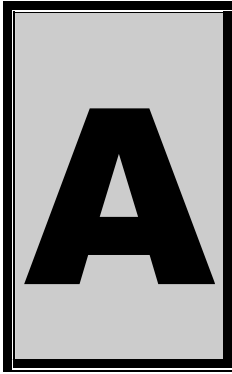
FOR PT100 RTD'S SET JUMPER TO 10mA
 FOR PT1000 RTD'S SET JUMPER TO 1mA



RTD Connection Diagram

Calibrating the PCI-773 with the THERMOCOUPLE adaptor

- i) Calibration is done on all the channels. The recommended connector wiring is to connect all the channels + inputs together and all the - inputs together.
- ii) All cables should be as short as possible.
- xv) You can now start the calibration software (*PCI700CCAL.EXE*).
- iii) Step 1 you can set until voltage is as close as possible to 0Volts.
- iv) Step 2 to Step 17 you need to supply 0Volts to all the channels and calibrate until the reading is as close to 0Volts as possible.
- v) Before doing the Hardware Gain calibration, you need to supply a very accurate 50mVolt signal to all the channels. Gain setting is done automatically.
- vi) Step 19 is to calibrate the CJC reading. Set CJC CAL (*VR1*) until the reading is the same as the ambient temperature.
- vii) **SAVE SETTINGS!**
- viii) Great you're done.



A. Specifications

Analog Input Characteristics – PCI773

Input Characteristics

Input Signal Ranges

MODEL	Channel Gain	Range
PCI-773R16	+/-1	± 2.5 V
PCI-773T16	+/-30	± 70 mV

Input Coupling
Maximum Working Voltage

DC
± 2.5V differential inputs

Conversion Characteristics

Maximum A/D Sampling Rate
Resolution
Maximum full scale error

10 kHz
14 bits
0.05%

Digital Input Characteristics

Number of Channels
Compatibility
I/O Characteristics

16
74HCT573

Level	Min	Max
Input Low Voltage	0V	0.8V
Input High Voltage	2.0V	5.25V
Low Level Input Current		- 100 uA
High Level Input Current		100 uA
Output High Voltage	2.4V	
Output Low Voltage		0.6V
Low Level Output Current		-24 mA
High Level Output Current		4 mA

Digital Input Characteristics

Number of Channels
Compatibility
I/O Characteristics

16
74HCT374

Level	Min	Max
Input Low Voltage	0V	0.8V
Input High Voltage	2.0V	5.25V
Low Level Input Current		- 100 μ A
High Level Input Current		100 μ A
Output High Voltage	2.4V	
Output Low Voltage		0.6V
Low Level Output Current		-24 mA
High Level Output Current		4 mA

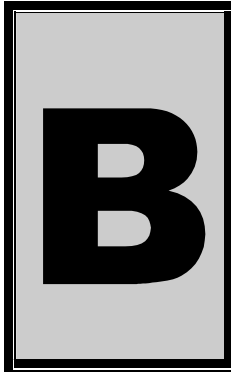
Other

Bus Interface

PCI 2.2 Compatible
Master & Slave
3.3V or 5V

Power Requirements

+5V (\pm 5%) @ 1.3 A



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.
APIO	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.
ADBUFSIZE	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_FREQUENCY	-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

Analog Input Gain Codes – PCI773-T/R 16

Name	Value	Description
GAIN 1.00	0	Gain of 1 ($\pm 2.5V$)
SET BY HARDWARE (default 30.0)	1	Gain of 30 ($\pm 70mV$)

ThermoCouple Type Codes

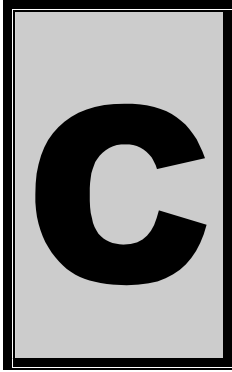
Thermocouple Type	Value
Type J	0
Type K	1
Type E	2
Type T	3
Type S	4
Type R	5
Type B	6
Type N	7

Color codes for thermocouples

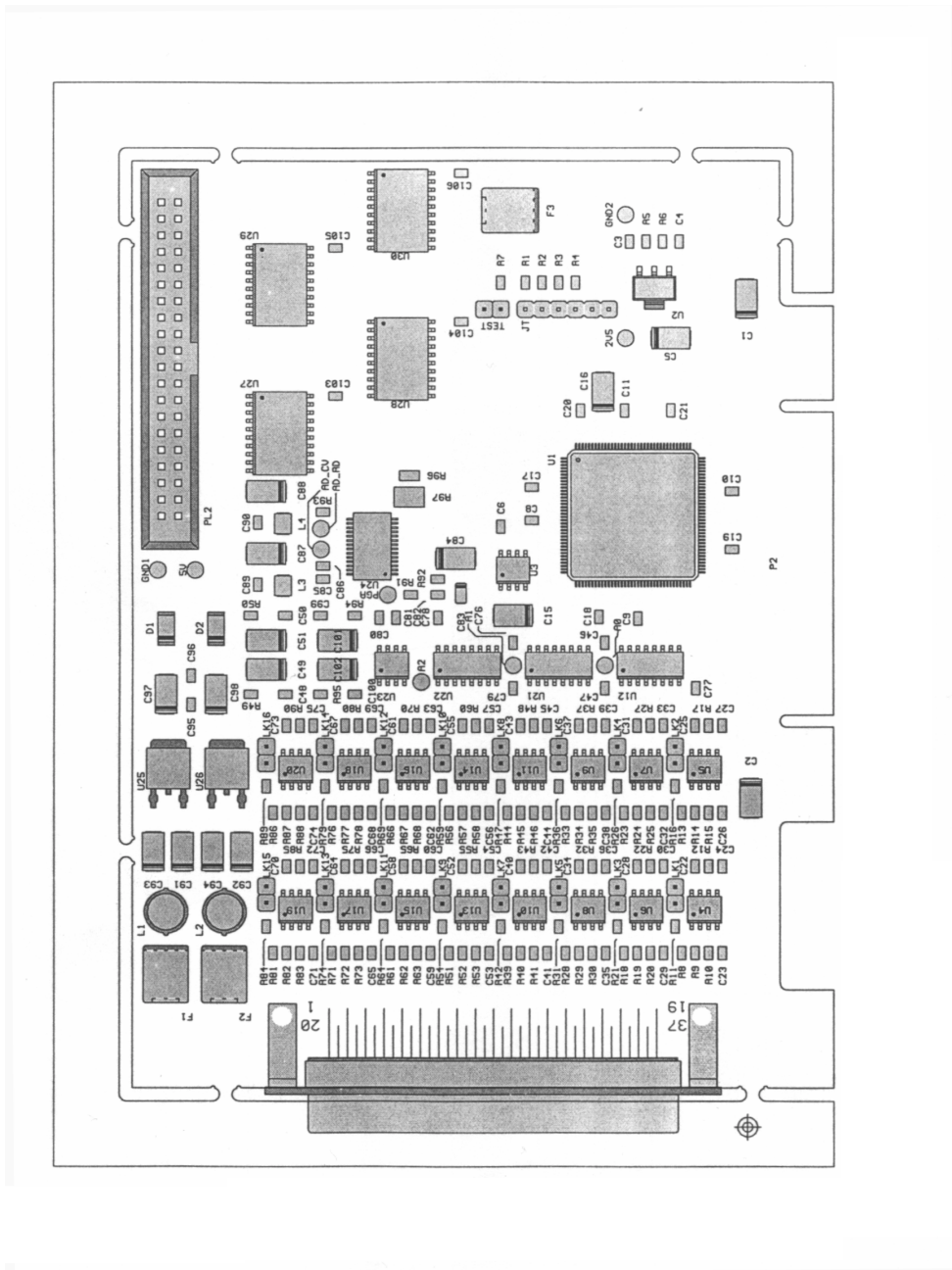
THERMOCOUPLE Codes, Conductor Combinations & National color coding for Insulation of Thermocouple and Extension cable							
Code	Conductor Combinations		British	American	German	French	Japanese
	+ leg	- leg					
K	Nickel -Chromium	Nickel-Aluminium (magnetic)					
V	Copper	Copper-Nickel					
T	Copper	Copper-Nickel					
J	Iron (magnetic)	Copper-Nickel					
E	Nickel-Chromium	Copper-Nickel					
R	Platinum-13% Rhodium	Platinum					
S	Platinum-10% Rhodium	Platinum					
B	Platinum-30% Rhodium	Platinum-6% Rhodium					
U	Copper	Copper-Low Value Nickel					

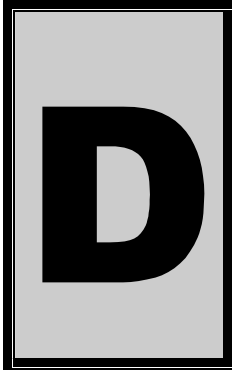
Note: With reference to ANSI/MC96.1 color coding, it is noted that

- * a brown overall sheath color, relating that shown, denotes the incorporation of thermocouple grade conductors where relevant.
- * These color codes normally relate only to the *compensating cable* for use with the appropriate thermocouple conductor combination type code.



C.Layout Diagram





D. Ordering Information

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

Board	Description
PCI 773T16	16 Channel thermocouple inputs, 16 digital inputs and 16 digital outputs
PCI 773R16	16 Channel RTD inputs, 16 digital inputs and 16 digital outputs

Table D-1 Ordering Information

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